TRANSACTIONS

OF THE

ENTOMOLOGICAL SOCIETY

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ENTOMOLOGICAL SOCIETY OF LONDON

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OF THE

ENTOMOLOGICAL SOCIETY OF LONDON.

HONORARY FELLOWS.

Date of Election.

1900 AURIVILLIUS, Professor Christopher, *Stockholm.*

1915 BERLESE, Professor Antonio, *via Romana*, 19, *Firenze, Italy.*

1905 BOLIVAR, Ignacio, *Museo nacional de Historia natural, Hipodromo,* 17, *Madrid.*

1911 COMSTOCK, Prof. J. H., *Cornell University, Ithaca, New York, U.S.A.*

1894 FOREL, Professor Auguste, M.D., *Yvorne, Canton de Vaud, Switzerland.*

1898 GRASSÍ, Professor Battista, *The University, Rome.*

1915 HOWARD, Dr. L. O., *National Museum, Washington, U.S.A.*

1914 LAMEERE, Professor A., 74, *rue Defarq, Bruxelles.*

1918 MARCHAL, Dr. Paul, President of the Entomological Society of France, 45, *rue de Verrières, Antony, Seine, France.*

1908 OBERTHÜR, Charles, *Rennes, Ille-et-Vilaine, France.*

1913 TIAN-SHANSKI, A. P. Semenoff, *Vassili Ostrov*, 8 *lin.*, 39, *Petrograd, Russia.*

1911 WASMANN, Fr. Erich, S.J., *Valkenburg (L.) Ignatius Kolleg, Holland.*

SPECIAL LIFE FELLOWS.

Date of Election.

1916 (1894) MIALL, Louis Compton, F.R.S., (COUNCIL, 1903, 1908), *Norton Way N., Letchworth.*

1916 (1888) YERBURY, Colonel John W., late R.A., F.Z.S., (COUNCIL, 1896, 1903–5), 2, *Ryder-street, St. James's*, S.W.

FELLOWS.

(*The names of those who have not yet paid either the Entrance Fee or the first year's subscription are not included.*)

*Marked * have died during the year.*
Marked † have compounded for their Annual Subscriptions.
Marked ‡ have signed the Obligation Book (to Dec. 1919).
Marked || have ceased to be Fellows during the year.

Date of Election

1914 † ADAIR, E. W., B.A., *Turf Club, Cairo, Egypt.*

1913 ‡ ADAMS, B. G., 15, *Fernshaw-road, Chelsea*, S.W.

1877 ‡ Adams, Frederick Charlstrom, F.Z.S., 2b, *Montague Mansions, Portman-square*, W. 1.

1902 Adkin, Benaiah Whitley, *Trenoweth, Hope-park, Bromley, Kent.*

1885 ‡ Adkin, Robert, (Council, 1901–2, 1911–13), *Hodeslea, Meads, Eastbourne.*

1912 Allen, J. W., M.A., 266, *Willesden-lane, London*, N.W. 2.

1911 Anderson, T. J., *Entomological Laboratory, Kabeti, Brit. E. Africa.*

1919†‡Andrewes, Christopher Howard, 1, *North-grove, Highgate*, N. 6.

1910†‡Andrewes, H. E., 8, *North-grove, Highgate*, N. 6.

1899 ‡ Andrews, Henry W., *Woodside, Victoria-road, Eltham*, S.E. 9.

1901 ‡ Anning, William, 39, *Lime Street*, E.C. 3.

1908 † Antram, Charles B., *Somerdale Estate, Ootacamund, Nilgiri Hills, S. India.*

1913 ‡ Armytage, Edward O., *Ingleby, Armytage, Victoria, Australia.*

1907 ‡ Arnold, G., M.Sc., A.R.C.S., Curator, *Rhodesia Museum, Bulawayo, S. Africa.*

1899†‡Arrow, Gilbert J., (Council, 1905–7), 9, *Rossdale-road, Putney*, S.W. 15 ; and *British Museum (Natural History), Cromwell-road*, S.W. 7.

1911‡Ashby, Edward Bernard, 36, *Bulstrode-road, Hounslow, Middlesex.*

1907†‡Ashby, Sidney R., 39, *Park-lane, Wembley, Middlesex.*

1886 Atmore, E. A., 48, *High-street, King's Lynn.*

1913 Avinoff, André, *Liteyny*, 12, *Petrograd, Russia.*

1914 Awati, P. R., Medical Entomologist, c/o Grindlay & Co., Bankers, 26, *Westmorland-street, Calcutta.*

1901 ‡ Bacot, Arthur W., (Council, 1916–18), *York Cottage, York-hill, Loughton, Essex.*

1904†‡Bagnall, Richard S., *Penshaw Lodge, Penshaw, Durham.*

1909 ‡ Bagwell-Purefoy, Capt. Edward, *East Farleigh, Maidstone.*

1916 ‡ Balfour, Miss Alice, 4, *Carlton-gardens*, S.W., *and Whittingehame, Prestonkirk, Scotland.*

1912 Ballard, Edward, Govt. Entomologist, *Agricultural College and Research Institute, Coimbatore, Madras, S. India.*

1886 ‡ Bankes, Eustace R., M.A.

1890 Barclay, Francis H., F.G.S., *The Warren, Cromer.*

1886 Bargagli, Marchese Piero, *Piazza S. Maria, Palazzo Tempi No.* 1, *Florence, Italy.*

1895 Barker, Cecil N., 81, *Bellevue-road, Durban, Natal, South Africa.*

1902 ‡ Barraud, Philip J., *Chester Cottage, Benhill-road, Sutton, Surrey.*

1907 ‡ Bartlett, H. Frederick D., 1, *Myrtle-road, Bournemouth.*

1894†‡Bateson, Prof. William, M.A., F.R.S., Fellow of St. John's College, Cambridge, *The Manor House, Merton, Surrey.*

1908 Bayford, E. G., 2, *Rockingham-street, Barnsley.*

1904 Bayne, Arthur F., c/o Messrs. Freeman, *Castle-street, Framlingham, Suffolk.*

1912 ‡ BAYNES, Edward Stuart Augustus, 120, *Warwick-street, Eccleston-square*, S.W. 1.

1896†‡BEARE, Prof. T. Hudson, B.Sc., F.R.S.E., (V.-PRES., 1910; COUNCIL, 1909–11), 10, *Regent Terrace, Edinburgh.*

1908 ‡ BECK, Richard, *Heckitt, The Park, Yeovil.*

1905 BEDFORD, The Duke of, K.G., Pres. Z.S., etc., *Woburn Abbey, Beds.*

1912 BEDFORD, Gerald, Entomologist to the Union of South Africa, Veterinary Bacteriological Laboratory, *Ondestepoort, Pretoria, Transvaal.*

1913 BEDFORD, Capt. Hugh Warren, *Church Felles, Horley.*

1899 ‡ BEDWELL, Ernest C., (COUNCIL, 1917–19), *Bruggen, Brighton-road, Coulsdon, Surrey.*

1914 ‖ BENDERITTER, Eugène, 11, *Rue St. Jacques, Le Mans, France.*

1904 BENGTSSON, Simon, Ph.D., Lecturer, *University of Lund, Sweden*; Curator, Entomological Collection of the University.

1915 BENHAM, Prof. William Blaxland, M.A., D.Sc., F.R.S., *University of Otago, Dunedin, New Zealand.*

1906 ‡ BENTALL, E. E., *The Towers, Heybridge, Essex.*

1913 ‡ BEST-GARDNER, Charles C., *Rookwood, Neath, Glamorgan.*

1885 ‡ BETHUNE-BAKER, George T., F.L.S., F.Z.S., (PRES., 1913-14; V.-PRES., 1910–11, 1915; COUNCIL, 1895, 1910–15, 1919–), 19, *Clarendon-road, Edgbaston, Birmingham.*

1918 BEVERIDGE, Col. W. W. O., C.B., D.S.O., R.A.M.C., c/o J. H. Durrant, Esq., *Natural History Museum, Cromwell-road, S. Kensington*, S.W. 7.

1891 ‡ BLABER, W. H., F.L.S., 34, *Cromwell-road, Hove, Brighton.*

1904 ‡ BLACK, James E., F.L.S., *Nethercroft, Peebles.*

1904 ‡ BLAIR, Kenneth G., (COUNCIL, 1918–), *Claremont*, 120, *Sunningfields-road, Hendon*, N.W. 4.

1885*‡BLATHWAYT, Lt.-Col. Linley, F.L.S., *Eagle House, Batheaston, Bath.*

1904 ‡ BLISS, Maurice Frederick, M.C., M.R.C.S., L.R.C.P., 130, *High Town-road, Luton, Beds.*

1916 ‡ BOCOCK, Charles Hanslope, *The Elms, Ashley, Newmarket.*

1912 BODKIN, G. C., Govt. Entomologist, *Georgetown, British Guiana.*

1903 BOGUE, W. A., *The Bank House, Watchet.*

1911 BOILEAU, H., 99, *Rue de la Côte St. Thibault, Bois de Colombes, Seine, France.*

1891 BOOTH, George A., F.Z.S., M.B.O.U., *The Hermitage, Kirkham, Lancs.*

1902 ‡ BOSTOCK, E. D., *Oulton Cross, Stone, Staffs.*

1913 BOWATER, Captain William, 20, *Russell-road, Moseley, Birmingham.*

1888 ‡ BOWER, Benjamin A., *Langley, Willow Grove, Chislehurst.*

1894†‡BOWLES, E. Augustus, M.A., *Myddelton House, Waltham Cross.*

1912 † BOWRING, C. Talbot, *Hoihow, Hainan, S. China.*

1919 ‡ BOX, Lieut. L. A., 35, *Great James-street*, W.C. 1.

1916 BOX, Leonard Charles, F.R.H.S., *Dominion Experimental Station, Fredericton, New Brunswick.*

1910 BOYD, A. Whitworth, *Frandley House, nr. Northwich.*

1905 Bracken, Charles W., B.A., 5, *Carfrae Terrace*, *Lipson*, *Plymouth*.
1919 Bradley, Prof. J. Chester, M.Sc., Asst. Prof. of Systematic Entomology, *Cornell University*, *Ithaca*, *New York*, *U.S.A.*
1917 Breijer, Dr. H. G., Ph.D., Director of the Transvaal Museum, *Pretoria*, *Transvaal*, *S. Africa*.
1870 ‡ Briggs, Thomas Henry, M.A., *Rock House*, *Lynmouth S.O.*, *N. Devon*.
1894 ‡ Bright, Percy M., *Cheriton*, 26, *Portchester-road*, *Bournemouth*.
1909 Britten, Harry, 22, *Birch-grove*, *Levenshulme*, *Manchester*.
1902 ‡ Broughton, Major T. Delves, R.E., *Mhow*, *India*.
1878 * Broun, Major Thomas, Chev. Legion of Honour, *Mount Albert*, *Auckland*, *New Zealand*.
1904 ‡ Brown, Henry H., *Tower House*, 8, *Bruntsfield-terrace*, *Edinburgh*.
1919 Brown, James Meikle, B.Sc., F.I.S., F.C.S., 176, *Carterknowle-road*, *Millhouses*, *Sheffield*.
1910 Browne, Horace B., M.A., *Kenilworth*, *Scratcherd-lane*, *Morley*, *Yorks*.
1911 Brutzer, Rev. Henry W., *Upton Vicarage*, *Peterborough*.
1909 ‡ Bryant, Gilbert E., 89, *Westbourne-terrace*, *Hyde Park*, W. 2.
1898 † Buchan-Hepburn, Sir Archibald, Bart., J.P., D.L., *Smeaton-Hepburn*, *Prestonkirk*.
1917 Buckley, Dr. George Granville, M.D., F.S.A., *Rye Croft South*, *Manchester-road*, *Bury*, *Lancs*.
1919 Buckhurst, A. S., 9, *Souldern-road*, W. 14.
1916 Bugnion, Prof. E., *La Luciole*, *Aix-en-Provence*, *France*.
1907 Bulleid, Arthur, F.S.A., *Wimboro*, *Midsomer Norton*, *Somersetshire*.
1919 ‡ Bunnett, E. J., M.A., 9, *London-road*, *Forest Hill*, S.E. 23.
1896 † ‡ Burr, Malcolm, D.Sc., F.L.S., F.Z.S., F.G.S., A.R.S.M., (V.-Pres., 1912; Council, 1903, 4, 1910–12), *United University Club*, *Pall Mall East*, S.W. 1.
1909 ‡ Burrows, The Rev. C. R. N., *The Vicarage*, *Mucking*, *Stanford-le-Hope*, *Essex*.
1868 † ‡ Butler, Arthur G., Ph.D., F.L.S., F.Z.S., (Sec., 1875; Council, 1876), *The Lilies*, *Beckenham-road*, *Beckenham*.
1883 ‡ Butler, Edward Albert, B.A., B.Sc., (Council, 1914–16), 14, *Drylands-road*, *Hornsey*, N. 8.
1902 ‡ Butler, William E., *Hayling House*, *Oxford-road*, *Reading*.
1905 ‡ Butterfield, Jas. A., B.Sc., *Ormesby*, 21, *Dorville-road*, *Lee*, S.E.
1914 † Butterfield, Rosse, Curator, *Corporation Museum*, *Keighley*, *Yorks*.
1912 † ‡ Buxton, Patrick Alfred, M.B.O.U., *Fairhill*, *Tonbridge*; and *Trinity College*, *Cambridge*.
1904 ‡ Byatt, Sir Horace A., K.C.M.G., B.A., *Government House*, *Dar-es-Salaam*, *E. Africa*.

1917 Cameron, Dr. Alfred E., M.A., D.Sc., *University of Saskatchewan*, *Saskatown*, *Canada*.
1902 ‡ Cameron, Surgeon-Commander Malcolm, M.B., R.N., (Council, 1919–), 7, *Blessington-road*, *Lee*, S.E.

1885 Campbell, Francis Maule, F.L.S., F.Z.S., etc., *Kilronan, S. Nutfield, Surrey.*

1898 Candèze, Léon, *Mont St. Martin* 75, *Liège.*

1880 Cansdale, W. D., *Sunny Bank, South Norwood*, S.E. 25.

1889 ‡ Cant, A., 33, *Festing-road, Putney*, S.W. 15.

1910 Carlier, E. Wace, M.D., F.R.S.E., *Morningside, Granville-road, Dorridge*, and *The University, Birmingham.*

1892 ‡ Carpenter, The Honble. Mrs. Beatrice, 22, *Grosvenor-road*, S.W. 1.

1919 Carpenter, Cyril F., 7, *Cranbrook-road, Redlands, Bristol.*

1910 ‡ Carpenter, Geoffrey D. H., D.M., B.Ch., *c/o* Prof. Poulton, *University Museum, Oxford.*

1895 ‡ Carpenter, Prof. George H., B.A., D.Sc., *Royal College of Science, Dublin.*

1898 ‡ Carpenter, J. H., *Redcot, Belmont-road, Leatherhead.*

1915 Carr, Professor John Wesley, M.A., F.L.S., F.G.S., Professor of Biology, *University College, Nottingham.*

1915 Carr, William, B.Sc., *Station-road, Bentham, Lancaster.*

1911 * Carson, George Moffatt, Entomologist to the Government of New Guinea, *Port Moresby, Papua, viâ Australia.*

1895 Carter, Sir Gilbert, K.C.M.G., *Greycliffe, Lower Warberry-road, Torquay.*

1912 Carter, Henry Francis, Assistant Lecturer and Demonstrator in Medical and Economic Entomology, *Liverpool School of Tropical Medicine, University of Liverpool.*

1906 ‡ Carter, H. J., B.A., *Garrawillah, Kintore-street, Wahroonga, Sydney, N.S.W.*

1900 Carter, J. W., 15, *Westfield-road, Heaton, Bradford.*

1889 †‡ Cave, Charles J. P., *Ditcham Park, Petersfield.*

1900 Chamberlain, Neville, *Westbourne, Edgbaston, Birmingham.*

1871 ‡ Champion, George C., F.Z.S., A.L.S., Librarian, 1891– (Council, 1875–7); *Heatherside, Horsell, Woking;* and 45, *Pont-street*, S.W. 1.

1914 ‡ Champion, Harry George, B.A., Assistant Conservator of Forests, *W. Almora, U.P., India.*

1891 ‡ Chapman, Thomas Algernon, M.D., F.R.S., F.Z.S., (V.-Pres., 1900, 1904–5, 1908, 1916–17 ; Council, 1898–1900, 1903–5, 1907–9, 1916–18), *Betula, Reigate.*

1919 Chatterjee, Nibaran Chandra, B.Sc., *Forest Research Institute, Dehra Dun, United Provinces, India.*

1897 ‡ Chawner, Miss Ethel F., *Forest Bank, Lyndhurst S.O., Hants.*

1913 ‡ Cheavin, Capt. W. H. S., F.C.S., F.R.M.S., F.N.P.S., Demonstrator, Chemistry Dept., Middlesex Medical College, *Middlesex Hospital Medical School*, W. 1.

1919 Cheesman, Miss L. Evelyn, *Entomological Dept., Zoological Society, Regent's Park*, N.W. 8

1889 Christy, William M., M.A., F.L.S., *Watergate, Emsworth.*

1914 Chrystal, R. Neil, B.Sc., 277, *First-avenue, Ottawa, Canada.*

1909 Clark, Lt.-Col. C. Turner, F.Z.S., *Hillcrest, St. Augustine's-avenue, S. Croydon.*

1908 Clark, Edgar L., 34, *Smith-street, Durban, Natal.*

1914 Cleare, L. D., Dept. of Science and Agriculture, *Georgetown, British Guiana.*

1914 Cleghorn, Miss Maude Lina West, F.L.S., 14, *Alipore-road, Calcutta, India.*

1908 Clutterbuck, Charles G., *Heathside*, 23, *Heathville-road, Gloucester.*

1908 Clutterbuck, P. H., *Indian Forest Department, Naini Tal, United Provinces, India.*

1904 ‡ Cockayne, Edward A., M.A., M.D., F.R.C.P., (Council, 1915–18), 65, *Westbourne-terrace*, W. 2.

1917 Cockerell, Prof. T. D. A., *University of Colorado, Boulder, Colorado, U.S.A.*

1917 ‡ Cocks, Frederick, 26, *Crown-street, Reading.*

1914 Coleman, Leslie C., Dept. of Agriculture, *Bangalore, Mysore, India.*

1899 ‡ Collin, James E., F.Z.S., (V.-Pres., 1913; Council, 1904–6, 1913–15), *Sussex Lodge, Newmarket.*

1906 Collinge, Walter E., D.Sc. (St. And.), M.Sc. (Birm.), F.L.S., Research Fellow of the University of St. Andrews, *The Gatty Marine Laboratory, St. Andrews, Scotland.*

1918 Comstock, Dr. John Adams, *c/o* the South-Western Museum, *Marmion-way and Avenue, Los Angeles, California, U.S.A.*

1913 ‡ Coney, Miss Blanche A., *The Poplars, Pucklechurch, Gloucestershire.*

1919 Constable, Miss Florence B., 17, *Colville Mansions*, W. 11.

1919 ‡ Corbett, H. H., 3, *Thorne-road, Doncaster.*

1916 Cornford, The Rev. Bruce, 13, *Havelock-road, Portsmouth.*

1911 Cotton, Sidney Howard, 1a, *Chesterfield-street, Mayfair*, W. 1.

1913 Coward, Thomas Alfred, F.Z.S., 36, *George-street, Manchester.*

1895 Crabtree, Benjamin Hill, *Holly Bank, Alderley Edge, Cheshire.*

1913 Cragg, Capt. F. W., M.D., I.M.S., *Central Research Institute, Kasauli, Punjaub, India.*

1919 Crampton, Prof. E. Chester, *Massachusetts Agricultural College, Amherst, Mass.*, U.S.A.

1909 ‡ Crawley, W. C., B.A. (Council, 1917–19), 29, *Holland Park-road*, W. 4.

1890 Crewe, Sir Vauncey Harpur, Bart., *Calke Abbey, Derbyshire.*

1880*† Crisp, Sir Frank, LL.B., B.A., J.P.

1907 Croft, Edward Octavius, M.D., 12, *North Hill-road, Headingley, Leeds.*

1908 Culpin, Millaïs, M.B., F.R.C.S., *Stydersgate, Loughton, Essex.*

1919 ‡ Cumming, Bernard Douglas, *Royal Exchange Assurance, Royal Exchange*, E.C. 3.

1908 Curtis, W. Parkinson, *Drake North, Sandringham-road, Parkstone, Dorset.*

1901 ‡ Dadd, Edward Martin.
1900 Dalglish, Andrew Adie, 7, *Keir-street, Pollokshields, Glasgow.*
1886 ‡ Dannatt, Walter, *St. Lawrence, Guibal-road, Lee*, S.E.
1911 Davey, H. W., Inspector of Department of Agriculture, *Melbourne, Victoria, Australia.*
1913 Davidson, James, M.Sc., *Institute of Plant Pathology, Rothamsted, Harpenden, Herts.*
1905 Davidson, James D., 32, *Drumsheugh Gardens, Edinburgh.*
1912 Davis, Frederick Lionel, J.P., M.R.C.S., L.R.C.P., *Belize, British Honduras.*
1910 ‡ Dawson, William George, 44, *London-road, Bromley, Kent.*
1903 Day, F. H., 26, *Currock-terrace, Carlisle.*
1898 Day, G. O., *Sahlatston, Duncan's Station, Vancouver Island, British Columbia.*
1917 ‡ Dicksee, Arthur, 24, *Lyford-road, Wandsworth Common*, S.W. 18.
1875 ‡ Distant, William Lucas, (V.-Pres., 1881, 1900; Sec., 1878-80; Council, 1900-2), *Glenside*, 170, *Birchanger-road, South Norwood*, S.E. 25.
1887 ‡ Dixey, Frederick Augustus, M.A., M.D., F.R.S., Fellow and Bursar of Wadham College, (Pres., 1909-10; V.-Pres., 1904-5, 1911; Council, 1895, 1904-6), *Wadham College, Oxford.*
1909 † Dobson, Thomas, 33, *The Park, Sharples, nr. Bolton.*
1905 Dodd, Frederick P., *Kuranda, viâ Cairns, Queensland.*
1912 ‡ Doig, Major Kenneth Alan Crawford, R.A.M.C., M.R.C.S., L.R.C.P., *Hook Heath, Woking.*
1906 * Dollman, Hereward, *Hove House, Newton-grove, Bedford-park*, W. 4.
1906 ‡ Doncaster, Leonard, M.A., *The University Museum of Zoology, Cambridge.*
1891 ‡ Donisthorpe, Horace St. John K., F.Z.S., (V.-Pres., 1911; Council, 1899-1901, 1910-12), *Durandesthorpe*, 19, *Hazlewell-road, Putney*, S.W. 15.
1913 ‡ Dow, Walter James, 5, *Great College-street, Westminster*, S.W. 1.
1910 Downes-Shaw, Rev. Archibald, *Scotton Rectory, Gainsborough.*
1884 ‡ Druce, Hamilton H. C. J., F.Z.S. (Council, 1903-5), 26, *South Hill Park, Hampstead*, N.W. 3.
1900 Drury, W. D., *Clarendon, Laton-road, Hastings.*
1894 Dudgeon, G. C., 1, *Zetland House, Cheniston-gardens, Kensington*, W. 8.
1913 Duffield, Charles Alban William, *Stowting Rectory, Hythe*, and *Wye College, Kent.*
1906 ‡ Dukinfield Jones, E., *Castro, Reigate.*
1883 ‡ Durrant, John Hartley, (V.-Pres., 1912-13; Council, 1911-13, 1919-), *Merton*, 17, *Burstock-road, Putney*, S.W. 15; and *British Museum (Natural History), Cromwell-road, S. Kensington*, S.W. 7.

1910 ‡ Eales-White, Capt. J. Cushny, 49, *Chester-terrace, Eaton-sq.*, S.W. 1.
1912 ‡ Earl, Herbert L., M.A., 12, *Avondale-road North, Southport, Lancs.*

1865 ‡ Eaton, The Rev. Alfred Edwin, M.A., (Council, 1877–9), *Richmond Villa, Northam S.O., N. Devon.*

1902 ‡ Edelsten, Hubert M., *The Elms, Forty Hill, Enfield, Middlesex.*

1919 Edwardes, Capt. Tickner, R.A.M.C., *The Red Cottage, Burpham, Arundel, Sussex.*

1911 ‡ Edwards, F. W., 56, *Norton-road, Letchworth.*

1886 Edwards, James, *Colesborne, Cheltenham.*

1884 ‡ Edwards, Stanley, F.L.S., F.Z.S. (Council, 1912–14), 15, *St. Germans-place, Blackheath*, S.E. 3.

1913 Edwards, William H., *Natural History Dept., The Museum, Birmingham.*

1916 ‡ Effalatoun, Hassan, *Shoubrah-avenue, Cairo, Egypt.*

1900 ‡ Elliott, E. A., 41, *Chapel Park-road, St. Leonards-on-Sea.*

1900 ‡ Ellis, H. Willoughby, F.Z.S. (Council, 1916–18), 3, *Lancaster-place, Belsize Park*, N.W. 3.

1919 Elston, Albert H., *Delemont, Childers-street, N. Adelaide, Australia.*

1903 ‡ Eltringham, Harry, M.A., D.Sc., F.Z.S. (V.-Pres., 1914, 1918; Council, 1913–15, 1918–), *Woodhouse, Stroud, Gloucestershire*, and *Hope Department, University Museum, Oxford.*

1878 Elwes, Henry John, J.P., F.R.S., F.L.S., F.Z.S. (Pres., 1893–4; V.-Pres., 1889–90, 1892, 1895; Council, 1888–90), *Colesborne, Cheltenham.*

1903 Etheridge, Robert, *Curator, Australian Museum, Sydney, N.S.W.*

1908 Eustace, Eustace Mallabone, M.A., *Wellington College, Berks.*

1919 Evans, Lt.-Col. Wm. Henry, D.S.O., R.E., c/o Messrs. Cox & Co., 16, *Charing Cross*, W.C. 2.

1919 Falconer, William, *Wilberlee, Slaithwaite, Huddersfield.*

1907 Feather, Walter, *Kibwezi, British East Africa.*

1900 ‡ Feltham, H. L. L., *Mercantile Buildings, Summonds-street, Johannesburg, Transvaal.*

1861 ‡ Fenn, Charles, *Eversden House, Burnt Ash Hill, Lee*, S.E. 12.

1910 Fenyes, A., M.D., 170, *North Grange Grove-Avenue, Pasadena, California, U.S.A.*

1918 Ferguson, Anderson, 22, *Polworth-gardens, Glasgow, W.*

1889 Fernald, Prof. C. H., c/o H. T. Fernald, Esq., *Amherst, Mass., U.S.A.*

1900 Firth, J. Digby, F.L.S., *Boys' Modern School, Leeds.*

1900 ‖ Flemyng, The Rev. Canon W. Westropp, M.A., *Coolfin, Portlaw, co. Waterford.*

1898 ‡ Fletcher, Prof. T. Bainbrigge, R.N., *Agricultural Research Institute, Pusa, Bihar, India.*

1883 † Fletcher, William Holland B., M.A., *Aldwick Manor, Bognor.*

1905 Floersheim, Cecil, 16, *Kensington Court Mansions*, S.W.

1885 Fokker, A. J. F., *Zierikzee, Zeeland, Netherlands.*

1914 Fordham, William John, M.R.C.S., L.R.C.P., 20, *Spring View-road, Sheffield.*

1913 Foster, Arthur H., M.R.C.S., L.R.C.P.(Eng.), M.B.O.U., *Sussex House, Hitchin, Herts.*
1900 Foulkes, P. Hedworth, B.Sc., *Harper-Adams Agricultural College, Newport, Salop.*
1898 ‡ Fountaine, Miss Margaret, 804, *Elizabeth-street, Paradeux, California, U.S.A.*
1880 ‡ Fowler, The Rev. Canon, D.Sc., M.A., F.L.S., (Pres., 1901–2; V.-Pres., 1903; Sec., 1886–96), *Earley Vicarage, near Reading.*
1908 Fraser, Frederick C., Capt., M.D., I.M.S., *Bombay Natural History Society*, 6, *Apollo-street, Bombay, India.*
1896 Freke, Percy Evans, *Southpoint, Limes-road, Folkestone.*
1888 ‡ Fremlin, H. Stuart, M.R.C.S., L.R.C.P., *Markwith, Nether-street, North Finchley.*
1910 ‡ Frisby, G. E., 31, *Darnley-road, Gravesend.*
1908 Froggatt, Walter W., F.L.S., Government Entomologist, *Agricultural Museum, George-street North, Sydney, New South Wales.*
1891 ‡ Frohawk, F. W., *Uplands, Thundersby, Essex.*
1906*† Fry, Harold Armstrong, *P.O. Box* 46, *Johannesburg, Transvaal.*
1900 ‡ Fryer, H. Fortescue, *The Priory, Chatteris, Cambs.*
1907 ‡ Fryer, John Claud Fortescue, M.A. (Council, 1916–18), *Board of Agriculture and Fisheries*, 4, *Whitehall-place*, S.W. 1.
1876 ‡ Fuller, The Rev. Alfred, M.A., *The Lodge*, 7, *Sydenham-hill, Sydenham*, S.E. 26.
1898 ‖ Fuller, Claude, Government Entomologist, *Pietermaritzburg, Natal.*

1887 ‡ Gahan, Charles Joseph, M.A., D.Sc., Vice-President (Pres., 1917–18; V.-Pres., 1916; Sec., 1899–1900; Council, 1893–5, 1901, 1914–19), 8, *Lonsdale-road, Bedford Park*, W. 4; and *British Museum (Natural History), Cromwell-road*, S.W. 7.
1890 Gardner, John, *Laurel Lodge, Hart, West Hartlepool.*
1901 †‡ Gardner, Willoughby, F.L.S., F.S.A., *Deganwy, N. Wales.*
1913 ‡ de Gaye, J. A., *King's College, Lagos, S. Nigeria.*
1919 ‡ Gedye, Alfred Francis John, P.O. Box 216, *Nairobi, British East Africa.*
1899 ‡ Geldart, William Martin, M.A., 10, *Chadlington-road, Oxford.*
1913 ‡ Gibb, Lachlan, 38, *Blackheath Park, Blackheath*, S.E. 3.
1915 Gibson, Arthur, *Entomological Branch, Dept. of Agriculture, Ottawa, Canada.*
1908 Giffard, Walter M., *P.O. Box* 308, *Honolulu, Hawaii.*
1907 Giles, Henry Murray, Head Keeper of Zoological Gardens, *South Perth, W. Australia.*
1904 ‡ Gilliat, Francis, B.A., *Windham Club, St. James's-square, Piccadilly*, S.W. 1.
1919 Gimingham, Conrad Theodore, O.B.E., F.I.C., *Lynwood, Long Ashton, Bristol.*
1914 Godfrey, E. J., Education Dept., *Bangkok, Siam.*

1865*†Godman, Frederick Du Cane, D.C.L., F.R.S., F.L.S., F.Z.S. (Pres., 1891–2; V.-Pres., 1882–3, 1886, 1889–90, 1902; Council, 1880–1, 1900), *South Lodge, Lower Beeding, Horsham*; and 45, *Pont-street*, S.W.

1904 Goodwin, Edward, *Canon Court, Wateringbury, Kent.*

1898 ‡ Gordon, J. G. McH., *Corsemalzie, Whauphill S.O., Wigtownshire.*

1898 ‡ Gordon, R. S. G. McH., *Drumblair, Inverness.*

1855 Gorham, The Rev. Henry Stephen, F.Z.S., (Council, 1882–3), *High-croft, Great Malvern.*

1913 Gough, Lewis, Ph.D., Entomologist to the Govt. of Egypt, *Dept. of Agriculture, Cairo.*

1909 Gowdey, Carlton C., B.Sc., *Biological Laboratory, P.O. Box.* 5, *Kampala, Uganda, E. Africa.*

1918 Grace, George, B.Sc., A.R.C.Sc., 23, *Alexander-crescent, Ilkley, Yorks.*

1914 Graveley, F. H., *The Indian Museum, Calcutta.*

1911 ‡ Graves, Major P. P., *Turf Club, Cairo, Egypt.*

1891†‡Green, E. Ernest, F.Z.S. (V.-Pres., 1915; Council, 1914–16), *Way's End, Beech-avenue, Camberley.*

1910 Green, Herbert A., *The Central Fire Station, Durban, Natal.*

1894 Green, J. F., F.Z.S., *City of London Club, Old Broad-street*, E.C. 2.

1893 † Greenwood, Henry Powys, F.L.S., *Whitsbury House, Salisbury.*

1888 Griffiths, G. C., F.Z.S., *Penhurst*, 3, *Leigh-road, Clifton, Bristol.*

1894 ‡ Grimshaw, Percy H., *Royal Scottish Museum, Edinburgh.*

1905 Grist, Charles J., *The Croft, Carol Green, Berkswill, Coventry.*

1906 Gurney, Gerard H., *Keswick Hall, Norwich.*

1910 Gurney, William B., Asst. Govt. Entomologist, *Department of Agriculture, Sydney, Australia.*

1912 Hacker, Henry, *Butterfield-street, Bowen Bridge-road, Brisbane, Queensland.*

1919 Hadwen, Dr. Seymour, D.Vet.Sci., *Biological Central Experimental Farm, Ottawa, Canada.*

1906 ‡ Hall, Arthur, 7, *Park-lane-mansions, Croydon.*

1890†‡Hall, Albert Ernest, c/o *City Librarian, Surrey-street, Sheffield.*

1885 ‡ Hall, Thomas William, *Wood Grange, Shire-lane, Chorley Wood, Herts.*

1912 Hallett, Howard Mountjoy, 64, *Westbourne-road, Penarth, Glamorganshire.*

1898 ‖ Hamlyn-Harris, R., D.Sc., F.L.S., F.Z.S., F.R.M.S., Director of the Queensland Museum, *St. Ronans, Wilston, Brisbane, Australia.*

1915 Hamm, Albert Harry, 22, *Southfield-road, Oxford.*

1891 ‡ Hanbury, Frederick J., F.L.S., *Brockhurst, E. Grinstead.*

1905 † Hancock, Joseph L., 5454, *University-avenue, Chicago, U.S.A.*

1916 * Hannyngton, Frank, *Shorebank, Bognor, Sussex.*

1917 Harding, William G., *Christ Church, Oxford*, and *Junior Army and Navy Club, Whitehall*, S.W. 1.

1903 ‡ Hare, E. J., 4, *New-square, Lincoln's Inn*, W.C. 2.
1904 ‡ Harris, Edward, 58, *Wilson-street, Finsbury*, E.C.
1910 ‡ Harwood, Philip Bernard, 2, *Fern Villas, Melford-road, Sudbury.*
1919 Hawker-Smith, William, *Speedwell Cottage, Hambledon, Godalming, Surrey.*
1910 ‡ Hawkshaw, J. C.
1913 †‡ Hawkshaw, Oliver, 3, *Hill-street, Mayfair*, W. 1.
1919 ‡ Hayward, H. C., M.A., *Repton, Derby.*
1910 ‡ Hedges, Alfred van der, *Stoke House, Stoke Manderille, Bucks.*
1919 Hemming, Arthur Francis, *Oxford and Cambridge Club, Pall Mall*, S.W., and *Cambridge Lodge, Horley, Surrey.*
1910 Henderson, J., c/o Messrs. Osborne & Chappel, *Ipoh, Perak, Federated Malay States.*
1898 Heron, Francis A., B.A., 9, *Park House, Highbury Park*, N. 5.
1918 Herrod-Hempsall, Joseph, *Orchard House, Stockingstone-road, Luton, Beds.*
1903 Herrod-Hempsall, William, *W.B.C. Apiary, Old Bedford-road, Luton, Beds.*
1908 Hewitt, C. Gordon, D.Sc., Dominion Entomologist, *Dept. of Agriculture, Ottawa, Canada.*
1913 Hewitt, John, B.A., Director, *Albany Museum, Grahamstown, S. Africa.*
1913 Hill, Gerald F., *Veterinary School, University of Melbourne, Parkville, Victoria, Australia.*
1876 † Hillman, Thomas Stanton, *Eastgate-street, Lewes.*
1907 ‡ Hoar, Thomas Frank Partridge, *Mercia, Albany-road, Leighton Buzzard.*
1917 Hockin, John W., *Castle-street, Launceston.*
1914 Hodge, The Rev. Canon Edward Grose, *The Rectory, Birmingham*
1912 Hodge, Harold, 91, *Highbury-place*, N. 5.
1883 Hodson, The Rev. J. H., B.A., B.D., *Rhyddington, Clifton Drive, Lytham.*
1902 Hole, R. S., c/o Messrs. King and Co., *Bombay.*
1910 ‡ Holford, H. O., *Elstead Lodge, Godalming, Surrey.*
1887 Holland, The Rev. W. J., D.D., Ph.D., *Carnegie Museum, Pittsburgh, Penn., U.S.A.*
1898 Holman-Hunt, C. B., Asst. Entomologist, Department of Agriculture, *Kuala Lumpur, Federated Malay States.*
1910 ‡ Holmes, Edward Morrell, *Ruthven, Sevenoaks.*
1901 ‡ Hopson, Montagu F., L.D.S., R.C.S.Eng., F.L.S., 7, *Harley-street*, W. 1.
1897 Horne, Arthur, *Bonn-na-coile, Murtle, Aberdeenshire.*
1919 de Horrack-Fournier, Mme., 90, *Boulevard Malesherbes, Paris*, and *Château de Voisins, Louveciennes, Seine et Oise, France.*
1903 Houghton, J. T., 1, *Portland-place, Worksop.*
1907 † Howard, C. W., *Canton Christian College, Canton, China.*
1900 Howes, W. George, 259, *Cumberland-street, Dunedin, New Zealand.*

1907 ‡ Howlett, Frank M., M.A., *Wymondham, Norfolk.*

1865†‡Hudd, A. E., 108, *Pembroke-road, Clifton, Bristol.*

1888 Hudson, George Vernon, *Hill View, Karori, Wellington, New Zealand.*

1919 Hugh, Williams, J.P., *Tresaison, Cloverdale, British Columbia.*

1907 Hughes, C. N., 178, *Clarence Gate-gardens, Regent's Park*, N.W. 1.

1912 Huie, Miss Lily, *Hollywood, Colinton-road, Edinburgh.*

1917 Hunter, David, M.A., M.B., *The Coppice, Nottingham.*

1897 ‡ Image, Prof. Selwyn, M.A., (Council, 1909–11), 78, *Parkhurst-road, Camden-road*, N. 7.

1912†‡Imms, A. D., D.Sc., M.A., F.L.S., (Council, 1919-), *Rothamsted Experimental Station, Harpenden, Herts.*

1908 ‖ Irby, Col. Leonard Paul, *Evington-place, Ashford, Kent.*

1918 Isaacs, P. V., Assistant Entomologist, *Madras Agricultural College and Research Institute, Coimbatore, India.*

1907 Jack, Rupert Wellstood, Government Entomologist, Department of Agriculture, *Salisbury, Rhodesia.*

1917 ‡ Jackson, Miss Dorothy J., *Swordale, Evanton, Ross-shire.*

1907 ‡ Jackson, P. H., 112, *Balham-park-road*, S.W. 12.

1911 ‡ Jacobs, Major J. J., R.E., *Holmesleigh, Burgess Hill, Sussex.*

1910 ‖ Jacobs, Lionel L., c/o Algoma Steel Corporation, *Sault Ste. Marie, Ontario, Canada.*

1914 Janse, A. J. T., 1*st-street, Gezina, Pretoria, S. Africa.*

1869 ‡ Janson, Oliver E., 44, *Great Russell-street, Bloomsbury*, W.C. 1. ; and *Cestria, Claremont-road, Highgate*, N. 6.

1898 Janson, Oliver J., *Cestria, Claremont-road, Highgate*, N. 6.

1912 ‖ Jardine, Nigel K., *The Glenan, Helensburgh, Dumbartonshire.*

1919 Jeans, Miss Gertrude M., *Penn Court*, 54, *Cromwell-road*, S.W. 7.

1886 Jenner, James Herbert Augustus, *East Gate House, Lewes.*

1909 Jepson, Frank P., *Peradeniya, Ceylon.*

1917 ‡ Jermyn, Col. Turenne, *Highcliffe, Weston-super-Mare*, and 41, *Norland-square*, W. 11.

1886 John, Evan, *Llantrisant S.O., Glamorganshire.*

1907 Johnson, Charles Fielding, *West Bank, Didsbury-road, Heaton Mersey.*

1917 Johnson, Jesse, 16 and 17, *Marston-road, Stafford.*

1889 Johnson, The Rev. W. F., M.A., *Acton Rectory, Poyntz Pass, co. Armagh.*

1908 Joicey, James J., *The Hill, Witley, Surrey.*

1888 ‡ Jones, Albert H., (V.-Pres., 1912, 1918; Treas., 1904–17; Council, 1898–1900, 1904–1918), *Shrublands, Eltham*, S.E. 9.

1894†‡Jordan, Dr. K., (V.-Pres., 1909; Council, 1909–11), *The Museum, Tring.*

1910 ‡ Joseph, E. G., 23, *Clanricarde-gardens*, W. 2.

1910 ‡ Joy, Ernest Cooper, *Eversley, Dale-road, Purley.*

1902 ‡ Joy, Norman H., M.R.C.S., L.R.C.P., *Theale, Berks.*
1919 Jurriaanse, J. H., *Schiekade*, 75, *Rotterdam, Holland.*

1911 Kannan, Kunhi, M.A., Asst. Entomologist to the Govt. of Mysore, *Bangalore, South India.*
1876 † ‡ Kay, John Dunning, *Leeds.*
1896 † Kaye, William James, (Council, 1906–8), *Caracas, Ditton Hill, Surbiton.*
1907 ‖ Kelly, Albert Ernest McClure, Division of Entomology, Department of Agriculture, *Pretoria, S. Africa.*
1890 ‡ Kenrick, Sir George H., *Whetstone, Somerset-road, Edgbaston, Birmingham.*
1904 Kershaw, G. Bertram, *Ingleside, West Wickham, Kent.*
1906 Keynes, John Neville, M.A., D.Sc., 6, *Harvey-road, Cambridge.*
1900 Keys, James H., 7, *Whimple-street, Plymouth.*
1919 Khare, Jagamath Layman, Lecturer in Entomology, *Agricultural College, Nagpur, India.*
1912 King, Harold H., Govt. Entomologist, *Gordon College, Khartoum, Sudan.*
1889 King, Prof. James J. F.-X., 1, *Athole Gardens-terrace, Kelvinside, Glasgow.*
1913 Kirby, W. Egmont, M.D., *Hilden*, 46, *Sutton Court-road, Chiswick*, W. 4.
1917 ‡ Kirkpatrick, Thos. W., *The Deanery, Ely*, and *Room* 270, *War Office, Whitehall*, S.W. 1.
1887 † Klein, Sydney T., F.L.S., F.R.A.S., *Lancaster Lodge, Kew Gardens, Surrey.*

1916 ‡ Laing, Frederick, *Natural History Museum, Cromwell-road*, S.W. 7.
1910 ‡ Lakin, C. Ernest, M.D., F.R.C.S., 105, *Harley-street*, W. 1.
1911 † ‡ Lamborn, W. A., M.R.C.S., L.R.C.P., *The Malaria Bureau, Kuala Lampur, Federated Malay States.*
1919 Lamont, Sir Norman, Bart., 4, *Queen-street, Mayfair*, W. 1, and *Palmiste, Trinidad, B.W.I.*
1917 Langham, Sir Charles, Bart., *Tempo Manor, Co. Fermanagh.*
1916 Latta, Prof. Robert, D.Phil., *University of Glasgow.*
1912 Latour, Cyril Engelhart, *Port of Spain, Trinidad, British West Indies.*
1895 Latter, Oswald H., M.A., *Charterhouse, Godalming.*
1899 Lea, Arthur M., Government Entomologist, *Museum, Adelaide, S. Australia.*
1914 Leechman, Alleyne, M.A., F.L.S., F.C.S., *Corpus Christi College, Oxford;* and *St. Hubert's, Main-street, Georgetown, British Guiana.*
1910 Leigh, H. S., *The University, Manchester.*
1900 Leigh-Phillips, Rev. W. J., *Burtle Vicarage, Bridgwater.*
1903 † ‡ Levett, The Rev. Thomas Prinsep, *Frenchgate, Richmond, Yorks.*
1876 ‡ Lewis, George, F.L.S., (Council, 1878, 1884), 30, *Shorncliffe-road, Folkestone.*

1908 † Lewis, John Spedan, *Grove Farm, Greenford Green, South Harrow;* and 277, *Oxford-street*, W.

1892 Lightfoot, R. M., *South African Museum, Cape Town, Cape of Good Hope.*

1914 ‡ Lister, J. J., *St. John's College, Cambridge;* and *Merton House, Grantchester, Cambs.*

1903 Littler, Frank M., *Box* 114, *P.O., Launceston, Tasmania.*

1865 † Llewelyn, Sir John Talbot Dillwyn, Bart., M.A., F.L.S., *Penllergare, Swansea.*

1881 † Lloyd, Alfred, F.C.S., *The Dome, Bognor.*

1919 Lloyd, Llewellyn, Chief Entomologist in N. Rhodesia, *Cartref, Slingsby, Malton, Yorks.*

1885†‡Lloyd, Robert Wylie, (Council, 1900–1), I, 5 and 6, *Albany, Piccadilly*, W. 1.

1903 Lofthouse, Thomas Ashton, *The Croft, Linthorpe, Middlesbrough.*

1908 ‡ Longsdon, D., *The Flower House, Southend, Catford*, S.E. 6.

1904†‡Longstaff, George Blundell, M.A., M.D., (V.-Pres., 1909, 1915, 1917; Council, 1907–9, 1915–17), *Highlands, Putney Heath*, S.W. 15.

1899 || Lounsbury, Charles P., B.Sc., Government Entomologist, *Box* 513, *Pretoria, S. Africa.*

1893 Lower, Oswald B., *Pinarro, South Australia.*

1901 Lower, Rupert S., *Bartley-terrace, Wayville, S. Australia.*

1898 ‡ Lucas, William John, B.A., (Council, 1904–6), 28, *Knight's Park, Kingston-on-Thames.*

1903 Lyell, G., *Gisborne, Victoria, Australia.*

1912 Lyle, George Trevor, 7, *Scrope-terrace, Cambridge.*

1909 Lyon, Francis Hamilton, 89, *Clarence Gate-gardens, Upper Baker-street*, N.W. 1.

1887 M'Dougall, James Thomas, *St. Lawrence, Isle of Wight.*

1910 Macdougall, R. Stewart, M.A., D.Sc., F.R.S.E., *Edinburgh University.*

1919 McLeod, Murdoch Campbell, *The Fairfields, Cobham, Surrey*, and McLeod & Son, *Calcutta, India.*

1900 Mackwood, The Hon. F. M., M.L.C., *Colombo, Ceylon.*

1919 Mackworth-Praed, Cyril Winthrop, *Dalton Hill, Albury, Surrey.*

1899†‡Main, Hugh, B.Sc., (Council, 1908–10), *Almondale, Buckingham-road, South Woodford*, N.E.

1914 Mallock, J. Russell, State Entomologist's Office, *Urbana, Illinois, U.S.A.*

1905 Mally, Charles Wm., M.Sc., *Dept. of Agriculture, Cape Town, S. Africa.*

1892 ‡ Mansbridge, William, *Dunraven, Church-road, Wavertree, Liverpool.*

1894†‡Marshall, Alick.

1895 ‡ Marshall, Guy Anstruther Knox, D.Sc., F.Z.S., Vice-President, (Council, 1907–8, 1919–), 6, *Chester-place, Hyde Park-square*, W. 2.

1896 Marshall, P., M.A., B.Sc., F.G.S., *University School of Mines, Dunedin, New Zealand.*

1897 Martineau, Alfred H., *Barum, Crewkerne, Somerset.*

1919 Marumo, N., *Zoological Institute, Agricultural College, Imperial University, Komaba, Tokyo, Japan.*

1895 Massey, Herbert, *Ivy-Lea, Burnage, Didsbury, Manchester.*

1865 Mathew, Gervase F., F.L.S., Paymaster-in-chief, R.N., (Council, 1887), *Lee House, Dovercourt, Harwich.*

1887 Matthews, Coryndon, *Stentaway, Plymstock, S. Devon.*

1912 Maulik, Prof., *Department of Zoology, University of Calcutta, Calcutta, India.*

1900 ‡ Maxwell-Lefroy, H., *Imperial College of Science and Technology, South Kensington,* S.W.

1916 ‡ May, Harry Haden, *Blackfriars House, Plymouth.*

1913 ‡ Meaden, Louis, *Melbourne, Dyke-road, Preston, Brighton.*

1919 Mellows, Charles, M.A., *The College, Bishop's Stortford.*

1885 Melvill, James Cosmo, M.A., F.L.S., *Meole Brace Hall, Shrewsbury.*

1907 ‡ Melville, Mrs. Catharine Maria, *Kapai, Elburton, S. Devon.*

1914 Menon, J. R., B.A., *Trichur, Cochin State, S. India.*

1887 ‡ Merrifield Frederic, (Pres., 1905–6 ; V.-Pres., 1893, 1907 ; Sec., 1897–8 ; Council, 1894, 1899), 14, *Clifton-terrace, Brighton.*

1912 Metcalfe, Rev. J. W., *The Vicarage, Ottery St. Mary, Devon.*

1880 ‡ Meyrick, Edward, B.A., F.R.S., F.Z.S., *Thornhanger, Marlborough.*

1883 ‡ Miles, W. H., c/o E. Step, Esq., 158, *Dora-road, Wimbledon Park,* S.W. 19.

1913 Miller, F. V. Bruce, *Livingston, N. Rhodesia, Africa.*

1919 Mills, Herbert William, N.D.A., *The Gardens, Lydney Park Glos.*

1905 ‡ Mitford, Robert Sidney, C.B., *Thornlea, Weybridge.*

1914 Miyaké, Dr. Tsunekata, *The Agricultural College, Tokyo Imperial University, Komaba, Tokyo, Japan.*

1879 || Monteiro, Dr. Antonio Augusto de Carvalho, 70, *Rua do Alecrinar, Lisbon.*

1902 ‡ Montgomery, Arthur Meadows, 34, *Shalimar Gardens, Pembridge-road, North Acton,* W. 11.

1899 ‡ Moore, Harry, 12, *Lower-road, Rotherhithe.*

1916 Moore, Ralph Headley, B.A., *Heathfield, Plymstock, Devon.*

1886 Morgan, A. C. F., F.L.S., 135, *Oakwood-court, Kensington,* W. 14.

1889 †‡ Morice, The Rev. F. D., M.A., F.Z.S., Fellow of Queen's College, Oxford, Vice-President, (Pres., 1911, 1912, V.-Pres., 1902, 1904, 1913 ; Council, 1902–4, 1918–), *Brunswick, Mount Hermon, Woking.*

1895 †‡ Morley, Claude, F.Z.S., *Monk Soham House, Suffolk.*

1893 Morton, Kenneth J., 13, *Blackford-road, Edinburgh.*

1910 ‡ Mosely, Martin E., 94, *Camden Hill-road, Kensington,* W. 8.

1882 Mosley, S. L., *The Museum and Technical College, Huddersfield.*

1911 ‡ Moss, Rev. A. Miles, c/o Messrs. Booth & Co., *Para, Brazil,* 1907 †‡ MOULTON, John C., O.B.E., M.A., B.Sc., F.Z.S., &c., Director, *Raffles Museum and Library, Singapore, Straits Settlements,* and *The Hall, Bradford-on-Avon.*

1911 MOUNSEY, J. Jackson, 24, *Glencairn-crescent, Edinburgh.*

1901 †‡ MUIR, Frederick, *H.S.P.A. Experiment Station, Honolulu, Oahu, H.T.*

1912 † MULLAN, Jal Phirozshah, M.A., F.L.S., F.Z.S., Professor of Biology, *St. Xavier's College, Lamington-road, Grant Road Post, Bombay, India.*

1869 †‡ MÜLLER, Albert, F.R.G.S., (COUNCIL, 1872–3), c/o Herr A. Müller-Mechel, *Grenzacherstrasse* 60, *Basle, Switzerland.*

1918 MUNRO, Lieut. James W., R.A.M.C., *Forestry Commission,* 23, *Grosvenor-crescent,* S.W. 1.

1914 MURRAY, George H., *Government Station, Kikori, Delta Division, Papua.*

1917 MUSCHAMP, Percy A. H., *Charterhouse School, Godalming.*

1909 MUSHAM, John F., 48, *Brook-street, Selby, Yorks.*

1903 ‡ NEAVE, S. A., M.A., D.Sc., F.Z.S., SECRETARY, 1919– (V.-PRES., 1918 ; COUNCIL, 1916–), 88, *Queen's Gate,* S.W. 7, and 24, *de Vere-gardens, Kensington,* W. 8.

1919 ‡ NELL, Louis, *Imperial Bureau of Entomology, British Museum (Nat. Hist.), S. Kensington,* S.W. 7.

1919 NELSON, William George Frazer, 6, *Craven Hill,* W. 2.

1901 ‡ NEVINSON, E. B., *Morland, Cobham, Surrey.*

1907 ‡ NEWMAN, Leonard Woods, *Bexley, Kent.*

1913 NEWMAN, Leslie John William, *Bernard-street, Claremont, W. Australia.*

1909 NEWSTEAD, Alfred, *The Grosvenor Museum, Chester.*

1890 NEWSTEAD, Prof. Robert, M.Sc., F.R.S., A.L.S., Hon. F.R.H.S., Dutton Memorial Professor of Entomology, *The School of Tropical Medicine, University of Liverpool.*

1914 ‡ NICHOLSON, Charles, 35, *The Avenue, Hale-end, Chingford,* E. 4.

1909 ‡ NICHOLSON, Gilbert W., M.A., M.D., (COUNCIL, 1913–15), *Oxford and Cambridge Club, Pall Mall,* S.W. 1.

1918 ‡ NIMMY, Ernest William, 210, *Whippendell-road, Watford, Herts.*

1906 NIX, John Ashburner, *Tilgate, Crawley, Sussex.*

1916 NOHIRA, Akio, *Tchijoji, Otagigun, Kyoto, Japan.*

1914 NORRIS, Frederic de la Mare, *The Agricultural Department, Kuala Lumpur, Federated Malay States.*

1915 NORTHCOTE, Dr. A. B., *Blenheim House, Monkgate, York.*

1878 * NOTTIDGE, Thomas, *Ashford, Kent.*

1895 NURSE, Lt.-Colonel C. G., *Authors' Club,* 2, *Whitehall-court,* S.W. 1.

1877 OBERTHÜR, René, *Rennes (Ille-et-Vilaine), France.*

1893 † OGLE, Bertram S., *Steeple Aston, Oxfordshire.*

1910 ‡ OLDAKER, Francis A., M.A., *The Red House, Haslemere.*

1918 O'NEIL, Rev. Fr., S.J., *Salisbury, Rhodesia.*
1913 ‡ ORMISTON, Walter, *Kalupahani, Haldummulle, Ceylon.*

1895 ‡ PAGE, Herbert E., (COUNCIL, 1918–), *Bertrose, Gellatly-road, St. Catherine's Park*, S.E. 15.
1916 PALMER, Arthur Raymond, *Ingleholme, Norton Way, Letchworth, Herts.*
1919 PARAVICINI, Louis, *Villa Aleucita, Arlesheim, Bâle, Switzerland.*
1918 PARRIS, R. Stanway, 6 *High-street, Bishop's Stortford.*
1918 PARSONS, Dr. Allan Chilcott, M.R.C.S., L.R.C.P., D.Ph., etc., *School of Army Sanitation, Aldershot.*
1912 * PATERSON, Edward J., *Fairholme, Crowborough.*
1919 PATTON, Major W. J., I.M.S., *Stoke St. Gregory, nr. Taunton.*
1913 PEACOCK, Alexander David, *Armstrong College, Newcastle-on-Tyne.*
1911 ‡ PEARSON, Douglas, *Chilwell House, Chilwell, Notts.*
1916 ‡ PEEBLES, Howard M., 13, *Chesham-street*, S.W. 1.
1919 PEED, John, *Whittlesey, Cambs.*
1915 PEILE, Major Harry Diamond, I.M.S., c/o *Alliance Bank of Sind, Peshawar, India.*
1914 PENDLEBURY, Major Wm. J. von Monté, *Broadlands, Shrewsbury*, and *Keble College, Oxford.*
1883 PÉRINGUEY, Louis, D.Sc., F.Z.S., Director, *South African Museum, Cape Town, South Africa.*
1903 † PERKINS, R. C. L., M.A., D.Sc., F.Z.S., *Park Hill House, Paignton, Devon;* and Board of Agriculture, Division of Entomology, *Honolulu, Hawaii.*
1907 † PERRINS, J. A. D., 3rd Seaforth Highlanders, *Davenham, Malvern.*
1897 ‡ PHILLIPS, Capt. Hubert C., M.R.C.S., L.S.A., 17, *Hereford-road, Bayswater*, W. 2.
1903†‡PHILLIPS, Montagu A., F.R.G.S., F.Z.S., *Devonshire House Preparatory School, Reigate.*
1917 ‡ PICKARD-CAMBRIDGE, Arthur D., M.A., *Balliol College, Oxford.*
1891 ‡ PIERCE, Frank Nelson, *The Old Rectory, Warmington, Oundle, Northants.*
1913 PLATT, Ernest Edward, 403, *Essenwood-road, Durban, Natal.*
1885 POLL, J. R. H. Neerwort van der, *Poste restante, Geneva, Switzerland.*
1919 POMEROY, Arthur W. Jobbins, Government Entomologist in Nigeria, *Ibadan, S. Nigeria*, and *Kneesworth House*, 78, *Elm Park-road, S. Kensington*, S.W. 3.
1870†‡PORRITT, Geo. T., F.L.S., (COUNCIL, 1887), *Elm Lea, Dalton, Huddersfield.*
1884†‡POULTON, Professor Edward B., D.Sc., M.A., F.R.S., F.L.S., F.G.S., F.Z.S., Hope Professor of Zoology in the University of Oxford, (PRES., 1903–4; V.-PRES., 1894–5, 1902, 1905; COUNCIL, 1886–8 1892, 1896, 1905–7), *Wykeham House, Banbury-road, Oxford.*
1905 POWELL, Harold, 7, *Rue Mireille, Hyères (Var), France.*

1908 ‡ Pratt, William B., 10, *Lion Gate Gardens, Richmond, Surrey.*

1878 Price, David, 48, *West-street, Horsham.*

1908 ‡ Prideaux, Robert M., (Council, 1917), *Woodlands, Brasted Chart, Sevenoaks.*

1904 ‡ Priske, Richard A. R., 9, *Melbourne Avenue, West Ealing.*

1893 ‡ Prout, Louis Beethoven, (Council, 1905–7), 84, *Albert-road, Dalston*, E. 8.

1910 Punnett, Professor Reginald Crundall, M.A., *Caius College, Cambridge.*

1900 * Rainbow, William J., *The Australian Museum, Sydney, N.S.W.*

1912 Rait-Smith, W., *Hollybrook, Rose Heyworth-road, Abertillery, Monmouthshire.*

1914 Ramakrishna, T. V. Aiyar, B.A., F.Z.S., *The Agricultural College, Coimbatore, S. India.*

1913 Rao, H. Ananthaswamy, *Curator of the Government Museum, Bangalore, India.*

1916 Rao, Yelseti Ramachandra, M.A., *The Agricultural College, Coimbatore, S. India.*

1907 ‡ Rayward, Arthur Leslie, 52, *Addiscombe-road, Croydon.*

1898 Reuter, Professor Enzio, *Helsingfors, Finland.*

1910 ‡ de Rhé-Philipe, G. W. V., Chief Examiner of Accounts, North-Western Ry., *Abbott-road, Lahore, India.*

1912 ‡ Riley, Capt. Norman Denbigh, 94, *Drakefield-road, Upper Tooting*, S.W. 17; and *British Museum (Natural History), S. Kensington*, S.W. 7.

1908 ‡ Rippon, Claude, M.A., 28, *Walton-street, Oxford.*

1917 Roberts, A. W. Rymer, M.A., *Rothamsted Experimental Station, Harpenden.*

1905 Robinson, Herbert C., *Curator of State Museum, Kuala Lumpur, Selangor.*

1904 ‡ Robinson, Lady, *Worksop Manor, Notts.*

1869 † Robinson-Douglas, William Douglas, M.A., F.L.S., F.R.G.S., *Orchardton, Castle Douglas.*

1908 Rogers, The Rev. K. St. Aubyn, M.A., Church Missionary Society, *Mombasa, British East Africa.*

1907 ‡ Rosenberg, W. F. H., 57, *Haverstock-hill*, N.W. 3.

1868 ‡ Rothney, George Alexander James, *Pembury, Tudor-road, Upper Norwood*, S.E.

1888 † ‡ Rothschild, The Right Honble. Lord, D.Sc., F.R.S., F.L.S., F.Z.S., (Council, 1900), *Zoological Museum, Tring.*

1894 † ‡ Rothschild, The Honble. Nathaniel Charles, M.A., F.L.S., F.Z.S., (Pres., 1915–16; V.-Pres., 1914, 1917; Council, 1904, 1913–17), *Arundel-house, Kensington Palace Gardens*, W. 8.

1890 ‡ Routledge, G. B., *Tarn Lodge, Heads Nook, Carlisle.*

1913 ‡ Rowden, Alfred Oliver, 3, *Archibald-road, Exeter.*

1887 ‡ Rowland-Brown, Henry, M.A., (V.-Pres., 1908, 1910; Sec., 1900–10; Council, 1914–16), *Oxhey-grove, Harrow Weald.*
1910 Rudge, Charles Henry.
1892 ‡ Russell, S. G. C., *Monk's Wood, Heatherside, Park-road, Woking.*

1919 St. Aubyn, Capt. John G., c/o Sir Charles McGrigor & Co., 39, *Panton-street, Haymarket,* S.W. 1.
1905 St. Quintin, W. H., *Scampton Hall, Rillington, York.*
1906 Sampson, Colonel F. Winn, 115, *Tannsfield-road, Sydenham.*
1910 ‡ Saunders, H. A., *St. Ann's, Reigate.*
1901 Schaus, W., F.Z.S., *U.S. National Museum, Washington, D.C., U.S.A.*
1907 ‡ Schmassmann, W., *Beulah Lodge, London-road, Enfield,* N.
1912 Schunck, Charles A., *Ewelme, Wallingford.*
1911 ‡ Scorer, Alfred George, *Hill Crest, Chilworth, Guildford.*
1909 ‡ Scott, Hugh, M.A., Sc.D., Curator in Entomology, *University Museum of Zoology, Cambridge.*
1911 Selous, Cuthbert F., M.D., M.R.C.S., L.R.C.P., *Sleaford, Penn Hill, Parkstone, Dorset.*
1911†‡Sennett, Noel Stanton, 24, *de Vere-gardens, Kensington,* W. 8.
1862 ‡ Sharp, David, M.A., M.B., F.R.S., F.L.S., F.Z.S., (Pres., 1887–8; V.-Pres., 1889, 1891–2, 1896, 1902–3; Sec., 1867; Council, 1893–5, 1902–4), *Lawnside, Brockenhurst, Hants.*
1902 * Sharp, W. E., (Council, 1912–13), *The Bungalow, Crawthorne, Berks.*
1915 Shaw, Dr. A. Eland, c/o R. Kelly, Esq., Solicitor, 59, *Swanston-street, Melbourne, Victoria, Australia.*
1886 Shaw, George T. (Librarian of the Liverpool Free Public Library), *William Brown-street, Liverpool.*
1905 ‡ Sheldon, W. George, F.Z.S., (Treasurer, 1918–), *Youlgreave, South Croydon.*
1900†‡Shepheard-Walwyn, H. W., M.A., *Dalwhinnie, Kenley, Surrey.*
1887†‡Sich, Alfred, (Council, 1910–12), *Corney House, Chiswick,* W. 4.
1911 ‡ Simes, James A., *Greenacres, Woodside-road, Woodford-green, Essex.*
1904 ‡ Simmonds, Hubert W., *Sussex View, Cumberland-gardens, Tunbridge Wells.*
1913 Sitwell, Capt. F., *Wooler, Northumberland.*
1902 ‡ Sladen, Frederick William Lambart, 44, *Gwynne-avenue, Ottawa, Canada.*
1902 ‡ Sloper, Gerard Orby, F.Z.S., J.P., *Badminton Club, Piccadilly,* W. 1.
1907 ‡ Sly, Harold Baker, 16, *Sussex-square, Brighton.*
1906 ‡ Smallman, Raleigh S., *Eliot Lodge, Albemarle-road, Beckenham, Kent.*
1916 Smart, Capt. H. Douglas, R.A.M.C., *Shelley, Huddersfield.*
1915 ‡ Smith, Adam Charles, *Horton, Mornington-road, Woodford Green.*
1901 Smith, Arthur, *County Museum, Lincoln.*
1911 ‡ Smith, B. H., B.A., *Frant Court, Frant, Tunbridge Wells.*

1918 Smith, Patrick Aubrey Hugh, *Sconner House, St. German's, Cornwall*, and 28, *Bruton-street, Berkeley-square*, W.

1912 ‡ Smith, Roland T., 131, *Queen's-road, Wimbledon*, S.W. 19.

1919 Smith, S. Gordon, *Estyn, Boughton, Cheshire.*

1918 † Smith, 2nd Lieut. William Proctor, F.Z.S., *Haddon House, Ashton-on-Mersey.*

1898 Sopp, Erasmus John Burgess, F.R.Met.S., 34, *Ferndale-road, Hove.*

1885 ‡ South, Richard, (Council, 1890–1), 4, *Mapesbury-court, Shoot-up Hill, Brondesbury*, N.W. 2.

1916 ‡ Sowerby, Lieut. F. W., R.N.D., 94, *Ainslie-street, Grimsby.*

1908 ‡ Speyer, Edward R., *Ridgehurst, Shenley, Herts.*

1919 Staniland, L. N., *Trewint, Coppett's-road, Muswell Hill*, N. 10.

1910 Stanley, The Rev. Hubert George, *Marshfield Vicarage, Cardiff.*

1919 Stansfield, Capt. Leslie Rawdon, R.G.A., c/o *Army and Navy Club, Pall Mall*, S.W. 1.

1898 || Stares, C. L. B., M.R.C.S., L.R.C.P., *The Limes, Swanley Junction, Kent.*

1910 ‡ Stenton, Rupert, *St. Edward's, St. Mary Church, Torquay.*

1918 ‡ Stiff, Rev. Alfred T., *All Souls' Vicarage, Brighton.*

1910 ‡ Stoneham, Hugh Frederick, Capt. 1st Batt. E. Surrey Regt., *Stoneleigh, Reigate.*

1913 Storey, Gilbert, *Dept. of Agriculture, Cairo, Egypt.*

1915 ‡ Stott, Charles Ernest, *Eaton, London-road, Reigate.*

1896 ‡ Strickland, T. A. Gerald, *Southcott, Poulton, Fairford.*

1900 * Studd, E. A. C., *P.O. Box* 906, *Vancouver, British Columbia.*

1895 || Studd, E. F., M.A., B.C.L., *Oxton, Exeter.*

1908 Swierstra, Corn. J., 1st Assistant, *Transvaal Museum, Pretoria.*

1884 Swinhoe, Colonel Charles, M.A., F.L.S., F.Z.S., (V.-Pres., 1894; Council, 1891–3; 1902–4), 4, *Gunterstone-road, West Kensington*, W. 14.

1894 ‡ Swinhoe, Ernest, 4, *Gunterstone-road, West Kensington*, W. 14.

1876 ‡ Swinton, A. H., *Oak Villa, Braishfield, Romsey, Hants.*

1911 ‡ Swynnerton, C. F. M., *Gungunyana, Melsetter, S.-E. Rhodesia.*

1910 Tait, Robt., junr., *Roseneath, Harborough-road, Ashton-on-Mersey.*

1908 ‡ Talbot, G., 13, *Arthenden-road, Brockley*, S.E. 4.

1918 Tapp, Mrs. Eleanor Eva, *Loos*, 88, *Wickham Way, Beckenham, Kent.*

1918 Tapp, Capt. William Henry, F.R.A.S., F.R.G.S., *Loos*, 88, *Wickham Way, Beckenham, Kent.*

1916 Tatchell, Leonard Spencer, 43, *Spratt Hall-road, Wanstead*, E. 11.

1911 ‡ Tautz, P. H., *Cranleigh, Pinner, Middlesex.*

1911 Taylor, Frank H., *Dalmally Station*, viâ *Roma, Queensland.*

1903 Taylor, Thomas Harold, M.A., *Yorkshire College, Leeds.*

1914 Temperley, Reginald, *Sharpe House, Wiveliscombe, Somerset.*

1919 ‡ Temple, Major Watkin, *East Mersea, Essex.*

1910 ‡ Theobald, Prof. F. V., M.A., *Wye Court, Wye, Kent.*

1901 Thompson, Matthew Lawson, 40, *Gosford-street, Middlesbrough.*

1892 Thornley, The Rev. A., M.A., F.L.S., *Hughenden, Coppice-road, Nottingham.*

1907 Tillyard, R. J., M.A., D.Sc., F.L.S., Linnean Macleay Fellow in Zoology, *Kuranda, Mount Errington, Hornsby, New South Wales*

1911 ‡ Todd, R. G., 54, *Hornsey-lane, Highgate,* N.

1897 Tomlin, J. R. le B., M.A., (Council 1911–3), *Lakefoot, Hamilton-road, Reading.*

1907 ‡ Tonge, Alfred Ernest, (Council, 1915–17), *Aincroft, Reigate, Surrey.*

1914 de la Torre Bueno, J. R., 25, *Broad-street, New York, U.S.A.*

1907 Tragårdh, Dr. Ivar, *The University, Upsala, Sweden.*

1919 Tullett, Austin Augustus, *The Hill Museum, Witley, Surrey.*

1906 ‡ Tulloch, Col. B., *The King's Own Yorkshire Light Infantry, Crown Hill Hutment Camp, Plymouth.*

1895 ‡ Tunaley, Henry, *Castleton, Searle-road, Farnham.*

1910 Turati, Conte Emilio, 4, *Piazza S. Alessandro, Milan, Italy.*

1898 ‡ Turner, A. J., M.D., *The Manor War Hospital, Epsom,* and *Wickham Terrace, Brisbane, Australia.*

1893 ‡ Turner, Henry Jerome, (Council, 1910–12), 98, *Drakefell-road, New Cross,* S.E. 14.

1906 ‡ Turner, Rowland E., (Council, 1909–10), *British Museum (Natural History), S. Kensington,* S.W. 7.

1915 Tytler, Col. H. C., c/o Mrs. Tytler, Messrs. Grindlay & Co., *Parliament-street,* S.W. 1.

1893 Urich, Frederick William, C.M.Z.S., *Port of Spain, Trinidad, British West Indies.*

1904†‡Vaughan, W., *The Old Rectory, Beckington, Bath.*

1914 ‡ Veitch, Robert, Entomologist, c/o C.S.R. Co., *Lantoka Mills, Lantoka, Fiji Islands.*

1909 Vidler, Leopold A., *The Carmelite Stone House, Rye.*

1911 Vitalis de Salvaza, R., *Loang, Prakang, Indo-China.*

1895 * Wacher, Sidney, F.R.C.S., *Dane John, Canterbury.*

1897 ‡ Wainwright, Colbran J., (Council, 1901, 1912–14), 139, *Hamstead-road, Handsworth, Birmingham.*

1918 Walford, Lionel Julian, *The Cavalry Club, Piccadilly,* W.

1878 ‡ Walker, James J., M.A., R.N., F.L.S., President, (V.-Pres., 1916; Sec. 1899, 1905–1918; Council, 1894), *Aorangi, Lonsdale-road, Summertown, Oxford.*

1912 Wallace, Henry S., 6, *Kayll-road Villas, Sunderland.*

1914 Walsh, Mrs. Maria Ernestina, *Soekaboemi, Java, Dutch East Indies.*

1866*†‡Walsingham, The Right Honble. Lord, F.R.S., (Pres., 1889–90; V.-Pres., 1882, 1888, 1891–2, 1894–5; Council, 1896), *British Museum (Natural History), Cromwell-road,* S.W. 7.

1919 Ward, James Davis, *Limehurst, Grange-over-Sands, Lancs.*

1910 ‡ Ward, John J., *Rusinurbe House, Somerset-road, Coventry.*

1908 ‡ Warren, Brisbane C. S., *Pikescot, Pike's Hill-avenue, Lyndhurst.*
1901 † Waterhouse, Gustavus A., B.Sc., F.C.S., *Allonrie, Stanhope-road, Killara, New South Wales, Australia.*
1914 ‡ Waterston, Capt. the Rev. James, B.D., B.Sc., 21, *Arlington Park Mansions, Chiswick*, W. 4.
1919 Watson, E. B., *The Grange, Winthorpe, Newark.*
1918 Watson, John Henry, 70, *Ashford-road, Withington, Manchester.*
1914 Watt, Morris N., *St. John's Hill, Wanganui, New Zealand.*
1893 ‡ Webb, John Cooper, 89, *Dulwich Village*, S.E. 21.
1876 †‡ Western, E. Young, 27, *Pembridge-square, Notting Hill Gate*, W. 2.
1906 ‡ Wheeler, The Rev. George, M.A., F.Z.S., Secretary, 1911– ; (V.-Pres., 1914), 37, *Gloucester-place*, W. 1.
1910 ‡ White, Major Edward Barton, M.R.C.S., *Welsh Metropolitan War Hospital, Whitchurch, Cardiff.*
1918 White, Ronald Senior, *Suduganga Estate, Matale, Ceylon.*
1913 †‡ Whitley, Percival N., *Brantwood, Halifax*; and *New College, Oxford.*
1913 † Whittaker, Oscar, *Ormidale, Ashlands, Ashton-upon-Mersey.*
1911 Whittingham, Ven. Archdeacon W. G., *Glaston Rectory, Uppingham.*
1919 Whittle, F. G., 7, *Marine-avenue, Southend-on-Sea.*
1917 ‡ Wickham, Rev. Prebendary A. P., *East Brent Vicarage, Highbridge, Somerset.*
1906 Wickwar, Oswin S., *Woodford, Maitland Crescent, Colombo, Ceylon.*
1903 ‡ Wiggins, Clare A., M.R.C.S., *Watcombe, Park Town, Oxford.*
1896 ‡ Wileman, A. E., *Lane End, Westcott, Dorking.*
1911 ‡ Williams, C. B., M.A., *Port of Spain, Trinidad*, and 20, *Slatey-road, Birkenhead.*
1915 Williams, Harold Beck, 131, *Queen's-road, Wimbledon*, S.W. 19.
1919 Wilson, Lt.-Col. R. S., Governor of Western Desert Province, *Mersa Matruh, Egypt.*
1915 Winn, Albert F., *Library of McGill University, Westmount, Montreal, Canada.*
1919 Winterscale, J., *Sungei Klah Estate, Sungkai, Perak.*
1894 * Wolley-Dod, F. H., *Millarville P.O., Alberta, N.W.T., Canada.*
1919 Wood, H. Worsley, 31, *Agate-road, Hammersmith*, W. 6.
1905 Woodbridge, Francis Charles, *Briar Close, Latchmore-avenue, Gerrard's Cross S.O., Bucks.*
1914 ‡ Woodforde, Francis Cardew, B.A., c/o *University Museum, Hope Department, Oxford.*
1918 Woodruffe-Peacock, Rev. E. Adrian, F.L.S., F.G.S., *Cadney Vicarage, Brigg, Lincolnshire.*
1919 Wytsman, R., *Quatre Bras, Tervueren, Bruxelles, Belgium.*

1892 Youdale, William Henry, F.R.M.S., 21, *Belle Isle-street, Workington.*

ADDITIONS TO THE LIBRARY

During the Year 1919.

Abbott (W. S.). [See McIndoo (N. E.).]

Alexander (C. P.). [See Report of the Canadian Arctic Expedition, 1913–18.]

Aurivillius (Chr.). Eine neue Bienen-Art aus Nord-Schweden. [Ent. Tidskrift, 1914.]

——— Neue oder wenig bekannte Coleoptera Longicornia. 14, 15, 16. [Arkiv för Zool., Band 8, 9, 10, 1914, 1916].

——— New species of African Lasiocampidae and Striphnopterygidae from English collections. [Arkiv för Zool., Band 9, No. 11, 1915.]

——— Diagnosen neuer Lepidopteren aus Afrika. 10. [Arkiv för Zool., Band 10, No. 14, 1916.]

——— Neue Cerambyciden aus der Sammlung G. van Roon. [Tijdschr. voor Ent., LIX, 1916.]

——— Results of Dr. E. Mjöberg's Swedish Scientific Expeditions to Australia, 1910–1913. 12. Cerambycidae. [Arkiv för Zool., Band 10, No. 23, 1917.]

——— Svensk Insektfauna. 1. Aculeata. [Vespidae, Scoliidae, Mutillidae, Sapygidae, 1918.]

——— Svensk. Insektfauna. 2. Orthoptera. 1918.

——— Svensk. Insektfauna. 9. Coleoptera. Phytophaga. Uppsala, 1917. *The Author.*

——— [See Lampa (Sven).]

Back (E. A.) and Pemberton (C. E.). The Mediterranean Fruit-fly (*Ceratitis capitata* Wied.) in Hawaii. [U. S. Dept. Agric., Bull. No. 536, Jan. 1918.] *U. S. Dept. Agric.*

Bacot (A.). Lice: The Diseases carried by them and the Measures available for the Protection of Children and Civilians. [School Hygiene, March 1919.]

——— The Fleas found on Rats and their Relation to Plague. [Journ. Roy. Sanit. Institute, Vol. XL, 1919.]

——— Danger of Disease through Lice. [Pamphlet issued by the London County Council, 1919.] *The Author.*

——— and Linzell (L.). The incubation period of the eggs of *Haematopinus asini*. [Parasitology, Vol. XI, 1919.] *The Authors.*

Baker (A. C.) and Turner (W. F.). Apple-grain *Aphis*. [Journ. Agric. Research, Vol. XVIII, No. 6, Dec. 1919.] *U. S. Dept. Agric.*

Baker (A. W.). [See Report of the Canadian Arctic Expedition, 1913–18.]

Baker (C. F.). Ichneumonoid parasites of the Philippines, I. Rhogadinae (Braconidae), I. [Philippine Journ. Sci., Vol. XII, No. 5, 1917.]

——— A Philippine *Aphrastobracon*. [Philippine Journ. Sci., Vol. XII, No. 4, July 1917.]

——— Ichneumonoid parasites of the Philippines, II. Rhogadinae (Braconidae), II: The genus *Rhogas*. [Philippine Journ. Sci., Vol. XII, Nov. 1917.] *The Author.*

Banks (N.). [See Report of the Canadian Arctic Expedition, 1913–18.]

Barber (G. W.). [See Caffrey (D. J.).]

Barker (C. N.). *Cicindela bertolonii* Horn, and the South African members of the *brevicollis* group.
[Ann. Durban Mus., Vol. II, Oct. 1919.] *The Durban Museum.*

Bemmelen (J. F. van). The value of generic and specific characters tested by the wingmarkings of Sphingides.
[Koninkl. Akad. Wet. Amsterdam, Proc. Vol. XXI, 1918.]
The Author.

Bernhauer (M.). [See Coleopterorum Catalogus.]

Beveridge (Colonel W. W. O.). [See Durrant (J. H.).]

Bickhardt (von H.). [See Wytsman's Genera Insectorum.]

Bodkin (G. E. B.). Plant diseases and pests notes.
[Journ. Board Agric. Brit. Guiana, Vol. XII, April 1919.]
Board Agric., Brit. Guiana.

Bolivar (I.). [See Wytsman's Genera Insectorum.]

Borchmann (F.). [See Coleopterorum Catalogus.]

Borden (A. D.). [See Sasscer (E. R.).]

Brittain (W. H.). An infestation of Apple-sucker, *Psylla mali* Schmidt, in Nova Scotia.
[Agric. Gazette of Canada, Vol. VI, July 1919.]
Canad. Dept. Agric.

——— and Good (C. A.). The Apple Maggot (*Rhagoletis pomonella* Walsh) in Nova Scotia.
[Nova Scotia Dept. Agric., Bull. No. 9, Jan. 1917.]
Nova Scotia Dept. Agric.

Brocher (F.). Recherches sur la Respiration des Insectes aquatiques adultes. I. La Nèpe cendrée. II. L'Hydrophile.
[Bull. Soc. Zool. Genève, 1908.]

——— Importance des phénomènes capillaires dans la biologie aquatique.
[Rev. Suisse de Zool., Tome XVII, 1909.]

——— Métamorphoses de l'*Hemerodromia praecatoria* Fall.
[Ann. Biol. lacustre, Tome IV, 1909.]

——— Métamorphoses du *Tipula lunata* Lin.
[Ann. Biol. lacustre, Tome IV, 1909.]

——— Recherches sur la Respiration des Insectes aquatiques adultes. Les Dyticidés.
[Ann. Biol. lacustre, Tome IV, 1911.]

——— Observations biologiques sur quelques Insectes aquatiques.
[Ann. Biol. lacustre, Tome IV, 1911.]

——— Recherches sur la Respiration des Insectes aquatiques adultes. Les Elmides.
[Ann. Biol. lacustre, Tome V, 1911.]

——— Le travail au microscope et l'accommodation.
[Archiv. Sciences Physiques et Naturelles (4). Tome XXXI, 1911.]

——— Recherches sur la Respiration des Insectes aquatiques adultes. Les *Haemonia.*
[Ann. Biol. lacustre, Tome V, 1911.]

——— Observations biologiques sur quelques Curculionidés aquatiques.
[Ann. Biol. lacustre, Tome V, 1911 (1912).]

——— Recherches sur la Respiration des Insectes aquatiques (imagos). Nèpe, Hydrophile, Notonecte, Dyticidés, Haemonia, Elmidés.
[Soc. Entom. Jahrg. 27, 1912.]

——— L'appareil stridulatoire de l'*Hydrophilus piceus* et celui du *Berosus aericeps.*
[Ann. Biol. lacustre, Tome V, 1912.]

——— Recherches sur la Respiration des Insectes aquatiques adultes. L'Hydrophile. Étude physiologique et anatomique.
[Ann. Biol. lacustre, Tome V, 1912 (1913).]

BROCHER (F.). Études anatomiques et physiologiques du système respiratoire chez les larves du genre *Dyticus*.
[Ann. Biol. lacustre, Tome VI, 1913.]
——— Recherches sur la Respiration des Insectes aquatiques adultes. La Notonecte (2ième Article).
[Zool. Jahrb., 1913.]
——— Les Dyticidés (Second Article), suivi d'une notice sur les mouvements respiratoires de l'Hydrophile.
[Ann. Biol. lacustre, Tome VII, 1914.]
——— Physiologie de la Respiration chez les Insectes imagos.
[Archiv. Zool. Exper., Tome LIV, 1914.]
——— Observations biologiques sur les Dyticidés.
[Ann. Biol. lacustre, Tome, VI 1914.]
——— Recherches sur la Respiration des Insectes aquatiques.
[Revue Suisse de Zool., Tome, XXIII, Dec. 1915.]
——— Nouvelles observations biologiques et physiologiques sur les Dyticidés.
[Archiv. Zool. Expér., Tome LV, Jan. 1916.]
———La Nèpe cendrée.
[Archiv. Zool. Expér., Tome LV, May 1916.]
——— La Respiration des Insectes aquatiques imagos.
[Revue critique, Genève, 1916.]
——— Nouvelles observations sur la respiration des Dyticidés (4me Article.)
[Archiv. Zool. Expér., Tome LVI, fasc. 1, Sept. 1916.]
——— Étude expérimentale sur le fonctionnement du vaisseau dorsal et sur la circulation du sang chez les Insectes.
[Archiv. Zool. Expér., Tome LVI, fasc. 6, May 1917.]
——— Étude expérimentale sur le fonctionnement du vaisseau dorsal et sur le circulation du sang chez les Insectes. IIe Partie: Les larves des Odonates.
[Archiv. Zool. Expér., Tome LVI, fasc. 10, Oct. 1917.]
——— Observations sur le développement et la vie larvaire du *Pseudagenia carbonaria* (Scop.).
[Bull. de l'Institut. Nat. Genevois, Tome XLIII, 1918.]
——— Les Organes pulsatiles méso- et métatergaux des Lépidoptères.
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The Royal Society, towards the publication of D. Sharp's paper on the Genitalia of Coleoptera, £60.

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TRANSACTIONS

OF THE

ENTOMOLOGICAL SOCIETY

OF

LONDON

FOR THE YEAR 1919.

I. *Butterfly Vision.* By H. ELTRINGHAM, M.A., D.Sc., F.Z.S.

[Read December 4th, 1918.]

PLATES I–V.

So much has already been written on the structure and function of the compound or facetted eye of Arthropods, that the worker who is unequipped with a profound knowledge of optics, mathematics and other sciences, may well feel some hesitancy in adding to the already voluminous literature of the subject. Nevertheless, since most works on insects in general give but a very imperfect summary of existing knowledge, whilst comparatively few papers on the insect eye are written in English, it is hoped that the observations here recorded will not be regarded as altogether superfluous.

If my examination of the matter appears to have resulted in but little that is new, at least I can claim to have repeated many of the known experiments and thus helped to remove at least some of the uncertainty which has hitherto tended to make the subject of insect vision an unstable compound of opposing theories. My attention was first called to the subject by the articles on the sense of sight written by Hess, in the "Handbuch der vergleichender Physiologie," in which he describes very extensive and elaborate experiments on animal vision. As the result of these he announces that all insects, or at least those on which he experimented, are totally colour-blind.

How many of us have not been first attracted to the study of insects by their beautiful colours and their association with flowers? So far as butterflies are concerned, colour would seem to be inseparably associated with their very existence, and to be told, with an alleged weight of evidence, that their own colours and those of their surroundings have for them no existence, is to receive a rude shock to our most cherished traditions, however clearly we may realise the obvious fact that the existence of colours is no proof that they were intended to be seen.

My original intention then was to try to carry out a series of experiments on the question of colour vision only, but closer acquaintance with existing works on insect vision convinced me that there was scope for a somewhat wider examination of the subject, in spite of the fact that, given the power of sight, by whatever means this power may be exercised, the histological structure of the creature's eyes is but little likely to demonstrate or disprove the power to distinguish colours.

The present paper resolves itself, therefore, into two parts, the nature and position of the image in the eye, together with the character of the supposed organs of perception, and secondly, the evidence for and against a capacity for distinguishing those differences in the wave-lengths of light which we ourselves speak of as colours.

Rather for the latter purpose than the former I have chosen as a type the insects referred to in the title, since the question, Do insects distinguish colours? is about as vague as an inquiry as to whether birds are black. There are many species of insects which can have no use whatever for a sense of colour, apart from the many which we know to be blind. Nevertheless, in examining the subject of insect sight we shall have to refer to insects of other orders and even to animals which are not insects at all.

The Structure and Function of Facetted Eyes.

So far as the histological structure of the compound eye is concerned, the difficulties, though considerable, are not so great as those which appertain to the nature of their function. The extent of our knowledge of the vision of any creature will always have certain limits, though in the case of the vertebrate eye we feel able to attain to more nearly final conclusions, owing to our personal knowledge of our own visual powers and the known homology of other vertebrate eyes. Thus we know that in our own eyes there is a lens which can, and in fact does, project an image of external objects on to a sensitive layer, the retina, in the same way as the lens of a photographic camera throws an image on to the sensitive plate at the back. There are minor differences, such as the curved surface of the retina, the method of focal adjustment, etc., but the general principle is the same. The image is sharp and complete, and as in the camera it is upside down. That we are unconscious of the latter fact is merely due to interpretation based on experience. Objects viewed in a flat mirror appear to us to be laterally reversed though not inverted. Such operations as we habitually perform with the aid of a mirror are done with perfect facility and proper co-ordination of movement, whilst those which are not generally done by reflection, such as writing or drawing, are found, when attempted, to be extremely difficult. Nor are we normally conscious of the fact that owing to the possession of two eyes we see two images, those of near objects differing considerably, whilst those of more distant ones are less diverse. Our perceptive faculties combine the two images into one, at the same time utilising their differences to obtain an estimate of distance. The well-known stereoscopic photograph is adapted to this faculty and gives an apparently solid picture from two rather different flat ones. Examination of other vertebrate eyes shows their structure to be so similar that we are justified in assuming that their action is the same, though there are a few exceptions, such as the chamaeleon, whose eyes can be moved quite independently, and cannot be supposed to give a stereoscopic image except when they both happen to be looking in the same direction.* Also most fishes' eyes would seem to be so placed that both can hardly see the same object at once.

So far, then, we may claim to know something of the nature of our own eyes and of those which are similarly formed. The knowledge does not carry us very far. An image optically described as a real image, as opposed to what is known as a virtual image, seen in certain lens combinations, is projected on to a highly complicated nervous tissue, the retina. How that image in all its intricacy of form and colour is conveyed to and perceived by the brain, we do not know.

* As Prof. Poulton reminds me, the chamaeleon's eyes are always co-ordinated at the moment of striking.

In the Invertebrata we find many types of eyes, *i. e.* organs whose function is to perceive light. In lower forms such organs are of so simple a character as to preclude the possibility of their doing more than detecting the difference between light and darkness. All stages of complication and multiplication are found. Some molluscs have hundreds of such organs, many of them capable of producing images, though in many cases the existence of a nervous mechanism capable of perceiving such images seems doubtful, and the value of so many eyes to creatures of such sedentary habit is rather obscure.

In other invertebrate creatures, and notably in spiders and insects, we find what are known as simple eyes or ocelli each having a single lens producing an inverted image, though to what extent such image is perceived by the animal's consciousness it is difficult clearly to define.

The most remarkable form of invertebrate eye is, however, the compound or facetted eye of insects and Crustacea.

Before summarising the various views and theories which have been advanced on the subject of the vision of the compound eye, it will be well to give some description of its structure, so that the references of former workers to its various parts may be more easily understood.

Plate I shows a section through the eye of an ordinary Small Tortoise-shell butterfly (*Vanessa urticae*) which may conveniently be taken as a type. The outer part of the eye presents the surface of rather more than a quarter of a sphere, and faces in all directions except inwards and backwards. It is separated from the corresponding eye of the other side by a hard chitinous framework, very narrow above and in front, but wider beneath, where a somewhat larger space is required for the palpi and the proboscis. The external layer of the eye is of fairly hard chitin divided into a great number of hexagonal elements, the facets, in *V. urticae* about 5000–6000 on each side. A facet consists of a minute lens, generally if not invariably colourless in the centre, but often yellow or brownish round the edges. This layer is called the corneal layer. In *V. urticae* and many other butterflies there are hairs projecting from sockets between the facets. As these are all radially arranged they do not interfere with the vision any more than do the eyelashes of vertebrates. In transverse section the lenses are more or less biconvex, and frequently, especially in butterflies, there lies beneath the lenses a layer of transparent material which has been called the *processus corneae.* Beneath this layer and corresponding to the number and position of the corneal facets are found the structures known as "ommatidia." The form of the ommatidium varies within rather wide limits. In *V. urticae* it is as follows—

Adjacent to the inner surface of the *processus corneae* is a highly refractive body of a chitinous nature and having a conical shape. It is known as the crystalline cone, or shortly, the cone. In life it is entirely transparent and apparently structureless, though in prepared microscopic specimens it is seen to consist of four cells whose contact surfaces lie parallel to the long axis of the cone. At the outer end or base of each cell is a nucleus, the so-called Semper's nucleus. The whole conical body appears in stained preparations as a cone enclosed in a sheath like a nut in its shell, and in differential staining the sheath, and sometimes the nuclei, take that stain which indicates a lesser degree of chitinisation, the cone itself usually taking the same stain as the corneal facets. At the inner or apical end the cone sheath is continued as a long transparent rod, forming the central part of the ommatidium. This rod is known as the "rhabdom" (Pl. II, fig. 2, *r.*). Surrounding it but not, in *V. urticae*, reaching quite to the cone apex, there are several (eight in *V. urticae*) elongated cells known as the retinulae, or visual cells (Pl. II, fig. 1, *ret.*). These extend backwards from near the cone apices to a transverse septum in the depth of the eye, called the "basal membrane." In butterflies, or at least in those I have examined, the rhabdom does not reach the basal membrane, but stopping abruptly just short of it, leaves an interval which is partly occupied by a highly refractive chitinous body which is a development of the tracheal system. Of this structure, which has been observed but hitherto incorrectly interpreted, I shall have more to say later. As regards the relationship of the rhabdom to the retinulae, most observers are of the opinion that the former is really a complex structure formed from the secretion by each retinula cell of a chitinous rod along its inner surface, and I am inclined to support this view. In more primitive eyes the rhabdom is incomplete and irregular and seems to be little more than a supporting structure. In more highly developed eyes it would appear to be of optical importance. In addition to the structures already mentioned we find in the eye several series of cells containing pigment granules. Their precise number and arrangement varies greatly in different eyes. In *V. urticae* there are two very conspicuous cells occupying the space between the apex of the cone and the outer ends of the retinulae; they form a dense black collar round the cone apex and the distal end of the rhabdom. Between the cones there are series of secondary pigment cells which extend processes towards the basal membrane, these meeting similar processes from pigment cells attached to, or extending from, the basal membrane. There are also pigment granules in the retinulae cells, and in or around the nerves and nerve cells beneath the basal membrane.

It has already been stated that the retinulae cells extend backwards to the basal membrane. The latter is perforated, and through the openings there pass eight nerve fibres, one to each retinula (Pl. II, fig. 1, *n.*). Below the basal membrane these nerve fibres (Pl. II. fig. 4, *n.*) are arranged more or less symmetrically round a large nucleated cell through the centre of which passes a small tracheal tube (Pl. II, fig. 4, *t.*). Passing backwards into the head, these nerve fibres are seen to occur in bundles, each bundle containing fibres appertaining to more than one set of retinulae. The bundles are separated by what appear to be large spaces. These are the lumina of a tracheal network lying horizontally in this part of the eye. Below this layer are several well-marked strata of nerve tissue, notably three ganglionic bodies named by Hickson (Quart. Jour. Micr. Sci. p. 215, etc., 1885), counting from within outwards, the "opticon," the "epi-opticon," and the "peri-opticon." In the peri-opticon the individuality of the ommatidia seems to be preserved, since transverse sections show a more or less regular geometrical arrangement. (See Pl. II, fig. 3). One might fancifully compare it with a telephone switch-board in which all wires or nerves arrive at their proper sockets, though traversing the intervening space, the tracheal area, in apparently haphazard bundles.

Beyond this area I have not so far attempted to trace the course of the fibres, since in the depths of the brain or ganglia the phenomena of sense transmission and perception constitute more of a psychological than a physiological problem, and a study of the inner ganglia is not calculated to throw much light on the visual capacity of the insect.

I have already spoken of a highly refractive body lying at the inner end of the rhabdom. Jonas (Zeit. Wiss. Zool. 1911) seems to have been the first to notice this, and strangely enough observed it in only one species of butterfly. He gives a small text figure and states that he is unable to offer any explanation of it. I have observed it in all the butterflies I have examined, and have studied it especially in *Vanessa urticae* and *Ganoris brassicae.* It is, as above stated, a part of the trachaeal system and has a somewhat remarkable structure. There passes through the basal membrane to each ommatidium a fine trachaeal tube (see Pl. II, fig. 1, *t.*) which immediately increases considerably in diameter, and the usual spiral thickening of its walls can be distinctly seen. This widened portion of the tube contains the refractive body already referred to. Judging by the manner in which it stains it is strongly chitinised. In longitudinal section it is cylindro-conical (see Pl. II, fig. 1, *tf.*), but in transverse section it is cruciform. Fig. 5, Pl. II shows a transverse section of four ommatidia, passing through these bodies near their basal or outer (distal) ends. It will be seen that the four arms of the cruciform section come outwardly into contact with the widened portion of the trachaeal tube, so that four spaces remain. A little higher up, fig. 6, each of these four spaces is divided into two, so that eight spaces are now seen, and these are the lumina of the eight trachaeal tubes which shortly afterwards pass outwards to the surface of the ommatidium and extend forwards towards the corneal layer, ending blindly not far from the crystalline cones. A similar arrangement appears in *V. io* and probably in other *Vanessidae.* In *G. brassicae* the structure is different. Instead of the conical body there is a thick chitinous septum which divides the trachaeal tube into two divisions only, and these pass forward to be again divided into two, but at a higher level than in *V. urticae*, ultimately resulting in only four trachaeal tubes. We may, I think, conveniently call this structure the "trachaeal distributor."

I have already pointed out that the nerves pass through the basal membrane into the retinulae or visual cells. They can still be seen in transverse sections, as eight small circles lying outside the eight branches of the trachaeal system (Pl. II, fig. 6, *ret.*). Negative results in research are rarely satisfactory, and a recital of the efforts I have made to trace the course of these nerve fibres would make long and profitless reading. Thousands of preparations have been made, and various processes which seemed to be indicated have been tried in vain, and I am forced to the conclusion that the nerve does not continue as fibrils into the body of the ommatidium, but that the retinulae are themselves merely large elongated nerve-end cells. Workers on the Crustacea claim in certain cases to have observed nerve fibrils passing from the retinulae horizontally into the rhabdom. So far as my researches go no such structure can be seen in the eyes of butterflies, nor in those of many other insects which I have examined. It will be seen later that certain other workers claim to have seen nerve fibres in various positions, such as the rhabdom and in and around the cones. I have repeated their methods and experimented with many others, but I have never succeeded in tracing the nerves as recognisable fibres further than a short distance beyond the basal membrane. That they do undoubtedly pass through that membrane there is no question whatever, and this fact should be remembered in connection with Lowne's theory to be mentioned later.

Some time after I had arrived at these conclusions in regard to the nature of the retinulae they received apparent confirmation by the work of Domingo Sanchez on the development of the retinal elements in *G. brassicae* (Trab. del Lab. de Investig. Biol. de Madrid, 1916–17).

My attention was called to this work by my friend Mr. J. Bronté Gatenby of the Department of Physiology at Oxford. Sanchez worked on the pupa of *G. brassicae* and succeeded, apparently by Cajal's modification of Golgi's silver chromate impregnation, in demonstrating the purely nervous nature of the retinulae cells. The process is very capricious in its action, and though I had already tried it without result, I made still further efforts, and after a time succeeded in obtaining a differentiation of the retinulae cells indicating their nervous nature.

The optical and primarily receptive layers are evidently to be sought between the basal membrane and the corneal layer, and having noted the general structure of the eye, we may now proceed shortly to review some of the theories which have been advanced in regard to the method and quality of vision of which such an eye may be deemed capable.

The theory which is at the same time the oldest and most generally accepted is that of Müller (Zur vergleichenden Physiologie des Gesichtsinnes der Menschen und der Thiere, 1826) and may be freely translated as follows—

"If light from a particular part of the object can only reach a particular part of the retina, all other parts of the retina will be excluded from this particular light, and so an image is formed. This happens in the composite eyes of insects and Crustacea by means of the cones which lie between the corneal facets and the fibres of the visual nerves, united to each at their extremities and clothed laterally with pigment. Each of these cones peripherally placed round a convex nerve mass passes, to the individual nerve endings with which it is united at its apex, only that light which falls directly through the axis of the cone. All other rays emanating from the same point and falling obliquely on the cornea will fail to reach the lower extremity of the cone and so will not come to the perception of the other fibres of the visual nerves. They will be absorbed, if they fall obliquely, by the pigment-covered walls of the cones, these being transparent only in their axes."

Further:—"The convexity of the corneal facets will guide the light in the direction of the axis, and cause a greater concentration in the depth of the eye. So it may happen that the whole light passing through the cone will be concentrated at the apex where the nerve fibres are attached, in the form of a point, whereby the brightness of the image must be much increased. The refraction of the outer surface of the cornea is, however, not so great that it can form a special small image for each facet. If it did no image could be produced, for if one were formed in the focal distance of the lens, it would necessarily be reversed. Not the whole field would be reversed, but the picture formed by each of the facets respectively and unnaturally. As also the facets in the compound eyes of insects frequently show little or no convexity, we can attribute to the peripheral convex surface no other function than the concentration of the light towards the pointed apices of the cones."

This is what is known as the "mosaic" theory of the sight of the compound eye, and may shortly be enunciated thus.

Each facet registers on a sensitive layer a spot of light corresponding in quality to the average of the light reflected, normally to the facet, by that part of the object within the facet's field of view. Hence an erect image will be formed made up of such spots of light in the form of a mosaic. Müller was of course mistaken in stating that the facets could not form an image.

The first to throw doubt on Müller's theory was R. Wagner (Archiv. f. Naturgesch. p. 372, 1835), who considered the sheath of the cone as the true nerve expansion. Will (Leipzig, 1840) regarded the compound eye as an aggregate of simple eyes. Gottsche (Beit. sur Anat. u. Physiolog., etc., Müller's Archiv. p. 483–92, 1852) reobserved the images formed by the facets of an insect's eye with the inside removed, and calculated the focal distance of the image. He considered that his work disproved Müller's theory, and certainly it was the cause of its temporary displacement. Leydig in various papers expressed the view that the cones were the nervous elements, forming with their thread-like continuations a perceptive element comparable with the retina of vertebrates. He thought all the small images were in some way conveyed to the brain and combined into one large picture. Claparède (Zur Morph. der Zusamm. Augen, etc., Zeit. Wiss. Zool. p. 191, 1859) points out that Müller's theory makes the definition of the object dependant on the number of the facets and states that bees can see the hive entrance at great distances. It hardly requires Grenacher's refutation to remind us that there is no proof that bees can *see* the hive any more than that carrier pigeons can see their pigeon-house, and indeed we know from many experiments that bees do not return to the hive door by sight, since they will return infallibly to the place where the door *was* if the hive be turned round. Claparède suggests that each facet sees a definite image and the view is made up of the sum of these images, the physiological difficulty of multiple inverted images being in his opinion no greater than in the case of several simple eyes. He regarded the cone as an optical and percipient element combined.

Ruete (1861) thought that not only the axial rays affected the nerve elements but many rays affected many neighbouring elements. Here we seem to have an anticipation of Exner's "superposition image." Dor (1861), examining the subject from an optical point of view, made out that the image was formed at the hinder end of the cone and condemned Leydig's theory of the nervous constitution of that body. He regarded the cone sheath as the retina, and in reply to the difficulty of its shape for receiving a picture points out that the human retina is not truly spherical.

Schültze (Untersuch. uber zusammenges. Aug. Bonn, 1868) held that the mosaic theory was physically untenable, as also Leydig's view of the nervous nature of the cones, these latter being in his view a purely dioptric apparatus for the production of the image. Schültze's monograph is one of the most interesting of the older works on the compound eye, since it enters into great detail on the question of the nerve distribution. According to that author the central rod or rhabdom of the ommatidium is the nerve rod, formed of several fibres in a common sheath. He claims to have seen these fibres very distinctly. They are said by him to have a laminated structure as though made up of a great number of small plates transversely superimposed. At the outer or distal end they divide and enter the cone, to the number in some cases of eight, being then apparently lost in the substance of the cone. Schültze's figures and descriptions are very convincing, and one feels almost inclined to believe that he saw the structures he describes, though Grenacher, who spent years in examining these eyes, does not appear to have found the nerve fibres, and indeed professes to doubt their existence. He states that Schültze found them only in a very few cases, and himself confessed that he was unable to find them in the majority. Boll (1871) pointed out the unimportance of Leuwenhoek's images, reobserved by Gottsche, these being an incidental consequence of the lenses of the facets. He also pointed out the lack of accommodation in the insect eye, and the impossibility of combining an endless number of images into one picture.

In 1879 appeared Grenacher's great work on the Arthropod eye (Untersuch. uber der Arthrop., etc., Gottingen, 1879). For beauty of illustration this work has probably not been surpassed. It will be necessary to review at some length that author's conclusions. In the course of his introduction, from which I have extracted part of the foregoing summary, he remarks that the perception of a number of inverted images need not at once be dismissed in view of the simple Arthropod and the Vertebrate eye, but its probability will depend on the nature, and especially on the number. of the percipient elements belonging to each corneal facet. If, where the light rays fall, there be only a single percipient organ, it must either perceive only a small portion of such picture, or else, if large enough to take in the whole, it will only record a mixture having the general luminosity of the picture. The difficulty of the reversed image is not in his view a good reason for rejecting it, since spiders with six to eight simple eyes, certain water-beetle larvae with twelve, and other creatures must have inverted images.

He proceeds to classify the two main theories as first, Müller's theory of mosaic vision, and second, "the little picture theory." Müller's theory provides that only a single perceptive element occurs behind each facet, one nerve element being joined to each cone. In opposition thereto the picture theory will be upheld when a multiplicity of such elements, serving as a retina, can be demonstrated. In all fairly well-developed visual organs in the animal kingdom are found structures of a quite specific kind, the rods, in a wide sense, which are to be regarded as the percipient end organs. In the simple Arthropod eye, and especially in the stemma of insects and spiders, these rods have been recognised. In their main agreement with those of other animals we must claim for them the same signification, the more so since other retinal elements which could be substituted for them are sought in vain. If we accept the projection on the retina of, for example, a spider's eye, of an inverted image, we must also agree that the external object can only be distinctly seen when its rays come to a focus on the rod-bearing region of the retina. For the sight with equal distinctness of objects at varying distances, the vertebrate eye possesses an accommodation or focussing apparatus of which there is no trace in the Arthropod eye. It may perhaps find a partial substitute in the relatively great length of the rods, so that distant objects whose images fall more on the distal ends of the rods, act more on those ends, while nearer objects focussed more in the depth of the retina may specially stimulate the hinder end. I may here remark in parenthesis that this remark has been made by other investigators, as for instance Patten (*vide infra*), and Avebury has raised the objection that the nerves which are first reached by the light would surely be affected by it. As against this objection, it may be urged that in our own experience the attention is more easily focussed on a defined image than on a blurred one, and thus the perceptive power might act in a selective manner. We shall see later, however, that probably neither action is called upon in the perception of the image. Grenacher further points out that the image projection must take place in any case only a short distance behind the distal ends of the rods, for it is here that they are surrounded by pigment. He considers that it is for obvious reasons established that the physiological region of the area of light perception lies between the distal and proximal ends of the rods. The same applies to the compound eye. In "acone" eyes * of *Tipula* and *Ctenophora* the light perception is associated with the seven rods, of which, especially in the latter, the central is much longer than the peripheral, so that the central must have a deeper zone of perception. He then considers those facetted eyes in which the central rod is drawn out into an axial rhabdom, as in Orthoptera, Hymenoptera, Lepidoptera, etc., where the rhabdom is extended into the whole length of the retinula. In these the sectional area is reduced to a minimum, namely the cross section of the rhabdom. Hence it reaches a very considerable depth, and there is nothing to prevent the nervous stimulus acting throughout its entire length. The visual area of the single facet will be reduced the more it departs from the structure of the simple eye. As to the acuity of vision we may come to some conclusion, in for example the spider's eye, by taking into account the distance apart of the percipient elements in different forms. An eye with a great number of small rods on the retinal surface will see more clearly than one sparsely provided. Thus the front eye of *Epeira* will surpass the hinder in this respect, for the former has an incomparably greater number of rods than the latter. On the contrary, the posterior eye has a larger visual field than the anterior. In the compound eye we may compare the number of elements in the retinulae. *Dytiscus* has only four, *Melolontha* seven. Whether or not the former is compensated by a smaller field, we know that the water-beetle is actively voracious and gives the impression of having a greater visual power than the cockchafer. The discovery of a single perceptive

* Grenacher divides Arthropod eyes into "acone," those which have no crystalline cones or any substitute for them; "pseudocone" eyes, those which have in place of the cone a more or less cylindro-conical membrane with fluid or semifluid contents; and "eucone" eyes, those which possess a true crystalline cone.

element behind each facet would have been overwhelmingly in favour of Müller's theory, but since we know there are more, it remains to ask whether this fact invalidates Müller's theory.

If Gottsche's image theory is to be supported it must be true for all facetted eyes; furthermore the image must be projected in the plane where the percipient elements lie, and there must be a retinal layer with many percipient elements to receive it. The formation of a reversed image will depend on the spherical surfaces of the refractive media acting as lenses. This condition is in most cases supplied. It is not to be excluded that the cones may serve this purpose through their convex anterior surfaces. The second condition demands that the image shall be projected where we know the percipient elements to lie, and behind the cones. The Gottsche experiments demanded that the image should pass unaltered through the cone to where the sensitive layer must lie. The material used by Gottsche was very ill adapted to illustrate the effect of the cones, since his flies were insects with pseudocone eyes, the cones of which must have been inevitably destroyed, and, shortly, the experiments do nothing more than show that the corneal lenses act in the same way as would lenses of glass. Grenacher proceeds to recount how he has tried similar experiments with the eyes of nocturnal moths, in spirit specimens of which the internal parts of the eye can be removed and the pigment destroyed by nitric acid. Such an eye so placed as to make it possible to look through it from the back, shows no images at the bases of the cones, but does show sharp images just behind the lenses, where, however, no sensitive elements lie.

The third point which Grenacher brings forward is the question whether the image, if formed, has the necessary area. In general the cone is pointed posteriorly, and therefore we look in vain for a projection which has any size at all. If an image be possible where the rods do reach the hinder end of the cone, it is clearly impossible in those cases where the rods are drawn out to a thread-like structure, often of considerable length. It is further impossible to suppose that an image produced at the forward part could be carried inwards like sound on a string. Grenacher then discusses the question of the existence of a retina, remarking that the reply depends very much on the number of elements necessary to form a tissue which can be so called. He suggests that what is known as the retinula may be regarded as a much-reduced retina having seven percipient elements. In certain acone and pseudocone eyes the perceptive elements are isolated, but it is to be noted that even if each were stimulated, seven elements could not impart to the sensorium an impression of every single object of the picture, nor could a number of pictures projected by neighbouring facets compensate for this deficiency. The difficulty is greater in those more developed eyes in which the rods are fused into a rhabdom, since the picture elements would be greatly reduced in size. From the close approach of the rods it must be doubtful if a single rod responds individually to any one stimulus without the co-operation of its neighbours.

Summing up, he states that in isolated cases there is a lack of the necessary curved refractive medium. In other cases there may be an image, but far behind the eye. In still other cases an image has been seen, but far from where it could be effective. The more proximal projection of this image is precluded by the position of the pigment, added to which there is in most cases the proximal withdrawal of the percipient from the refractive media. In all cases, without exception, the sharpest projection of an image would be without effect owing to the inadequate number of the perceptive elements in each ommatidium, and there is not in any case, he holds, much ground for regarding them as more than a single perceptive entity. The picture theory is therefore untenable. He then proceeds to discuss the path of the light rays entering each facet. The angle at which these fall will determine whether they are to be more or less totally absorbed or reflected. The axial rays will have a simple and direct path to the rhabdom, and these will be the principal ones to affect the percipient elements. He reasserts his opinion that though the rod elements are multiple, they can only be regarded physiologically as an entity. "Each set of rays will come relatively to the position they occupied in the outer world, and this constitutes the erect image of the compound eye." He points out the insufficiency of the facet unit for the reception of the many elements which must be distinguished to form a true image, the strong support which anatomical research gives to the mosaic theory, and the impossibility of understanding an aggregation of thousands of complete eyes, all perceiving images, the more so if each be inverted. He compares the simple and compound eye as starting from a primitive form, which developed on the one hand into an eye with better lens, and more perceptive elements (as in a spider's eye), on the other hand an individual retrogressive movement, compensated by great numbers of elements in definite arrangement and direction. By variation in form and co-operation of the pigment, they effect not, like the simple eye, the collection, but rather the isolation, of the separate rays.

Grenacher undoubtedly makes out a good case for the mosaic theory of vision, both on general principles and in view of the structure of the eye, though we shall see that his theories have to undergo considerable modification in view of more recent research.

Lowne's view (Trans. Linn. Soc. Zool. ii, pt. ii, p. 389, etc., 1884) that the insect retina lies behind the basal membrane merits little consideration in view of our present knowledge. It is largely based on the assertion that there is no evidence that the nerves pass through the basal membrane. It is difficult to understand how the author could have made such a statement had he examined even a moderate number of sections. Moreover, as will be described later, we can under certain circumstances see the image in an insect's eye, and that image certainly does not lie behind or even near the basal membrane. Hickson (*l.c.*) treats mainly of the eye of the Blow-fly, and more particularly with the nervous structure of the ganglia. He considers that the balance of opinion is in favour of regarding the retinulae as the true nerve-end cells. He states that the end elements of the human eye are only ·004 mm. apart, whilst the corresponding distance in *Musca* is ·01 mm.

Patten's work (Eyes of Molluscs and Arthropods, Mittheil. a.d. Stat. zu Neapel. V. 6, p. 542, etc.) has met with no general acceptance so far as it concerns the physiology of the compound eye. His main contention is that the cone is the seat of perception. He claims to have seen by his histological methods the nerve fibrillae which pass up the rhabdom, and, spreading out over the cone, end therein in minute horizontal branches. He is emphatically certain on this point, and one gains the impression that nothing could be easier than to proceed by his methods and see these fibrillae without the least difficulty; nevertheless others, including the present writer, have not succeeded in demonstrating the presence of such fibrils, and there is in fact no real evidence of their existence.

Jonas (*l.c.*) describes and figures the structure of many Lepidopterous eyes. In his description of the structure of the eye he insists on the transversely laminated structure of the rhabdom, which he says is quite easy to see. The writer cannot agree with this statement. An apparent transverse lamination of the rhabdom is occasionally seen in osmic acid preparations, but as a rule it is not visible. Whether the rhabdom is actually laminated or not, I have been unable to decide. Certainly in many cases the fine pigment granules when very slightly out of focus have a tendency to suggest transverse lines, and I feel certain that in some cases at least this appearance has been thus misinterpreted. Jonas failed to discover any nerve fibrillæ, though in cross sections of the retinulae he saw clear spots which he thought might be sections of nerves. He quotes Wagner as describing how in *Sphinx atropos* "the nerve threads or visual nerve bundles surround the apex of the cone like a calyx, passing thence to its anterior surface, and reaching the cornea; the nerve forms a true retina which surrounds the cone like a sheath." Leydig, as he says, took the same view, and he quotes Schültze's minute description of the nerve fibrils entering the cone and surrounding the apex in a cup-like fashion. He then states:—

"With the help of the apochromatic objective I have come to precisely the same results. . . . One almost gains the impression that the old authors were right in that they maintained that the cone sheath extends as a nerve-rod sheath as far as the basal membrane, but a definite opinion cannot be formed until entire proof has been obtained by the study of development."

It may be noted that these views support those of Patten referred to later.

Jonas, though asserting that he has come to the same conclusion as Schültze in regard to the nerve terminals in the compound eye, does not figure them and also states that he could not find them. The value of his observations is somewhat discounted by a very curious and isolated observation. He describes a "cigar-shaped structure" at the base of the rhabdom which he appears to have seen only in *Coenonympha pamphilus*. A small text figure shows the object as attached to the base of the rhabdom by a thread, and he states that he has no explanation to offer for the structure. Why he should have seen it only in *C. pamphilus* is difficult to understand, as a homologous structure is so obvious in *V. urticae*, *V. io*, and other diurnal Lepidoptera that it is a prominent feature in any good section. I have already described this feature and indicated its true nature as a part of the tracheal system. Kurt Bedau (Zeit. f. Wiss. Zool., xcvii, 1911 : Facettenauge der Wasserwanzen) states that his researches into the innervation of the retinula have not had much result. Even with a $\frac{1}{16}$-inch apochromatic and compensating ocular he has not been able to trace in the ommatidia the nerves which pass thence through the basal membrane. He has only been able to see with certainty that the number of nerve fibres corresponds to the eight visual cells. He criticises unfavourably Patten's work and expresses the view that what that author took for nerve fibrillae in the crystalline cone were the intensively stained plasma edges of the four cells of the cone. Many other authors have dealt with various aspects of the subject, but with one exception I have probably given a sufficient resumé of previous work to illustrate the difficulty and complexity of the insect eye. The exception referred to is the work of Prof. S. Exner ("Die Physiologie der facettirten Augen von Krebsen und Insekten. Leipsig und Wien, 1891). To Exner falls the credit of having demonstrated experimentally the existence and nature of the image in the facetted eye, or at least in certain types of that organ, and it is my intention here to set forth the conclusions arrived at in that admirable piece of research. It is the custom of many writers to quote from foreign works in the original, but while the practice may relieve them of any errors of interpretation, it is of little assistance to those readers who may not have had the opportunity of acquiring a knowledge of the languages in which such quotations are written. Exner's work is of such importance, and the only English summary I have seen ("Senses of Insects," Forel; Eng. Trans., Yearsley. London, 1908) so inadequate, that I feel justified in endeavouring to give a more complete account of it than has hitherto been attempted.

Exner first experimented with the eye of *Hydrophilus piceus*, and found that in such eyes the refraction of the rays by the dioptric portion is of a complicated character, due to the fact that the facets and cones are not homogeneous bodies, but have a refractive index which continually decreases from the axis to the outer wall. This form of refractive body he calls a lens cylinder.

In order more easily to explain the action of such an apparatus I have made the two diagrams on Pl. II, which are similar to those given in Exner's work. Fig. 7 represents a lens cylinder, the actual length of which is the same as its focal length. Now the rays emanating from some external point, and represented by the lines *cd*, *ef*, are made to converge by the refractive action of the medium so that they come to a focus at the base of the cylinder. Similarly rays from some other point, represented by *c′d′*, *e′f′*, come to a focus at the same level, and an inverted image is formed at the base of the cylinder. A peculiar difference between this action and that of a lens is, that whereas in the latter the central or chief rays, *ab*, *a′b′*, emerge at an angle, in the lens cylinder the chief rays emerge parallel. Now in the case where such a lens cylinder is twice as long as its own focal length we have the effect diagrammatically shown in fig. 8. Here the inverted image occurs in the middle of the cylinder, and the lower half of the cylinder acting in the same way, rays which enter the cylinder on the right, as *c′d′*, *e′f′*, emerge again on the right, and the image is thus erected. In insect eyes both these optical effects occur with apparently varying results. According to Exner two kinds of image are formed in the compound eye. The first is the superposition image. A very perfect example of this image is furnished by the eye of the male glow-worm, *Lampyris noctiluca*. In this insect the visual rods or retinulae do not extend forward so as to touch the ends of the cones, but are separated therefrom by a small space, filled with what in life is a doubtless transparent tissue. The pigment between the cones is not stationary, as in some other eyes we shall examine, but is capable of movement backwards or forwards according to the amount of light entering the eye. Thus if the light is weak the pigment moves forward towards the corneal layer, and exposes a larger portion of the apex of each cone. Now, as Exner has shown, the corneal facet and the cone in this beetle act *together* as a lens cylinder of twice its own focal length. Hence the rays emerging from the cone apex form a little *erect* image of that part of the visual field opposite its own particular facet. If the corresponding visual rod were adjacent to the cone apex and separated from other visual rods by a sleeve of pigment, such rod would receive only the stimulus proceeding from its own facet unit (lens and cone). But we have seen that not only are the visual rods at some distance behind the cones, but also the pigment is, under weak light conditions, drawn forward so as to expose a considerable part of the cone apex. The result is that each visual element receives not only the stimulus from its own facet unit, but also that of the peripheral rays from neighbouring facet units. The images it receives from such rays are superimposed upon those thrown from its own cone and lens, and thus the image is made brighter and more of the light entering the eye is utilised. This is the true superposition image. If the external light be strong, the pigment moves backwards like a dark sleeve, cutting off more and more of the peripheral rays, thus decreasing the luminosity of the image, without interfering with its clearness. The pigment, in fact, has a similar function to that of the iris of the vertebrate eye.

Owing to a peculiarity in the morphology of the glow-worm's eye this image can be easily seen. The cones are so firmly attached to the facet lenses that in a fresh eye all the nervous apparatus can be brushed away from the inside of the eye, leaving a little hemispherical shell consisting of the cornea with its cones in position.

If this little shell be mounted on a small drop of dilute glycerine (to reproduce the refractive effect of beetle blood) on a glass slide, and then viewed from the back through a medium-power objective, and using the plane mirror, any object placed between the corneal surface and the mirror can be distinctly seen as an *erect* image, allowing of course for the fact that it is inverted again by the microscope itself.

The beauty and sharpness of this image are remarkable. If the microscope be tilted up, the mirror removed, and the whole apparatus pointed towards a distant landscape, trees and any other objects in the field of view are all seen with surprising precision.

Exner succeeded in photographing such an image in an allied species, and I have repeated the experiment with the result shown on Pl. IV, fig. 2, which is a portrait of my friend Prof. Poulton taken through a glow-worm's eye.

It has, of course, lost much of its sharpness. The practical difficulties in making such a photograph are considerable. The exposure is prolonged, and whilst it is taking place the water is evaporating from the glycerine, altering all the time the refractive index, and thus affecting the clearness of the image. Moreover, small as the picture is, it is an enormously enlarged view of the optical image which in the actual eye has an area calculated roughly at ·154 sq. mm. Exner has given an elaborate mathematical proof of the formation of this image, but I have neither the space nor the mathematical knowledge to deal with that aspect of the matter.

It should be noted that the picture is not a mosaic at all, but a continuous image, and doubtless perceived as such by the insect. Those who have examined the beetle will have noted how the whole head, including the eyes, is completely overshadowed above by an opaque chitinous projection. Evidently the insect can only see forwards and downwards. No doubt the natural eye shade it possesses helps to give it an additionally acute vision for objects on the ground, amongst which is to be found its main object in life, its mate.

Exner points out that two features easily recognisable in the eyes of insects are, when present, especially adapted to the production of a superposition image. These are, first, the movement under varying light intensity of the "iris" pigment, and secondly, the existence of a space between the cone apices and the visual rods, or the thickest part of them.

Superposition images are found in all those insects which have to make the most of feeble light, and hence are specially characteristic of nocturnal and crepuscular Lepidoptera. The exclusively apposition image, on the other hand, is found only in diurnal insects, such as butterflies, flies, and dragon-flies. This form of image approximates very closely, according to Exner, to that of the original mosaic theory of Müller, in that the individual "image" produced by each facet unit is of less importance as an image than as a spot of light.

It is at this point that the results of my own researches in the case of butterflies, at any rate, lead me to conclusions markedly different from those of Exner; but I will speak of these later. To continue, Exner describes how he cut off slices of the eyes of various insects which have the retinulae adjacent to the cones. Having obtained such a section as, when mounted in the manner already described, showed a series of small dots of light corresponding to the cone apices, he proceeded to endeavour to study the image there formed.

In an ordinary humble-bee the light dots were so small that when he used two light spots as objects the brilliancy of the light dots was increased, but the two light rays could not be separated. It was thus hopeless to expect to see an image. On the other hand, he succeeded in the case of *Calliphora vomitoria* in seeing the two dots separately, and in proving that the image at the cone apex is an inverted one. By measuring the distance between the two light images, and then wiping away the cones, and measuring again, he found that the distance was practically the same, from which he concludes that the cone in this insect has an inappreciable optical effect. He admits his surprise at this result. The main conclusion is, however, that the images produced by the facet units in diurnal insects having apposition images are inverted, and therefore the picture presented to the percipient layer of the insect's eye is made up of a multitude of inverted images, or alternatively of mere light spots. One must conclude from this that the elements composing the whole picture are not, as images, of any value, but merely act as light spots of the average quality of that emanating from the portion of the field recorded by each facet.

If this be so, then the apposition image is, as an optical performance, very inferior to the superposition image, although nevertheless produced by a much more highly developed and intricate optical apparatus, at any rate in the case of eucone eyes.

I have here endeavoured to give as concise an account as possible of the image formation in the compound eye as set forth by Exner. There is much more in his book, which is a record of by far the most complete research yet made on the physiology of the compound eye, and is of a value which even the occasional profound obscurity of expression peculiar to the German language fails entirely to hide.

Author's Experiments

It remains to describe some of my own experiments, and to record the extent to which they confirm or refute previous results. I have already stated that I was able to see and photograph the image in the glow-worm's eye, and my observations on that insect convince me that there is no doubt whatever of the correctness of Exner's conclusions, both practical and theoretical, in regard to the nature of the superposition image.

The problem of the apposition image is much less easy to solve. Exner had already utilised the idea of freezing the eye in order to maintain the cones and other structures in their relative positions. The same idea occurred independently to my friend Prof. Poulton, though with the additional complication of maintaining the eye in a frozen condition during examination. A large dragonfly's eye seemed to promise the greatest facility in handling, and I therefore designed and constructed a somewhat elaborate apparatus for carrying out the experiment. A special hollow stage was made, having a central aperture into which were fitted type-metal blocks pierced through the centre for light, and accurately cast to fit the eyes of various large species of dragon-flies. Small copper pipes attached to the stage conveyed and withdrew a freezing mixture of ice and ammonium chloride, which was kept circulating by means of a small gunmetal force-pump actuated by an electro-motor. The lower side of the freezing stage was fitted with a glass box having an annular space containing calcium chloride, so that the corneal layer of the eye should be in perfectly dry air and free from the obscuration caused by condensation. It was hoped by these means to maintain the eye in a frozen state whilst the nervous and other tissue was gradually brushed away from the back, until the level of the cone apices was reached.

In its primary object the apparatus was entirely successful, the eye being completely frozen in a few minutes. I may also mention that both carbon dioxide and sulphur dioxide were tried as alternative freezing media, but the method described proved much superior to either.

Unfortunately the results obtained with this apparatus were not commensurate with the time and labour expended in its construction and use. With the eye of *Libellula depressa* the apices of the cones could be seen as bright points of light, but no image, inverted or erect, could be observed. A pencil or other object moved in front of the eye caused a shadow, not well enough defined to be called an image, and this shadow moved, as one would have expected, in the same direction (allowing for the effect of the microscope) as the movement of the pencil. A similar experiment with an eye of *Hemaris fuciformis* gave a rather clearer shadow or image. In general the observations, which were numerous, merely confirmed the results obtained by Exner with a large dragon-fly. The apices of the cones are so small that by the means at our disposal it is very difficult to see the image, if any, which occurs there. Nevertheless on another occasion, having succeeded in obtaining a portion of the cornea of a *Libellula* with the cones still attached, I could see first of all the usual sharp inverted image caused by the corneal facet, and focussing backwards, there appeared to be, in the neighbourhood of the cone apices, a much smaller, much less distinct image, still *inverted.* I have already mentioned that in the blow-fly Exner claims to have seen at the cone apices the two light points used by him as objects, and to have satisfied himself that the image at the apex is an inverted one. I have examined flies' eyes in the same way, and though the presence of an image at all, beyond that of the corneal facet, seems rather doubtful, there certainly seems no evidence that the cone reinverts the corneal image.

We must, I think, conclude that in flies and dragon-flies the picture presented to the perceptive elements is a mosaic of light spots but little if at all modified from that supposed by Müller. This may seem a disappointing performance for the enormous and complicated eye of a dragon-fly, but we must not forget the relative size of the eye. The sharpness of the view obtained with a mosaic of light dots obviously increases in proportion to the number of the elements making up the mosaic. If the rods and cones of the vertebrate eye are the separate elements of the visual apparatus, presumably each is stimulated by a minute bundle of rays which is in itself merely a light stimulus and not a picture, so that our own vision may be said to be a mosaic with exceedingly small elements, and the difference between this and the image of the facetted eye may be roughly compared with the difference between a half-tone block made with the very finest screen and the corresponding picture as represented by the very coarse screening used in the common newspaper pictorial reproduction.

Both flies and dragon-flies have pseudocone eyes, *i. e.* the cone is merely a fluid body, and not, as in butterflies, a true "crystalline cone." Presumably the latter is a higher development, whilst the former has persisted, at least in the dragon-flies, from great antiquity. It is when we turn to the butterfly eye that my observations do not confirm Exner's conclusions as to the manner of formation of an apposition image. Here we have to do with a eucone eye, and I am convinced that in butterflies at least there is at the apex of the cone a tiny *erect* image of that part of the field appertaining to each facet unit. I first saw this image in an eye of *Gonepteryx rhamni* which had been hardened in strong formol for twenty-four hours. A very thin slice was cut off and mounted on a drop of dilute glycerine on a cover slip and the whole set up on the microscope so that the objective was applied to the back of the section. Focussing down, in spite of the very small openings corresponding to the cone apices, the usual inverted image due to the corneal facets could be seen. Focussing up this image gradually disappeared and was replaced by a much less distinct but nevertheless erect image, *i. e.* an image of a pencil or similar object moves the same way as the object itself is moved, making due allowance for the reversal due to the microscope.

This peculiar effect is by no means easy to see. It is not due to the combined action of a large number of facet units, but is peculiar to each facet. One must have a very favourable section, and frequently before the necessary delicate adjustments are made the minute drop of dilute glycerine has suffered from the evaporation of the water, and all has to be done over again. For some time after I first saw it I was unable to get it again, and began to think I had been deceived. Since then, however, I have repeatedly observed it in the eye of *V. urticae*, and I am convinced that the rays of light which reach the sensitive layers of the butterfly's eye do so in their proper relations corresponding to their respective positions in the outer world. Let us now consider for a moment the difference which this fact may make in the acuity of the insect's vision. I have drawn on a large sheet of paper a curve representing a section of the corneal layer of the eye of *V. urticae*, and marked it off into as many divisions as I found facets in an actual section. Then I drew across the paper straight lines each perpendicular to an imaginary facet, and these lines formed a great sheaf radiating from the eye, the space between the lines of course increasing as the distance from the eye increased. Then a line two inches long, drawn two inches away from the eye, and at right angles to the centre line of the sheaf, would represent an object two inches from the insect's eye. Such a line cuts across a number of the other lines, and this number represents in linear fashion the number of facets which would be engaged in viewing an object two inches long, two inches from the eye. Another line of the same length but twelve inches from the eye cuts across a much smaller number of the lines, since here they are wider apart. From this diagram I obtained a number for the facets engaged in viewing an object two inches long but twelve inches away from the eye.

I was thus able to calculate approximately the number of facets of a tortoiseshell butterfly's eye which would be engaged in viewing another of the same species at distances of two and twelve inches respectively. I then made a drawing of the butterfly and divided it off into small areas equal to the number of facets at two and at twelve inches, and assuming that each facet unit conveys, not an image, but only a spot of light of the average value of that part of the field which it covers, I built up a drawing of the butterfly with spots of colour in number corresponding to the small areas into which my first drawing had been divided. I did this for both cases, the two-inch and the twelve-inch, and the result is shown on Pl. III. Fig. 1 shows the tortoiseshell butterfly as it appears to our eyes, fig. 2 the same as it may be supposed to appear if made up of little dots of light corresponding to the number of facets engaged at a distance of two inches, and fig. 3 the same at a distance of twelve inches. I have furthermore endeavoured to represent the appearance of the same butterfly at twelve inches, assuming that each facet unit records a sharp but inverted image of its own field of view. For this purpose I cut a drawing of the butterfly into hexagonal pieces each representing a facet view, and then turned them all upside down. The result is shown at Pl. IV, fig. 1. The effect is peculiar, and the reader may derive some amusement from trying to decide whether Pl. III, fig. 3, or Pl. IV, fig. 1 looks most like the original butterfly, for if we accept the mosaic theory, either as spots of light or as clear inverted images, one of these two pictures must represent the sort of view from which the sensitive layers of the insect's eye obtain their impression.

That these insects are extremely short-sighted every one who has observed them will agree. We know what a conspicuous object a white butterfly is. We can see it at great distances, and yet two white butterflies will often pass within a few feet of each other without either being apparently conscious of the other's presence. We know how readily one white butterfly will pursue and investigate another to see if it is a suitable mate, but I have never seen this kind of flirtation begin from a distance of more than a few feet. Nevertheless, in my view a butterfly's sight is much more acute than the figures on Pls. III and IV would suggest, and for this reason : I believe that the rays of light entering the facet unit are not recorded as a light spot, or as an inverted image, but as an erect image, the whole field of view being represented by a mosaic of little erect images, thus forming a continuous picture. I have already explained how I have actually seen these erect images, albeit with difficulty and not very clearly.

There is one feature of the butterfly's eye which does not appear to be present in dipterous and other pseudocone eyes—viz. the already described *processus corneae.* Now Exner regards the lens and cone *together*, in an apposition eye, as forming a lens cylinder of which the actual length and focal length are the same, hence giving an inverted image.

This condition may, and apparently does, obtain in some eyes in which the short cone is closely adjacent to the lens, forming what may be regarded as a physical entity, or where, as appears to be the case in a fly's eye, the pseudocone is of such feeble refractive power as to have little effect on the image already produced by the facet lens.

Now in the butterfly the *processus corneae* lies between the lens and the cone, so that these latter structures presumably do not act together as one lens cylinder of its own focal length. What I conceive takes place is that the lens produces an inverted image (this can, of course, be very clearly seen), the rays from it are collected by the cone, and that is a lens cylinder of its own focal length. Acting on the principle already explained, the cone reinverts the image, passing the rays out at its apex or inner end practically parallel.

From here they pass down the rhabdom and stimulate the retinula cells. The stimulation does not take place on the *ends* of the retinula cells, as, for instance, in the glow-worm's eye, but along the inner edge of each cell throughout its whole length.

Now Grenacher maintains that the retinula cells of each ommatidium, though multiple, can only be regarded as a physiological entity, and if we are to compare the receptive faculty of the compound with that of the vertebrate eye, we must compare the number of ommatidia in the former with the number of rods and cones in the latter.

However this may be in other compound eyes, I hold it to be an error for that of a butterfly. If there are eight retinula cells in each ommatidium of the eye of *V. urticae* I regard them as eight separate elements, the more so since in some species, as, for instance, *V. io*, they are to some extent separated by pigment. Hence the little pencil of light projected down the rhabdom by each facet unit, and having its rays arranged in their proper order and position by the re-erection brought about by the cone, is analysed, and presumably perceived with eight times the accuracy with which a mere amorphous spot of light would be perceived, and similarly one tortoiseshell butterfly may be supposed to see another, at a distance of two inches, eight times more distinctly than as shown at Pl. III, fig. 2. Two factors thus contribute to the better perception of the image, viz. the proper co-ordination of the rays and the multiplicity of the perceptive elements.

One point remains. It has been suggested that there is a difficulty in understanding how light passing down a transparent rod, the rhabdom, can effect the retinulae adjacent to it, since light entering a glass rod at one end emerges only at the other end and not through the sides.

I have submitted this point to Lord Rayleigh, who has kindly assisted me on several occasions. In his reply he points out that this action of a transparent rod is true for the rod surrounded by air, but that in the ommatidium of the compound eye this condition does not obtain.

The physiological continuity of the rhabdom and retinula cells doubtless provides for the due action on the latter of the light stimulus.

Technique

Many thousands of preparations of eyes were made in the course of my investigations. Of hardening re-agents

I have tried several. For some purposes the well-known saturated solution of corrosive sublimate in water to which is added 50 % of alcohol was found very good. About 1 % glacial acetic acid may be added if required. Sections thus prepared and stained for twenty-four hours in anilin-water-saffranin followed by a short immersion in a 2 % solution of light green in alcohol, give a very beautiful differentiation of the cones. For showing the peculiar structure of the trachaeal distributor at the base of the rhabdom the ordinary combined methyl blue and eosin (Mann's stain) is the best, and this also gives good preparations of the general nervous arrangement. One of the best fixatives of high penetrative power is "Picro-chlor-acetic acid" made up as follows :—

1 % Picric acid in alcohol . . .	6 parts
Chloroform	1 part
Glacial acetic acid	$\frac{1}{2}$

Fix for twenty-four hours and wash well in 90 % alcohol.

The nerve fibres passing from the periopticon to the retinulae are very well shown by Heidenhain's haematoxylin. Potassium bichromate and solutions containing formalin are, as a rule, of very little use, as they render any chitinous parts exceedingly brittle, and the softer parts are also made liable to pulverise at a touch. One of the great difficulties in all insect eye preparations is the pigment. If any fixative containing osmic acid be used all pigment cells are intensified and the pigment cannot be removed. The same applies in great measure to silver nitrate. For depigmentation after fixation the following solution works very well :—

80 % alcohol	2 parts
Glycerine	1 part
Hydrochloric acid	2 %

Sections after removal of paraffin or celloidin or both are put into this solution, and the pigment disappears in a few hours or less.

Buxton (Trans. Ent. Soc., 1917, p. 144) obtained good results with insect brain tissue by putting material into a 1 % solution of silver nitrate in water for ten days in the dark and then washing. The material is embedded in paraffin and sections cut. After removal of the paraffin and hydration of the sections they are placed in 1½ % silver nitrate and exposed to bright sunlight for ten minutes, washed in distilled water, and placed in 1 % gold chloride for two minutes in a bright light, washed again and placed in aqueous solution of pyrogallic acid to complete the reduction.

I have given this process at length because other workers may find it useful for brain tissues. For eye work I have not found it of much service on account of the old difficulty of the pigment cells, which are stained so deeply as to obscure any other structures with which they are in contact.

Methylene blue, Ranvier's lemon juice method, and other nerve processes have been tried, but without any marked success.

A method which promises good results in the differentiation of nerve tissue seems to be the double impregnation of silver chromate already referred to. Like most of these processes it is exceedingly capricious, and too much must not be expected of it. Sometimes nerves in one part of a section will be differentiated, whilst in others they remain unstained. Moreover, the material so prepared will rarely stand the usual embedding processes, and I find the most likely method of seeing the structures required is to tease out on a slide small portions of the tissue and examine them as non-permanent preparations. The material is placed in a 2 % solution of potassium bichromate to which a very little formol has been added, and the tube exhausted of air. The material remains in this solution for about three days, when it is placed in 1 % silver nitrate for two days, then returned to the bichromate solution (freshly prepared) for two days, and finally put back into silver nitrate for two days or more. It can then be washed in 90 % alcohol and examined.

For section-cutting I have used both paraffin and paraffin-celloidin. If chitinous parts are not required, cornea, etc., can be removed after fixation and only the soft parts left. Paraffin sections can then easily be made. For sections including the chitin I have found the following process the most satisfactory.

Fixed and dehydrated material is placed for two or three days in a solution of celloidin in clove oil.* Then

* Celloidin dissolves in clove oil only very slowly. Many weeks may be required for the solution to become saturated.

transfer the material to a weak solution of celloidin in ether and alcohol, and concentrate to a syrup at about 40° C. Pour into a mould and harden in chloroform vapour in the usual way, and then transfer to a saturated solution of paraffin in chloroform for twenty-four hours. Then place the block in melted paraffin having a melting point of about 55° C. and exhaust with a water air-pump, finally embedding in fresh melted paraffin.

This combination of clove-oil celloidin saturation with double embedding was suggested by Dr. C. J. Martin of the Lister Institute. In my experience it is superior to the much-vaunted spirit-soap treatment. The alleged chitin-softening action of spirit-soap seems to me to be much over-rated.

Nearly all my sections were cut with a Cambridge Rocking Microtome, which, except for pure celloidin sections, is quite as efficient as the more complicated and costly instruments.

Can Butterflies distinguish Colours?

Before investigating this question and considering such experiments as may be regarded as throwing some light on the subject, it will be as well to make clear the meaning of the question and the necessary limitations of any answer thereto. We know that light consists of vibrations or waves, and since we cannot imagine waves in nothing, and since light reaches us from the stars across illimitable tracts of empty space, we suppose the existence of an invisible, intangible, perfectly elastic medium called the aether, which is considered to permeate the universe and all material substances contained therein. The vibrations set up in this medium by a source of light are of differing wave lengths and wave frequencies, and our own visual organs record different sensations according to the frequencies of the waves which fall upon our eyes. The light we receive on our own retina may come direct from the source of light, or more commonly may be reflected from the surface of some substance upon which the direct light is falling. If the light we receive contains a normal admixture of all the rays of differing length and frequency we experience a sensation which we call "white." It is possible to separate the component rays of white light by passing them through a prism, as in the well-known spectroscope. The rays are bent or deflected from their original course, but all are not equally deflected. Those of the shortest wave length are deflected most, and hence it is possible to project on a screen a band of light, one end of which consists of the rays of shortest wave length, the other of those of the longest, those of intermediate wave lengths occupying the intermediate positions.

We are now, however, aware of a new fact, the band of light is no longer white, but the different portions of it produce in us different sensations which we call colour. Thus the band to a normal eye appears deep red at one end, and changes towards the other end into orange, yellow, green, blue, dark blue, and finally violet. An object such as a flower appears to us to be coloured because its substance absorbs some of the light falling upon it, and reflects the rest. Such colours in nature are rarely pure, *i. e.* they consist of mixtures of reflected rays, thus producing what we term various "shades" of colour. These mixtures of colours can be analysed by looking at the objects through special light filters which entirely absorb certain rays, while allowing the rest to pass unaltered. Some rather unsuspected effects may in this way be obtained. Thus a deep blue lobelia examined through a screen which is impervious to blue rays, looks deep red, showing that its colour consists partly of red rays. Similarly certain forms of pale pink pelargonium when examined through a filter impervious to red, appear bright blue, although we are not conscious of the blue component of the colour when seen under normal conditions.

It may thus be seen that we may be said to possess two separate visual faculties in relation to light. One, the fundamental perception of light as such, the other the capacity for distinguishing, apart from mere luminosity, lights of different wave lengths; and a totally colour-blind person is one who possesses only the former of these two faculties. Such cases are extremely rare, though partial, and especially "red-green" blindness is of frequent occurrence. In one case of total colour blindness or monochromatic vision, instanced by Sir William Abney ("Researches in Colour Vision," London, 1913), the subject had no sense of any colour, and moreover his sensation of luminosity was about one-thirtieth of that of a normal person, and much the same condition was observed in a second example given by the same author. That the two faculties mentioned are in fact quite distinct is shown by a third case in which the subject appeared to have the sensation of green, but little or no fundamental sensation of light.

Having thus explained something of the meaning of colour vision as applied to our own eyes, to what extent can we apply the terms we ordinarily use to the question of colour vision in an insect? Naturally we cannot know whether what we call red or blue appears red or blue to a butterfly, in the same sense as it does to us. We may, I think, leave out of account all philosophical verbiage on the subject of whether an insect is or is not a conscious organism. Consciousness is probably a matter of degree, and though in creatures of lowly cerebral organisation it may be reduced to a condition hardly definable by our limited imagination, some form of consciousness seems postulated in any creature which leads an independent and more or less complicated existence. When therefore we ask, can a butterfly distinguish colours? we mean, does it, as a nervous organism, possess the faculty of distinguishing those differences in the quality of light waves which we speak of as colour, in a sense distinct from their mere luminosity value? With butterflies comparatively few experiments have been made. With other insects such investigations as have so far been recorded have naturally been carried out with species in which a colour sense might be supposed to be of some use in the creature's economy. In nature animals are rarely endowed with faculties which are superfluous to their mode of life, though at the same time we must not too readily assume that any given insect can have no use for a sense of colour, since there are probably few species of the ultimate details of whose life history we have absolute knowledge.

Bees, with their intimate relationships to flowers have naturally prompted a considerable measure of research, more especially as the theory has been advanced, first by Sprengel in 1793, that flowers attract insects, and especially bees, by their bright and conspicuous colours. H. Müller's experiments resulted in the statement that, *caeteris paribus*, a flower will be sought by insects in proportion as it is conspicuous. Wery arrived at similar conclusions. Müller also pointed out that the perfume is a powerful attraction. Many early researches might be quoted, but the methods are frequently faulty and the results inconclusive or contradictory.

Plateau's conclusion that all flowers might be green without their due pollination being interfered with does not seem to me to prove that flowers which are not green gain no advantage from their different appearance. Such observations, however they may affect the question of the origin of colours in flowers, seem to prove or disprove very little in relation to the insect's power of chromatic perception.

Lord Avebury's experiments merit a greater consideration. He experimented largely with bees. In one case he gave a bee a drop of honey on a blue paper, and then three feet away placed a similar drop of honey on an orange paper. After the bee had had two feeds the papers were transposed, but the bee returned to the blue paper. After a while the papers were again transposed, and the bee returned to where the blue paper had last been, and found the orange one. It evidently looked different, as she stopped and made for the blue paper again. The author thus comments on the experiment : "No one who saw her at that moment could have the slightest doubt about her perceiving the difference between the two colours."

The experiment does not, however, really prove that the bee distinguished the colours. A totally colour-blind person might be able to separate blue and orange papers, not by means of their colours, but through their different luminosity. The same author also carried out a rather complicated experiment with honey on slips of glass which had coloured paper attached to them. By changing and removing these and carrying out the experiment many times, he arrived at the conclusion that his bees showed a marked preference for blue, then white, and successively yellow, red, green, and orange.

The order of the colours is peculiar, especially the position of the red. If bees are colour-blind and guided mainly by luminosity the yellow and green should have been the most conspicuous colours, but we have here the red coming between these, a result which would not, I venture to suggest, be obtained with a colour-blind animal.

That insects are *attracted* by the colours of the flowers is very improbable, and the theory that flower colour has been developed because its attractiveness assists in pollination has little foundation. Nevertheless, the colours of flowers may well have been developed as an aid to *conspicuousness*, as opposed to attractiveness. My friend, Dr. Church, who has made a special study of floral mechanism and the visits of insects, fully agrees that a flower which is more conspicuous will be likely to be visited before one which is less so. From the experiments of Forel, Avebury, Plateau and others we have evidence that insects, especially bees, have a remarkable memory, not only for locality, but also for colour. Thus a bee which has been given honey on a blue paper rapidly associated the idea of honey and blue, or whatever sensation the blue colour may convey to it. Lest it should be supposed that bees are specially associated with blue, we may instance another experiment of Lord Avebury. Equal-sized discs of red, yellow, green, and blue were provided, and honey was placed on the red disc. A marked bee was also placed on the red disc. After the bee had fed, gone back to the hive and returned a few times, the red disc was replaced by a blue disc with honey, and another red disc was placed near, but without honey. When the bee returned it went to the red disc and searched for the honey it had been accustomed to find thereon. Nor could it find the honey on the blue disc, though this was close at hand, showing a defective sense of smell. Numerous further experiments showed that bees rarely confuse colours except blue and green. Forel tried the same experiment in the opposite order, when the bee always went to the blue disc, and even to a strip of blue paper, showing that it was not the form which guided it.

More valuable evidence than all these observations is given by Forel when he describes how a bee, fed on blue paper, afterwards sought out and examined all the pieces of blue paper in various corners of the room, in whatever surroundings they happened to be. The latter part of the sentence discounts entirely the mere luminosity value of the blue paper.

Before describing my own experiments which have been made with butterflies, I must briefly review the work of Hess, referred to in the first part of this paper, from which that author deduces the opinion that insects, bees and butterflies included, are totally colour-blind. In attempting to show that his results with these insects are inconclusive I do not wish to detract from the value of his research with other animals, especially those with birds and dyed grain, which are very interesting and ingenious. He experimented with larvae of *Hyponomeuta variabilis* by placing them in a glass vessel with parallel sides, and found that for the most part they crept to the lid nearest the light. If a strong light were arranged in one half and a weak light in the other, they crept into the bright half. When a spectrum of suitable width was thrown on to the parallel-sided glass vessel, they crept into the yellow green. If the vessel were moved so as to bring those in the yellow green into the red, they moved again into the yellow green. With a photometric apparatus consisting of a red and blue lamp the larvae sought the blue, even when to the human eye the red was the brighter colour.

Larvae of *Porthesia chrysorrhoea* crept to the most brightly lighted part. In the spectrum they moved from the other colours into the yellow green. Larvae of *Vanessa io* behaved in a similar manner, and imagines hatched from them were investigated in the same way. In the spectrum the butterflies fluttered out of the red, blue, and violet into the yellow green. When the cage was lighted half with bright red, half with dark blue, the greater number went into the blue. "All my larvae behaved as they must behave if their visual powers are the same as, or similar to, those of a totally colour-blind person. There is nothing comparable to the colour sense of the normal human being." With other experiments he shows fairly conclusively that mosquitoes and their larvae are insensitive to red light, whilst still further investigations show that Chalcids, lady-birds, and house flies tend to move from other colours into yellow green.

Bees were experimented on, first by showing that they were strongly positively phototropic, and then by showing that they moved out of the other colours into the yellow green. Given the choice of blue and red, they moved out of the red into the blue. With the photometric apparatus they preferred the blue to the red, even when the latter appeared to the operator to be brighter than the former. By increasing still further the red light the bees moved into the latter. He concludes from these and other experiments that the bees behaved essentially in the same way as the other insects he experimented upon.

After quoting at considerable length the experiments of Avebury, Plateau, Forel, and others, Hess thus disposes of them :—

"The value of such numerous observations and laborious experiments is discounted by the fact that they have, almost without exception, been undertaken without knowledge of colour physiology. Perusal of the extensive literature bearing on the subject has not disclosed to me a single fact which makes even probable, from the point of view of scientific chromatology, the existence of a colour sense in bees. In my own experiments the bees, like all other invertebrates investigated, behaved as they must do if their visual power were the same as, or similar to, that of a totally colour-blind man. In all the results hitherto obtained in this direction by zoologists and botanists, there is nothing to contradict this."

As to whether the experiments of others, which Hess so ponderously dismisses as valueless, are really so devoid of merit as he maintains, I will leave others to form their own judgment. Let us suppose for the sake of argument that all the accumulated work of Avebury, Forel, Plateau, and others has failed to prove that insects distinguish colours. To what extent does the work of this expert in scientific chromatology prove that insects are colour-blind?

He takes certain insects having a marked positive phototropism, and having confined them in a cage makes the surprising discovery that they tend on the whole to make their way towards the light. Caterpillars and mosquito larvae we should hardly credit with a high degree of colour sense in any case. As to the bees, they showed a tendency to regard a dark blue as more luminous than a bright red, and the peacock butterflies showed the same preference. At the most this only suggests a "short vision" at the red end of the spectrum. Avebury has shown that ants at least are sensitive to the ultra-violet rays which are invisible to us. Why not bees also and even butterflies? Avebury submitted negatively phototropic ants to light from two screens of a colour which appeared the same to the human eye, but one of the screens was made opaque to ultra-violet rays. The ants chose the latter colour to hide under, as it evidently appeared to them the darker.

Hess considers that his insects behaved exactly as a totally colour-blind *person* would have done. Now totally colour-blind persons are extremely rare, and their behaviour under given circumstances is not exhaustively tabulated. But even accepting the very unsatisfactory anthropomorphic comparison, let us see what these "colour-blind" insects did.

To the instinct of a positively phototropic creature, light and freedom are probably closely associated. The imprisoned bees and butterflies presumably responded to that stimulus which guided them towards what in their experience, or nervous reflexes, or whatever conscious or unconscious psychological process we may fancy, indicated escape. I imagine that a human being bent on escaping from a dark cave would make for the opening whose light was of the greatest luminosity, as suggesting the shortest route to the outer world. Such action would not prove him to be totally colour-blind. Hess is at some pains to explain that the existence of colours is no proof that they must have been developed in order to be seen, and calls attention to the colours of such substances as egg yolk, blood, chlorophyl, and the green bones of certain fishes. I hardly think any one would care to argue very long over so obvious and well-known a point.* Let us then see whether there is any evidence that butterflies can distinguish colours, or alternatively whether it can be shown that they are not blind to those portions of the spectrum which would probably be invisible to a totally colour-blind eye.

The only serious experiments with butterflies which I have been able to find are those of Seitz, recorded in a paper read by him at the International Congress of Entomology at Oxford in 1912. He observed that at El Kantara in Algeria the top of a certain range of hills was frequented by a yellow black-margined butterfly (*Anthocaris charlonia*), and was a meeting-place for the males who came there to mate. He made coloured paper models of the butterflies, and these attracted the real ones to such an extent that as many as six were seen at one time trying to pair with the paper model. They did not appear to see it at a distance of more than eight feet. To test the accuracy of their vision a graduated series of models was made differing in size, colour, and markings. Exact models were very attractive, whilst those which were of the right colour and markings, but three times the size, attracted the real males only for an instant. Accurately coloured models were always first visited, whilst those of similar but not of exactly matching colours were only noticed after the correct

* See Poulton, "Colours of Animals," 1890, pp. 12–14.

ones had proved disappointing. Models distinctly wrongly coloured were disregarded. The sense of smell was shown in these cases to have little apparent influence. From the position adopted by the male relatively to the female it was found that the male could recognise the head from the tail of the model only at a distance of about two to four inches, whilst the wrong colour seemed to be recognised at six feet, and abnormal size at from $1\frac{1}{2}$ to $4\frac{1}{2}$ feet.

From their behaviour in trying to pair with paper models fluttering in the wind, it was evident that the difference of texture between the paper and the real wing was not recognised.

As some evidence of colour perception Seitz remarks that the vertebrate eye can see red further away than blue. He observed in South America certain Pierine butterflies flying at some height over a mass of blue flowering shrubs, amongst which there were isolated flowers of a brilliant red. The butterflies precipitated themselves on the red flowers first, afterwards visiting the blue ones. This was the more remarkable as the blue-flowered plant was the food plant of the larva and might have been supposed to attract the insects first.

I have not quoted these observations because they carry us very much further, but they seem to be the only experiments of the kind so far recorded.

My own researches have not gone so far as I could wish. Much that was done in 1917 suggested other lines of investigation by which I hoped to profit in 1918. I had special flower-beds planted and other preparations made, only to be disappointed by the total disappearance of all butterflies at the end of August. The absence of *V. urticae* was especially noticeable, since in the garden where I had arranged my flowers this species usually flies in great numbers well into October.

However, while not claiming the essential virtue of being a "scientific chromatologist," I may give my results so far as they go, and leave others to judge of the extent to which they throw light on the subject.

It having been suggested that butterflies are either "short" in the red, or, if totally colour-blind, then red-blind, I endeavoured to prove or disprove this theory in the following way. I obtained a dye which I ascertained, by means of the spectroscope, transmitted only red rays. I am unable to give its composition, as it is a proprietary colour used for painting lantern slides. With this I painted over the eyes of numerous examples of *urticae*. I was very careful by microscopical examination to see that this was thoroughly done and that no pinhole of normal light could reach the eye. All the butterflies were marked so that they could be easily recognised again. That the insects so treated were certainly not totally blind, as they would have been had they been red-blind, was very completely shown by the fact that they immediately, or at least after a short period of "shock," flew to the window of the room, and also in some cases alighted on the curtains, the latter performance necessitating a judgment of distance little if anything removed from the normal. All my butterflies were then liberated, and both on that and succeeding days I observed them flying in the garden and alighting on flowers. Unfortunately I had not a sufficiently large number to judge fairly the extent to which their selection of flowers was modified by their "red spectacles." One I caught two days later was found on examination to have its coating of red quite unimpaired. The behaviour of these insects was in marked contrast to that of one whose eyes I covered with black dye. This totally blinded example, though repeatedly thrown into the air, merely fell to the ground and remained motionless, except for a certain amount of aimless creeping about. It would appear that *Ganoris brassicae*, *Pieris napi*, and *P. rapae* are distinctly shorter in the red than *V. urticae*, for similar treatment had a different effect. They still flew to a window, showing that a degree of light perception remained, but on being liberated flew aimlessly, and with marked lack of control.

It may be suggested that the examples of *urticae* which found the flowers in spite of their eyes being red, did so by the sense of smell. That this sense has little to do with their feeding habits I was easily able to show by coating the antennae of several specimens with shellac varnish. These continued to find the flowers with the same facility as before. In my view a strong scent may, and doubtless often does, help to attract butterflies, as, for instance, in the case of the well-known *Buddleia* flowers. I believe, however, that having once discovered a source of food, butterflies will return to it day after day, guided in great measure by the same remarkable locality sense, which in a much higher development has been so frequently observed

	Deep pink phlox.	White phlox.	Pale pink aster.	Pale mauve aster.	*Rudbeckia.* (Yellow, black centre.)	Deep purple aster.	Deep pink aster.	Pale mauve pansy.	Scarlet gladiolus.	Crimson lobelia.	White pink-eyed phlox.	Bronze Daisy. (*Helenium.*)	Purple stock.	Orange Montbretia.	Magenta phlox.	Pale mauve Michaelmas daisy.	Pale pink phlox.	Blue lobelia.	White aster.	Pink antirrhinum.
megaera			7		1	2	2				1	2		1		5				
io			5	2	9	3						3	3		2	1	3	1		
urticae	7	2	67	40	68	69	11	2			2	11	10		18	17	4		1	2
brassicae . . .			2									1	1				4			
icarus					1							2					1			
phlaeas . . .				1	2							2				1	1			
atalanta . . .					1							1			2	1				
egeria			1	1		2														
rapae				1													2	1		
pamphilus . . .			2																1	
c-album . . .			1			1														1
	7	2	85	45	82	77	13	2			3	22	14	1	22	25	15	2	2	3

in bees. My next experiments had to do with visits to flowers. A large herbaceous border formed a convenient observation ground, and I sought to discover whether any particular colour was more frequently visited than the rest. If butterflies are at first guided merely by the luminosity of the flower we should expect white to receive at least a fair share of attention. My observation showed that the disregard of white was most marked. In the border were several phloxes. The white phlox gained two visits only against forty-eight visits to the coloured ones. Of the latter the white pink-eyed phlox gained the fewest, and the magenta, nearest to purple, the most. The accompanying table shows the results of some 420 observations. It should be noted that no case was included where a butterfly merely jumped from one flower to another; I only counted those observations where the insect in full flight selected and alighted on a particular flower. From time to time I drove them away and then waited for their return.

I regret I did not make any careful calculation of the relative proportions of the various flowers, but it is certain that the asters were much less numerous than the others and there were but few Rudbeckias.

The failure of white as a conspicuous colour is due, in the opinion of my friend Dr. Church, to the fact that so much white light is reflected from shiny leaves and similar objects. One feature of the table is remarkable, viz. the total failure of scarlet and crimson. It is true that neither crimson lobelia nor scarlet gladiolus, from the situation of the nectary, is well adapted to butterflies, and experience, acquired or hereditary, might be considered to account for their disregard of these flowers. A large bed of scarlet pelargonium in the same garden was hardly ever visited by a butterfly, except occasionally by *egeria*, but probably this flower secretes very little nectar. As already suggested, butterflies are probably "red short," and this condition apparently varies in different species. I have shown that *urticae* is not by any means red-blind, while the Pierine butterflies experimented with seemed largely so. As to *egeria*, I have observed an example stop and examine with care every one of three or four scarlet petals which had been scattered on a lawn, though this does not prove that the insect could distinguish red except by a difference in the luminosity.

The *Rudbeckia* which proved so attractive is a bright yellow Composite with a nearly black centre, and one of the most conspicuous flowers in the border. In connection with this flower I discovered a very remarkable fact. Forel, in remarking that insects are rarely deceived by artificial flowers, suggests that what appear to be close imitations to us have a different appearance to the insect's eye, and colours which we should match appear different to them. I investigated this point by means of photography, and whilst artificial roses, violets, etc., all affected a photographic plate in the same way as the real flowers, the *Rudbeckia* gave an entirely different appearance in a non-screened photograph to that which it presents to our eye.

In the unscreened photograph only the tips of the petals are luminous, the rest being almost as black as the centre. I found no other flower presenting a similar peculiarity, and the observation is merely of value in connection with the appended table as suggesting that the flower appears as conspicuous to the butterflies as it does to us, and that their sight is of a similar nature. With the exception of the crimson and the white, the flowers most visited, according to my observation, were those which were most conspicuous to our eyes.

I now turned my attention to a large bed of asters, the colours of which were white, three shades of pink, and three shades of purple. Leaving the white out of consideration, for reasons already stated, it may be remarked that the purple flowers were particularly conspicuous and sharply defined on their green background, a fact due not, of course, to their luminosity but to their colour. I observed the choice of colour in 427 instances, and these were divided as follows :—

White	47
Pink	135
Purple	245

It should be noted that the pink flowers were more numerous than the purple in the proportion of about four to three. The butterflies were mostly *V. urticae*, but *io*, *atalanta*, and *C.-album* were also occasional visitors.

On the assumption that the preference for purple is due to the fact that this colour is more *conspicuous* and that the purple flowers are more apt to " catch the eye " of the insect, I proceeded to endeavour to analyse the conspicuousness of this colour. I first photographed three white, three pink, and three purple asters, using a screen which gave the effect of relative luminosity only. Photograph A, Pl. V gives the result which shows that the purple flowers were certainly not specially conspicuous on account of their luminosity. By using a set of spectroscopically tested screens I was then able to secure photographs representing the relative luminosities of the flowers when certain rays were eliminated. Thus in photograph B all the light rays except the yellow-green were eliminated, and the plate was therefore red and blue blind. In C only the red and part of the green rays were used, the plate being thus blind to blue and blue-green. In D all the rays except red were used, the plate being thus blind to red. I leave it to the reader to judge whether an eye, blind to any of the selected parts of the spectrum, would be likely to see the purple asters better than one which had a normal range. So far as luminosity is concerned, the purple flowers are less conspicuous in all the abnormally produced photographs than in that which gives the value with all the rays in use.

I consider it a fair assumption, therefore, that if the preference for the purple flowers is due to the greater ease with which they can be seen, the cause lies in the same property which makes them conspicuous to my own eyes, viz. the colour.

Before leaving the subject of flowers I may mention a few isolated observations which seem to have a bearing on the issue. An *urticae* picked out and dived at with great accuracy, from a distance of about four feet, a purple aster which lay between two scarlet flowers. Occasionally an example would settle—though not approaching from any distance—on the disc of an aster from which I had removed the ray florets. On the other hand, the yellow disc is not the guiding attraction, since they frequently flew to and settled on an aster bud which showed no yellow disc, and was only distinguished from the rest of the foliage by the coloured tips of the ray florets. On another occasion I observed an *urticae* pick out with certainty a very small yellow flower on the lawn, the latter being itself greenish yellow, and after tasting the flower it flew to and inspected a bit of yellow leaf lying some little distance away. Again I observed *P. rapae* flying over the lawn and picking out with precision some scattered and very minute yellow flowers whose colour was the only feature which appeared to distinguish them from their surroundings. Every one knows how our white

Pierine butterflies, when passing each other sufficiently closely, turn aside and carry on a flirtation in the air. This is sight and not scent, since different species will behave thus until closer proximity reveals the error. I observed a male *G. rhamni* fluttering over a pansy bed. Except for its well-known pale yellow colour it would have passed at a distance for *P. brassicae.* That species and also *P. rapae* were flying about over the pansies, and whenever they came within each other's visual field the usual flirtation ensued. But though *rhamni* and the other Pierines frequently came so near together as to be almost touching, neither took any notice of the other. This is the more remarkable since the female *rhamni* is nearly white, though it must be remembered that the pairing instinct probably does not develop in this species till the spring. But even supposing the *rhamni* was all intent on feeding, the *brassicae* certainly were not, and under the circumstances it is difficult to conceive any factor other than colour which caused them to ignore the *rhamni.*

In the early part of 1918 I arranged to carry out some experiments with *B. euphrosyne*, which is common in woods near Oxford. For this purpose I made paper models of the butterfly by cutting out photographs and colouring them. Of these I had two green, two blue, two crimson, two tawny yellow (the natural colour), two brown, and two clear pale yellow. In all cases the spots were black as in the real fritillary. In addition to the models I had a few real butterflies, long dead and dried.

In the first place the superior attraction of the real butterflies was very noticeable. The live fritillaries dipped at and examined the paper models, but in the case of the real ones they fluttered over them, touched them, and made every effort to obtain some response. As to the paper models, those of the natural colour attracted 27 individuals, red models attracted 18, and pale yellow 2. The other colours were not noticed at all. Note that the only colours other than the natural shade which attracted the live butterflies were those which might have been confounded with the real colour. So far as luminosity is concerned, the brown models (a rather pale brown) about equalled the naturally coloured models, whilst the red, though suggestive of the natural colour, had much less luminosity.

While pinning up my models I broke one of the real ones and threw away the fragments. This accident provided one of the most convincing incidents of the afternoon's work. I had the advantage on that occasion of the assistance of Mr. A. H. Hamm, who twice noticed a passing *euphrosyne* dipping to the ground and examining something in the grass and debris. On going to the place we found one of the wings of the specimen I had broken. Considering the innumerable small objects of similar *luminosity* which must have been lying about, I confess I am unable to understand what sense except that of colour could have guided the butterflies in these two instances. There is only one alternative, viz. scent. But the dead butterfly was many years old, and if it had any scent it was more likely to be naphthaline than anything else. But I was to receive a remarkable confirmation of this observation on my next visit to the wood. I again observed a *euphrosyne* hovering over something on the ground, and on going to investigate I discovered a large bud scale of exactly the golden brown colour of the butterfly itself. Truly this seems to me to be a remarkable performance for a "totally colour-blind" organism.

Having noted the superior attraction of the real butterfly over the paper model, a fact which I attribute to acuity of vision at close quarters, I prepared some models by bleaching real examples of the butterfly, dyeing them various colours and replacing the spots with black paint. Some of my "real" models were dyed golden brown like the normal insect, others were coloured red, blue, greenish yellow, and pale buff. Two of each were set up together with two untreated specimens. In half an hour there were 13 visits to the naturally coloured, 13 to the untreated, and none at all to the others. The only difference in the behaviour towards the dyed and the untreated examples was that the butterflies actually settled on the latter, but only hovered over the others, a proceeding again attributable to the slightly unnatural appearance, at close quarters, of the dyed specimens.

Later in the afternoon the butterflies seemed more intent on feeding than love-making, and the blue bugle flowers were, as usual, receiving the greater share of their attentions.

I set up one of each variety of my models. In this case there were five visits to the naturally coloured, and thirteen to the untreated. With one exception none of the other models was noticed. This exception was a blue model on which the *euphrosyne* actually settled. Its action was very characteristic; there was none of the excited flutter which always accompanies the usual amatory advances, but a direct alighting with precision. There can be no doubt that the insect had mistaken my blue model for a bit of the bugle flower, which it closely matched in colour.

One further experiment was made to test the apparent colour sense from the spectroscopic point of view. I discovered that the tawny yellow colour of the real butterfly contained many green rays, and also that the dye I had hitherto used was spectroscopically almost the same as the ground colour of the insect. I therefore sought some dye which would give me a visual colour resembling the real butterfly, but spectroscopically different. I found this in "Orange G," which when examined with a set of colour filters appeared to reflect no green at all, and certainly looked quite different to the colour of the real butterfly. I dyed a bleached *euphrosyne* with this and repeated my experiments. To an untreated model there were 38 visits; to one dyed with Orange G, 14. Allowing for the more natural appearance of the untreated specimen, the observation seems to show that the yellow which to my eye nearly matched the real butterfly, though spectroscopically a very different colour, was also a good imitation for the live insect.

On the same occasion I made a test to prove that scent, however lingering, is not a potent factor in guiding the butterfly, at least in the early stages of courtship. I put up a specimen of *B. selene*, a very similar butterfly of a different species, and it gained 15 visits.

In the course of these experiments I took occasion to observe the distance at which one butterfly appeared to become visually conscious of the presence of another, and I gained the impression that for this species the limit was about $3\frac{1}{2}$ feet. The distance is greater when both insects are flying. If one is at rest another flying past has to come closer before it perceives it. A *euphrosyne* will pursue another species of butterfly on the wing if the other is more or less darkly coloured. It never notices any of our white Pierines.

I have stated that scent does not appear to be a strong factor in the early stages of courtship. It is quite otherwise when pairing is imminent or accomplished. Mr. Hamm noticed a pair of *euphrosyne*, *in coitu*, hidden on the underside of a small bush. We observed that every passing *euphrosyne* turned aside, even from positions whence the pair were invisible, and seeking them out, mobbed them furiously. Even after the pair had separated and flown away, other passing individuals turned aside and fluttered round the place. I have seen similar occurrences in connection with *C. pamphilus*, and I have recorded an example observed by Lamborn in a species of *Planema*. The remarks there made apply to the present cases.*

I have already explained my inability to continue these experiments during the past autumn. I hope to have better fortune in another season. So far, the chief results of my researches may be briefly summarised as follows :—

The peculiar refractive body at the base of the ommatidium in the butterfly eye, first observed in one species by Jonas, is commonly found in other species, and is a special structure of the trachaeal apparatus, varying in detail in the examples of different families investigated.

The periopticon in the butterfly eye seems to preserve in its structure the individuality and relative position of the nerve fibres relating to each facet.

There is every reason to suppose that the retinula cells are themselves the nerve endings of the receptive layer of the butterfly eye, and that the alleged existence of nerve fibres in or around the cone, or in the rhabdom, is an error due to incorrect observation. This view is strongly supported by the recent researches of Sanchez on the pupal eye.

The eucone eye, as found in butterflies, gives at the apex of each cone a small erect image made up of parallel rays which, proceeding down the rhabdom, stimulate the retinulae. The whole field of view is reproduced in a mosaic of correctly correlated elements forming a continuous and complete whole, the definition of which, owing to the comparative paucity of retinal elements decreases rapidly as the distance of the object increases, though at short distances the sight is comparatively acute.

The behaviour of butterflies under certain observed conditions lends strong support to the view that they can distinguish those differences of light-wave frequency which we call colour, and if the present evidence to that effect is not entirely conclusive, the testimony to the contrary is totally inadequate.

* See "Monograph of the genus *Acraea*," Trans. Ent. Soc., 1912, p. 8.

(H. Eltringham, del.)

(Oxford University Press.)

SECTION, EYE OF *VANESSA URTICAE.*

EXPLANATION OF PLATE I.

Section through an eye of *V. urticae* in the plane of the expanded wings × 60.

A. The corneal layer showing the lenses.
B. The *processus corneae.*
C. The layer of the "crystalline cones."
D. The ommatidia, each of which consists of eight elongated nerve end cells, the transparent inner longitudinal margins of which form the rhabdom.
E. The basal, or fenestrated membrane.
F. The nerve bundles leading from the ommatidia to the periopticon.
G. The periopticon.
H. The epiopticon.

In the neighbourhood of the cones is seen a layer of pigment granules, the contents of the pigment cells there situated. A second less dense pigmentation occurs at the basal membrane. Just beneath the latter is a layer of heavily nucleated cells of which there is one to each ommatidium. The blank areas between the nerve bundles are tracheal spaces.

Explanation of Plate II.

Fig. 1. Diagram of the proximal portion of an ommatidium × 1200.
bm. Basal membrane.
n. Nerve.
nc. Nucleated nerve cell.
t. Main tracheal tube.
tt. Tracheal branches.
ret. Retinula.
r. Rhabdom.
tf. Tracheal distributor.

2. An ommatidium and cone of *V. urticae* to show the relative size of the parts × 350.
cc. Crystalline cone.
r. Rhabdom.
tf. Tracheal distributor.

3. Transverse section of periopticon showing regular arrangements of the nerve bundles × 1350.

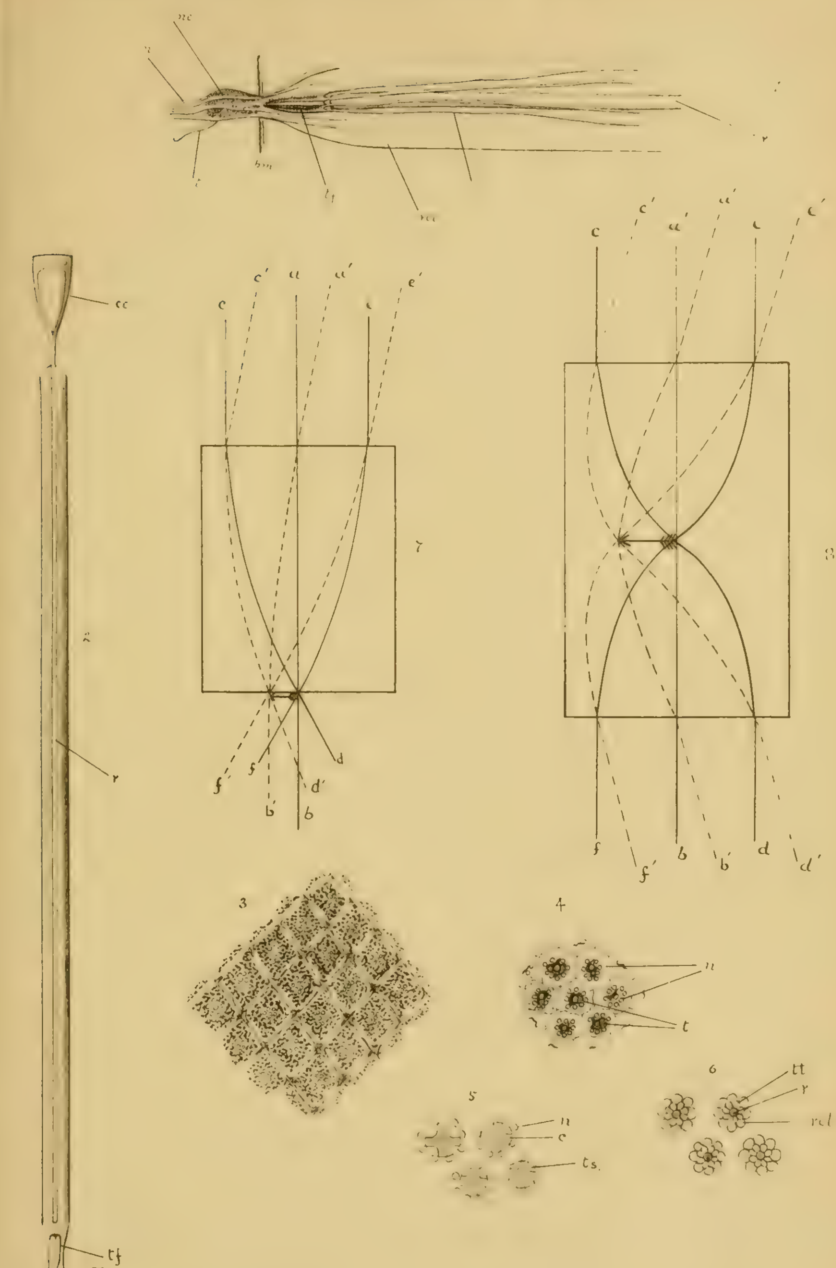
4. Transverse section of nerve bundles, nucleated cells, and tracheae just below basal membrane × 1350.
n. Nerves.
t. Tracheal tube.

5. Transverse section of tracheal distributor × 1350.
n. Nerves (retinulae).
c. Cruciform chitinous body in distributor.
ts. Tracheal spaces.

6. Transverse section of ommatidia above tracheal distributor × 1350.
tt. Tracheal branches.
r. Rhabdom.
ret. Retinula.

7. Diagram of a lens cylinder of its own focal length.

8. Diagram of a lens cylinder of twice its own focal length.



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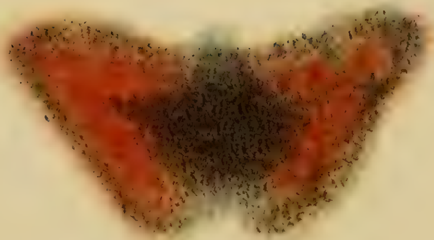
BUTTERFLY VISION.

1

2



3

H. Eltringham del. Sun Engraving Company, Limited

BUTTERFLY VISION.

Explanation of Plate III.

Fig. 1. A Tortoiseshell butterfly as it appears to the human eye.

2. The same as it might be supposed to appear to another of the same species, at a distance of two inches, assuming the correctness of the original mosaic theory.

3. The same, on the same assumption, at a distance of twelve inches.

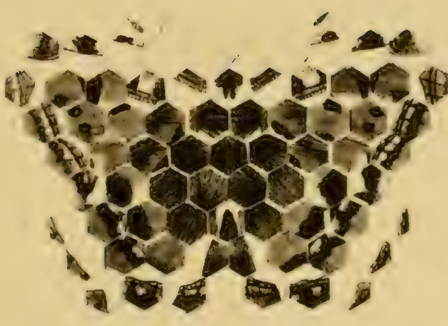
Note.—An image such as Fig. 3 may fairly be regarded as about the limit of recognisable visibility. It is produced by approximately 72 facets. Now the number of facets engaged varies inversely as the square of the distance, hence at three feet $\frac{1}{9}$ of 72, or eight facets only would be engaged. If, however, the theory here advanced be correct (*vide* p. 28), the image is eight times more distinct than was previously supposed, and hence at three feet the image would be equal to that produced, on the older theory, by 8×8, $= 64$ facets.

In other words, Fig. 3 would represent very nearly the degree of definition at a distance of three feet, and this distance is about the observed limit of recognition in these insects.

Explanation of Plate IV.

Fig. 1. A Tortoiseshell butterfly as it might be supposed to appear to another of the same species, at a distance of twelve inches, on the assumption that each facet unit gives a definite but inverted image.

2. Photograph, taken with a 12 mm. objective, of the erect image in the eye of a glow-worm, *Lampyris noctiluca*. The eye was mounted on a cover slip with a drop of dilute glycerine and a transparency of the portrait placed about two inches in front of it. The actual area of the image is about ·15 sq. mm. The definition is not nearly so good as when the image is viewed in the microscope by the human eye. Also it has lost much in reproduction.

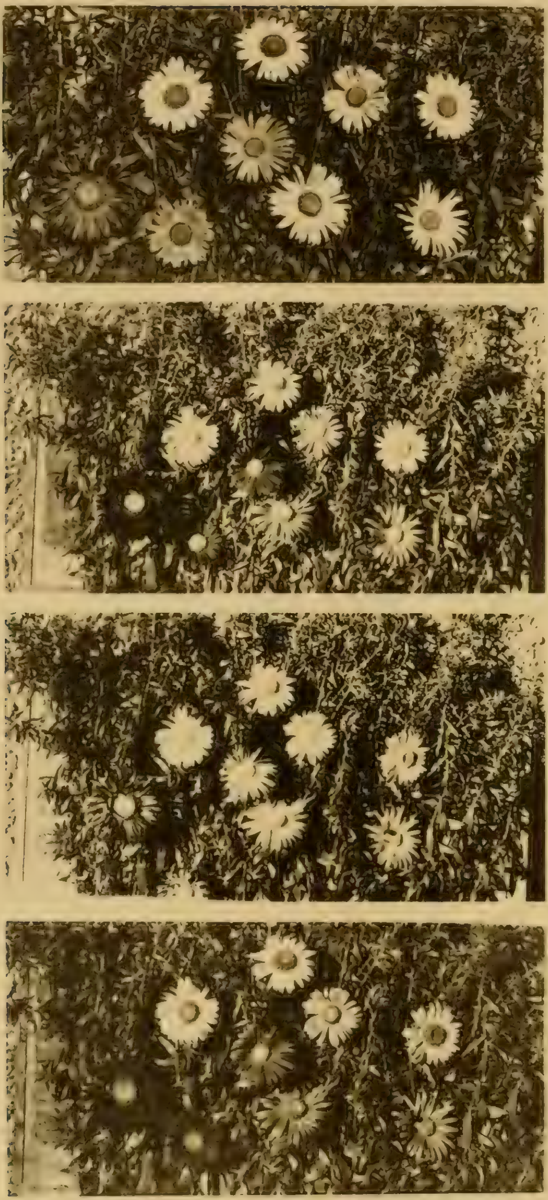


1

2

H. Eltringham, del et photo. (Oxford University Press.)

INSECT VISION.



A

B

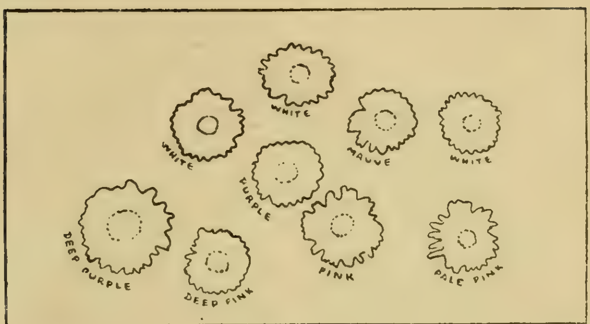
C

D

H. Eltringham, photo. (Oxford University Press.)

PHOTOGRAPHIC COLOUR-VALUES OF FLOWERS.

Explanation of Plate V.



A. Photograph of asters so screened as to give the relative luminosity values.

B. Ditto when only yellow green rays are used, the plate being thus red-blue blind.

C. Ditto when red and part of green rays are used, plate blue-blind.

D. Ditto with red rays eliminated, plate red-blind.

In the preparation of the foregoing work I desire to express my sincere thanks to Dr. F. A. Dixey, Mr. E. S. Goodrich, Mr. J. Bronté Gatenby, Mr. A. H. Hamm, Professor Poulton, Lord Rayleigh, Commander J. J. Walker, and others who have kindly helped me either with personal assistance or useful suggestions. Professor Poulton has specially helped me by kindly reading the proofs.

I have not given a bibliography of the subject, as the literature is so voluminous that it would occupy a great many pages of our Transactions, and economy of paper is still a necessity. Those specially interested will find bibliographies in nearly all the works I have mentioned in the text.

II. *The synonymy and types of certain genera of* Hymenoptera, *especially of those discussed by the Rev. F. D. Morice and Mr. Jno. Hartley Durrant in connection with the long-forgotten "Erlangen List" of Panzer and Jurine.* By J. CHESTER BRADLEY, M.S., Ph.D., Assistant Professor of Systematic Entomology in Cornell University, Ithaca, N.Y. Communicated by C. GORDON HEWITT, D.Sc.

[Read February 5th, 1919.]

THE two authors mentioned in the title in two comparatively recent joint papers (1914, 1916) which were read before the Society respectively on December 3rd, 1913, and November 1st, 1916, have brought to light and discussed with great detail a long-forgotten review, published anonymously, of Jurine's "Nouvelle Méthode de Classer les Hyménoptères et les Diptères."

This interesting review appeared some years in advance of the actual publication of Jurine's great work. Morice and Durrant have clearly shown that its real author was Panzer, but that the list of genera which he included in connection with it was transcribed to all intents and purpose directly from advance proofs furnished by Jurine, with whom Panzer was in frequent correspondence. Although, as a book review, the work was anonymous, the fact that it plainly stated that it was reviewing Jurine's work, that the author makes no claims for himself but gives entire credit for everything published to Jurine, makes it seem imperative to recognise the publication as valid, and to ascribe the list of genera, as Morice and Durrant suggest, to Jurine. In other words, the case is not essentially different from what it would have been if Jurine had published over his own signature an advance synopsis of the genera which he proposed to adopt in his forthcoming work.

This review seems to have been known to certain contemporaries of Panzer and Jurine, and to have influenced their own subsequently published work, but unfortunately was soon forgotten by the Entomological public, doubtless because of its inaccessibility and limited circulation. It involves, however, the status of many long-used genera of Hymenoptera, and consequently its treatment is of much importance to all students of that order.

The work of Morice and Durrant is both scholarly and laborious. They have placed all Hymenopterists in their debt. It is far from my intentions to belittle or criticise capriciously any part of it. They have, however, followed consistently certain methods of determining the types and status of the genera which do not appear to me to be in accordance with the mandates of the International Code of Zoological Nomenclature and its official interpretation as expressed in the published Opinions of the International Commission on Zoological Nomenclature (1910–1916).*

I wish to express my sincere thanks to the Rev. Mr. Morice, who has taken the pains to write to me at length his views on many of the points considered in this paper, and has expressed opinions in which I have in nearly every instance been able to concur, materially modifying my original conclusions, in several instances, especially in regard to *Ceropales* and to *Bremus*.

Inasmuch as the results arrived at by Morice and Durrant concern many fundamental genera of Hymenoptera, it has seemed to me worth while, in fact absolutely necessary, to revise their work in accordance with the Code and its official interpretation. There may be a few instances where the interpretation is in doubt, but most of the cases are clear-cut, and follow directly from the acceptance of certain premises.

* While zoologists are under no legal restraint in regard to the names that they adopt, there are many who feel, with the author, that the only possible hope for ultimate stability and uniformity of practice is to follow absolutely the International Code and its official interpretation, totally regardless of all personal predilections. Personally, the author is disposed to take exception to the reasonableness of certain of these interpretations, especially Opinion 46, which is one that is the cause of many of the dissensions hereinafter made from the conclusions of Morice and Durrant. But after all, uniformity of practice is the chief desideratum. We shall never all agree as to what is reasonable. However much we may feel that the International Commission is not representative, or may be inclined to dispute the source of its authority, there is nothing more representative with which to replace it, nothing that is constituted with even an approach to as great an authority. The decisions having once been made, it is to the interests of us all that they be followed implicitly.

The chief points upon which the decisions of this article differ from those of Morice and Durrant result from the following facts :—

(*a*) The "Histoire naturelle générale et particulière des Crustacés et des Insectes," par P. A. Latreille, Tome III, 1802, cannot be accepted as defining the types of genera not originating within its pages. After describing each genus it cites an "Exemple," more rarely "Exemples." But there is no evidence that Latreille intended these "exemples" to be in any sense types. The International Code, Art. 30, paragraph (*g*), says : "The meaning of the expression 'select a type' is to be rigidly construed. Mention of a species as an illustration or example of a genus does not constitute selection of a type."

(*b*) Concerning Lamarck, 1801, there is room for doubt. At first sight the case would seem to be identical with the one just discussed, Latreille 1802. But Lamarck (1801 : viii) explains his intentions as follows : "Pour faire connaître d'une manière certaine les generes dont je donne ici les caractères, j'ai cité sous chacun d'eux une espèce connue, ou très-rarement plusieurs, et j'y ai joint quelques synonymes que je puis certifier ; cela suffit pour me faire entendre."

It is difficult to decide whether Lamarck's intentions are thereby sufficiently clearly shown to have been equivalent to our idea of type fixation, as to permit us to "rigidly construe" his actions as selecting types in the sense of the Code. My own opinion is that we cannot accept his species mentioned as types. It is my intention to refer the question to the International Commission on Zoological Nomenclature for decision.

(*c*) Blumenbach, 1788, can by no means be accepted as designating genotypes. The case is exactly similar with Latreille, 1802.

(*d*) The genera of Latreille (1796), published without mention of included species, but accompanied by a sufficient diagnosis, are valid, and date from 1796.* The species first subsequently mentioned as belonging to the genus, and coming under the generic definition, are available for selection of the type, and only those.

(*e*) The elimination method of type selection, used to a

* This fact is established by Opinion 46 of the International Commission on Zoological Nomenclature. See also the discussion under the family *Thyreopidae*, *seq.*

limited extent by Morice and Durrant in certain instances, is not permitted by the Code.*

(*f*) Genera of similar but not identical spelling, as *Cepha* Billberg and *Cephus* Latr., are both valid under the code,† unfortunate as the fact may be in some instances.

In the following paper, in connection with the genera discussed by Morice and Durrant, the author has thought it worth while to introduce some additional genera which are affected directly or indirectly by these decisions, and also some names of higher groups, in order not to leave our nomenclature, in a measure, upset and not rebuilt.

It is to be understood that the present author accepts the conclusions, if not in every instance the methods, published by Morice and Durrant in the instances of genera which are not discussed in this paper.

In the pages which follow the genera included in the Erlangen list are given the numbers they bear in that list. Those not included are given a letter. The statement of the type in each case applies to the generic name immediately following the figure or letter, whether accepted as a valid name or rejected as a synonym or homonym. In order to make the matter as readily comprehensible as possible, all names used in a rejected sense are included in square brackets, while names used in their accepted sense are left free. In a few instances names have been inclosed in parentheses to indicate subgenera.

References following an author's name are by year and page to the List at the close of this article.

I. 1. TENTHREDO L. *nec.* auctt. = [*Allantus* auctt.].

Type: *Tenthredo scrophulariae* L. By designation of Latreille (1810 : 435).

Lamarck (1801 : 263) probably cannot be considered as having fixed a type for *Tenthredo*.‡ If not, the first valid designation was *scrophulariae* by Latreille as stated by

* See discussion under the case of the genus *Philanthus*, *seq.*

† In the International Code of Zoological Nomenclature, Art. 36, Recommendations, is found the following: "It is well to avoid the introduction of new generic names which differ from generic names already in use only in termination or in a slight variation in spelling which might lead to confusion. But when once introduced such names are not to be rejected on this account. Examples: *Picus*, *Pica*, *etc.*"

‡ See preceding discussion of this paper on p. 52.

Rohwer (1911 : 90). Consequently *Cryptus* and *Hylotoma* are not synonyms of *Tenthredo*. If Lamarck is correctly interpreted as establishing a type for *Tenthredo*, then the conclusions of Morice and Durrant are correct.

I. 2. CRYPTUS * Jur., 1801, *nec* Fabr., 1804 = [*Arge* Schrank, 1802] = [*Hylotoma* Latr., 1802].

TYPE: *Cryptus segmentaria* Panz. This was the only species included in the genus at the time species were first mentioned in connection with the generic name.

The genus *Cryptus* must date from the Erlangen list, 1801, where it was described but no species included. According to the official interpretation of the Code † the genus dated from 1801, but its type species must be selected from those coming under the original definition, which were first subsequently included under the generic name. Panzer (1804 : 88. pl. 17) was the first to give a species to the genus, and as he included only one, it became the type.

Fabricius (1804 : 70) used the name *Cryptus* for an entirely different group of Hymenoptera. If this publication actually antedated Panzer (1804 : 88. pl. 17) it would supply species for *Cryptus* were it not for the fact that none of them come under the generic definition of Jurine. *Cryptus* Fabr., 1804, is therefore a homonym of *Cryptus* Jurine, 1801.

a. [CRYPTUS Fabr., 1804, *nec* Jurine, 1801] = *Hedycryptus* Cam.?

TYPE: [*Cryptus*] *viduatorius* Fabr. = *Hedycryptus viduatorius* (Fabr.).

The only existing available synonyms for *Cryptus* Fabr. *sen. str.* seem to be *Hedycryptus* Cameron and *Steriphocryptus* Cameron, both published in September 1903 and based on Oriental species. Schmiedeknecht considers them both *Cryptus* in the sense of Fabr., that is congeneric with *viduatorius*, and is in all probability correct, certainly so as far as Cameron's description indicates. Unless examination of the types proves that Cameron actually had something different, we shall have to use one of these names in

* If Lamarck, 1801, is accepted as establishing genotypes, *Cryptus* becomes a synonym of *Tenthredo*, as Morice and Durrant state.

† Opinion 46, International Commission on Zoological Nomenclature.

place of *Cryptus* auctorum. Of the two, *Hedycryptus* appears to have priority. It was published in the Sept. 1903 issue of the Zeitschrift für systematische Hymenopterologie und Dipterologie, a copy of which is dated as having been received at the library of Cornell University, September 8, 1903. The September number of the Entomologist, containing the description of *Steriphocryptus* was received September 14, so presumably was issued later.

Undoubtedly it will eventually prove wise to unite with *Cryptus* auctorum as subgenera some of the closely related groups now treated as distinct genera. In such event the generic name will be that of some one of these other groups, and *Hedycryptus* will stand for the subgenus *Cryptus* auctorum. This was undoubtedly the intention of Viereck (1916 : 330) in using *Agrothereutes* Förster for *Cryptus* Fabr. But *Agrothereutes* is usually considered quite distant, although in the same tribe. Such a course would imply reducing most of the genera of the tribe to the rank of subgenera. As Mr. Viereck has not made his plan clear, farther than in the extent to which it applies to the fauna of Connecticut, it seems better to await its elaboration before giving it further consideration.

HEDYCRYPTINAE new subfamily name=[*Cryptinae* auctt.].

The International Code provides that the name of a family or subfamily must be changed when the name of its type genus is changed. Since *Cryptus* Fabr. is a homonym * of *Cryptus* Jurine, *Cryptinae* based on *Cryptus* Fabr. must be renamed *Hedycryptinae*, temporarily at least, following the corresponding similar change in the name of its type genus.

If other genera are united with *Hedycryptus* as subgenera, the generic and also family name will be eventually erected from the oldest one of these.

CRYPTINAE = [*Arginae* auctt.] = [*Hylotominae* auctt.].

Since *Cryptus* Jurine is an older name for *Arge* or *Hylotoma*, there is no actual change in the type genus of [*Arginae*] = [*Hylotominae*], but the generic name is changed to *Cryptus* and the subfamily name must be changed correspondingly.†

* See discussion under *Thyreopidae, seq.*

† See discussion under *Thyreopidae, seq.*

I. 3. [ALLANTUS Jur., 1801, and auctt.] = *Tenthredo* L.

Type: *Tenthredo scrophulariae* L. By designation of Curtis (1839 : 764).

Since *Allantus* dates from the Erlangen list, Rohwer (1911*b* : 218) is incorrect in making *togata* type of *Allantus* and therefore synonymising *Emphytus* with that genus. Morice and Durrant (1914 : 375) have correctly stated the type as *scrophulariae*, but since this is also type of *Tenthredo*, *Allantus* is a synonym of the latter genus.

I. 8. ORUSSUS Latr., 1796 = [*Oryssus* Fabr., 1798].

Type: [*Oryssus coronatus* Fabr.] = *Orussus abietinus* (Scop.). The genus originally described without species, only a single species was first subsequently included.

The genus must be attributed to Latreille, 1796,* and consequently retain the spelling *Orussus*. The type remains identical.

b. ASTATA Latr., 1796 = [*Astatus* Latr., 1796, *erratum*] = [*Dimorpha* Jur., 1801].

Type: [*Tiphia abdominalis* Panz.] = [*Sphex*] *boops* Schrank = *Astata boops* (Schrank) Spinola. The genus was described without species, and *abdominalis* was the one first subsequently included.

The genus *Astata* of Latreille is valid and dates from 1796.† Latreille printed the name *Astatus* (1796 : 114), but in the same work (1796 : xiii) states: "Page 114, au lieu d'*Astatus* lisez *Astata*." We can therefore hardly hold that he has preoccupied *Astatus* ‡ Jurine, 1801, a group of sawflies. Nor can the latter be considered as establishing species for *Astata* Latr., since the species therein

* See Opinion No. 46 of the International Commission on Zoological Nomenclature.

† See Opinion No. 46, International Commission on Zoological Nomenclature.

‡ International Code of Zoological Nomenclature, Art. 36, Recommendations: "It is well to avoid the introduction of new generic names which differ from other generic names only in termination or in a slight variation in spelling which might lead to confusion. But when once introduced, such names are not to be rejected on this account."

contained do not come under the generic definition of *Astata*.*

I. 9. ASTATUS Jur., May, 1801, *nec* Panzer, July, 1801, Konow, etc. = [*Cephus* Latr., 1802] = [*Trachelus* Jur., 1807].

TYPE: [*Sirex*] *pygmaeus* L. = *Astatus pygmaeus* (L.) Jur. = [*Cephus*] *pygmaeus* (L.) Latr.

The two species originally included in *Astatus* are identical.

c. EUMETABOLUS Schulz, 1906 = [*Astatus* Panzer, 1801, Konow, etc., *nec* Jurine, 1801].

TYPE: [*Sirex*] *troglodyta* Fabr. = [*Sirex*] *niger* Harris? = *Eumetabolus niger* (Harris) Rohwer.

Eumetabolus, without stated type, was proposed as a substitute for *Astatus*, sense of Konow, and therefore takes *ipso facto* the type of that genus.† Morice and Durrant strongly doubt the identity of *troglodyta* with what they term the mysterious *niger*, and possibly it would be better to call the species *trogolodyta*.

d. CEPHA Billberg, 1820 = [*Trachelus* Konow, *etc.*, *nec* Jurine] = [*Trachelastatus* Morice and Durrant, 1914].

TYPE: [*Sirex*] *tabidus* Fabr. = *Cepha tabida* (Fabr.)Billb. Genus monobasic.

It is impossible to replace *Cepha* Billberg with *Trachelastatus* Morice and Durrant on the suggested grounds of the similarity of *Cepha* Billberg with *Cephus* Latr.‡

The foregoing data may be tabulated for convenience as follows:—

Family LARRIDAE.

Astata Latr. Type: *boops*. = [*Dimorpha* Jurine].

* Opinion 46 of the International Commission on Zoological Nomenclature is summarised in part: "If (as in *Aclastus* Foerster, 1868) it is not evident from the original publication of the genus how many or what species are involved, the genus contains all of the species of the world which would come under the generic description as originally published. . . ."

† International Code of Zoological Nomenclature, Art. 30 *f*.

‡ International Code of Zoological Nomenclature, Art. 36, Recommendations.

Family ASTATIDAE = [Cephidae auctt.].

Astatus Jur. Type: *pygmaeus* = [*Cephus* auctt.].
= [*Trachelus* Jur., not sense of Konow and recent authors]
(not *Astatus* Konow and recent authors).

Cepha Billb. Type: *tabida* = [*Trachelus* auctt.]
= [*Trachelastatus* Mor. & Dur.].

Eumetabolus Schulz. Type: *niger* = [*Astatus*, sense of Konow and recent authors].

I. 10. SIREX L., 1761 = [*Paururus* Konow].

TYPE: [*Ichneumon*] *juvencus* L., 1758 = *Sirex juvencus* L. By designation of Curtis (1829 : 253).

If it be decided that Lamarck (1801) * is to be interpreted as establishing genotypes, the conclusions of Morice and Durrant must be accepted. Otherwise they will stand as given here and by Bradley (1913).

e. GASTERUPTION Latr., 1796 = [*Foenus* Fabr., 1798].

TYPE: [*Ichneumon*] *assectator* L. = *Gasteruption assectator* (L.) Schletterer. By designation of Viereck (1914 : 61), possibly previously by act of Latreille (1802 : 329).

Latreille (1802 : 329) certainly did not make *assectator* type of *Foenus*, and the designation of *jaculator* for the latter genus is valid, as indicated by Viereck (1914 : 60). However, the two are congeneric, and the name *Gasteruption* has precedence.†

III. 1. ICHNEUMON L. (1758).

The conclusions of Morice and Durrant are correct if Lamarck (1801) designated genotypes in the sense of the code. Otherwise those of Viereck (1914) as given by Morice and Durrant seem to be correct.

III. 2. ANOMALON Pz., 1804 = [*Paranomalon* Viereck, 1914] = *Anomalon* auct.

TYPE: *Anomalon cruentatus* Pz. Genus monobasic.

* See previous discussion concerning this paper on page 52.

† Opinion 46, International Commission on Zoological Nomenclature.

This is as shown by Morice and Durrant. Following the restoration of *Anomalon* in the accepted sense, it will no longer be used to replace *Bassus* auctt., but *Diplazon* will replace that name.

Viereck (1916 : 281) uses *Erigorgus* Förster to replace *Anomalon* auctt., probably with the intention of reducing his *Paranomalon* to the rank of a subgenus.

f. DIPLAZON (Nees) Grav., 1818 = [*Bassus* auctt., *nec* Fabr.].

Type : [*Ichneumon*] *laetatorius* Fabr. = [*Bassus*] *laetatorius* Panz. = *Diplazon laetatorius* (Fabr.). By designation of Viereck (1914 : 46).

The foregoing data, together with related facts brought out by Viereck (1914), may be conveniently tabulated as follows :—

Family Braconidae.

Subfamily *Braconinae* = [*Agathinae* auctt.].

Bracon Jur., *nec* auctt. Type : *desertor* L. = [*Cremnops* auctt.].

Bassus Fabr., *nec* auctt. Type : *calculator* Fabr. = [*Microdus* Nees *et* auctt.].

Agathis Latr. Type : *malvacearum* Latr.
etc.

Subfamily *Vipioninae* = [*Braconinae* auctt.].

Microbracon Ashm. Type : *sulcifrons* = [*Bracon* auctt., *nec* Jur.].

Vipio Latr.* Type : *desectus* n. n.† = [*Glyptomorpha* Holmg.] = [*Pseudovipio* Szepl.].

Zavipio Vier. Type : *marshalli* Schm. = [*Vipio* auctt.].
etc.

* The removal of *Bracon* Jur. to the group containing the genus *Agathis* has left the subfamily containing *Microbracon* Ashm. and allied genera without a type genus. This deficiency has been appropriately supplied by Viereck, who has selected the oldest of the genera concerned, *Vipio*, and by the erection of the family *Vipionidae* (1916 : 181) made it type genus.

† The type of *Vipio* Latreille is *Ichneumon desertor* Fabricius, not of Linnaeus. The latter insect is the *type* of *Bracon*. *Ichneumon desertor* Fabricius is a homonym and must be changed ; I therefore propose :—

Vipio desectus n. n. for *Vipio desertor* (Fabr.), described as *Ichneumon desertor* Fabr., *nec* Linnaeus.

Family ICHNEUMONIDAE.

Subfamily *Ophioninae.*

Anomalon Pz. Type: *cruentatus* = [*Paranomalon* Vier.].

Subfamily *Tryphoninae.*

Tribe *Diplazonini* = [*Bassini* auctt.].

Diplazon (Nees) Grav. Type: *laetatorius* = [*Bassus* auctt., *nec* Fabr.].

g. PSAMMOCHARES Latr., 1796=[*Pompilus* Fabr., 1798].

According to Opinion 46 of the International Commission on Zoological Nomenclature *Psammochares* must date from 1796 and not 1802.

h. TRYPOXYLON Latr., 1796 = [*Apius* Jur., 1801].

TYPE: [*Sphex*] *figulus* L. = *Trypoxylon figulus* (L.) Latr. Genus described without species, *figulus* was the first species placed in it subsequently, and agreeing with the generic definition becomes *ipso facto* type.*

III. 10. [DIMORPHA Jur., 1801] = *Astata* Latr., 1796.

TYPE: [*Tiphia abdominalis* Panz]=[*Sphex*] *boops* Schrank = *Astata boops* (Schrank) Spinola. Genus monobasic.

III. 12. SCOLIA F. = [*Discolia* Sauss. et Sichel].

TYPE: *Scolia* 4-*punctata* Fabr. By designation of Latreille (1810 : 437).

The so-called designation of *flavifrons* as type by Latreille (1802 : 347) is not valid under the code,† nor is the designation of *haemorrhoidalis* by Lamarck (1801 : 269).

III. 13. SAPYGA Latr., 1796..

and

III. 14. MYRMOSA Latr., 1796.

These two genera must date from 1796.‡ The types are as given by Morice and Durrant (1914 : 398).

* Opinion 46, International Commission on Zoological Nomenclature.

† International Code of Zoological Nomenclature, Art. 30, g.

‡ Opinion 46, International Commission on Zoological Nomenclature.

III. 23. PHILANTHUS Fabricius, 1790 = [*Simblephilus* Jurine, 1801].

TYPE: [*Crabro androgynus* Rossi] = [*Vespa*] *triangulum* Fabr. = *Philanthus triangulum* Fabr. By designation of Curtis 1829.

Morice and Durrant, p. 410, state that "Jurine's revision of *Philanthus* (30. v. 1801), being a year prior to that of Latreille (after iv. 1802), his restriction of its possible types to *laetus*, *arenarius*, and *labiatus*, must be accepted. This means that *arenaria* L. is the type, for *laetus* is a synonym of *arenarius*, and *labiatus* was not originally included in the Fabrician *Philanthus*."

The citation of only 3 supposed species in connection with *Philanthus* by Jurine in 1801 does not restrict selection of the type of that genus to any one of them. That was in a measure the now discarded principle of type-fixation by elimination.* There being no basis for the fixation of a type of *Philanthus* in the original publication of Fabricius (1790) † the first subsequent actual designation of the type by any author, if in accordance with paragraph *e* of Art. 30 of the code, must be accepted.‡ Latreille (1810 : 438) cannot be considered to have designated a type, since he mentions two different species both as type.§ The first actual designation of a type seems to

* See Opinion 6 of the International Commission on Zoological Nomenclature. This Opinion provides that when a later author divides the genus A, species A b and A c, leaving genus A, only species A b, and genus C, monotypic with species C c, the second author is to be construed as having fixed the type of the genus A. From the discussion of the case it is perfectly clear that this principle cannot be carried further, to the extent of including cases in which more than two species were included in the original description of the earlier genus.

See further, Opinion 58, in the discussion of which is stated, concerning a somewhat similar case: "'*Esox* Cuvier' is a restricted group of '*Esox* Linn.' Only one species is mentioned, and this becomes the type (by monotypy) of '*Esox* Cuvier.' This rigidly construed is not, however, a designation of the genotype for '*Esox* Linn.'"

† See International Code, Art 30, i.

‡ Art. 30, *g*: "If an author, in publishing a genus with more than one valid species fails to designate or to indicate its type, any subsequent author may select the type, and such designation is not subject to change."

§ If it should be interpreted that the first of these was the actual designation of a type, and the other intended as a synonym (which it is not), or as a supplementary illustration, the result would be have been by Curtis (1829 : 273) as *Crabro androgynus* Rossi, which is a synonym of *Vespa triangulum*, a true *Philanthus* in the sense of modern authors.

i. CERCERIS Latreille.

TYPE : [*Philanthus ornatus* Fabr.] = [*Sphex*] *rybiensis* L. = *Cerceris rybiensis* (L.) Schletterer. By designation of Latreille (1810 : 438).

Following from the conclusions relative to *Philanthus*, as above stated, *Cerceris* is not a synonym of that genus, but each will fortunately stand in the sense in which they were applied by Latreille, and which has been followed by modern authors.

III. 18. [SIMBLEPHILUS Jurine, 1801] = *Philanthus* Fabr., 1790.

TYPE : *Philanthus* [*pictus* Panzer] = *Philanthus triangulum* Fabr. Genus monotypic.

Following the above, *Simblephilus* is restored to its prior position as an absolute synonym (isogenotypic) with *Philanthus*.

III. 19. MELLINUS Fabr., 1790.

TYPE : [*Vespa*] *arvensis* L. = *Mellinus arvensis* (L.) Fabr. By designation of Curtis (1836 : 580).

From considerations given above Latreille (1802 : 339) cannot be considered as having fixed the type for *Mellinus*. Latreille (1810 : 438) cites two species. Apparently the first valid designation was by Curtis (1836 : 580).

j. [GORYTES Latr., 1804] = [*Hoplisus* Lep. *et* auctt.].= *Ceropales* Latr., 1796.

TYPE : [*Mellinus*] *quinquecinctus* Fabr. = [*Gorytes*] *quinquecinctus* (Fabr.) Latr.= *Ceropales quinquecinctus* (Fabr.) Latr. By original designation.*

Gorytes, *Hoplisus* and *Ceropales* are isogenotypic.

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the same, as *pictus*, first mentioned by Latreille, is a synonym of *triangulum*.

* I have not seen the description of this genus, and give this designation on the authority of Morice and Durrant.

k. [HOPLISUS Lep., 1832] = [*Gorytes* Latr.] = *Ceropales* Latr., 1796.

TYPE: [*Mellinus*] *quinquecinctus* Fabr. = [*Hoplisus*] *quinquecinctus* (Fabr.) Lep. = [*Gorytes*] *quinquecinctus* (Fabr.) Latr. = *Ceropales quinquecinctus* (Fabr.) Latr. By designation of Westwood (1840 : 80).

III. 20. ARPACTUS Jurine, 1801 = [*Gorytes s.s.* auctt., *nec* Latr.].

TYPE: [*Sphex*] *mystacea* L. = *Arpactus mystaceus* (L.) Jur.

Arpactus was founded by Jurine (1801 : 164) with mention of two species, "*Mellinus mystaceus, quinquecinctus*," without selection of either as type. The subsequent designation of *quinquecinctus* as type of *Gorytes* by Latreille (1804) *ipso facto* established *mystaceus* as the type of *Arpactus*.* This leaves it necessary to use *Arpactus* to replace the common usage of *Gorytes s.s.*

l. AGRAPTUS Wesmael, 1852 = [*Arpactus* auctt. *nec* Jurine].

TYPE: [*Sphex*] *concinna* Rossi = *Agraptus concinnus* (Rossi) Wesm. Genus monobasic.

The facts above outlined may be compared, as a matter of convenience, as follows, assuming that the groups are best entitled to subgeneric rank.

m. CEROPALES Latreille, 1796, *nec* auctt. = [*Gorytes* Latr., 1804] = [*Hoplisus* Lep. *et* auctt.].

TYPE: [*Mellinus*] *quinquecinctus* Fabr. = *Ceropales quinquecinctus* (Fabr.) Latr.

Ceropales, proposed in 1796 and described without included species, is valid from that date, and the type species must be selected from those first included in it by a subsequent author.† The first inclusion of species in *Ceropales* was by Latreille (1802: 340), "*Mellinus 5-cinctus; campestris* ? F."

* Opinion 6 of the International Commission on Zoological Nomenclature: "When a later author divides the genus A, species A b and A c, leaving genus A, only species A b, and genus C monotypic with species C c, the second author is to be construed as having fixed the type of the genus A."

† Opinion 46 of the International Commission on Zoological Nomenclature.

Genus **Ceropales** Jurine, 1801.

Subgenus **Arpactus** Jurine, 1801, type *mystacea* = [*Gorytes* in the sense of recent authors].
Subgenus **Ceropales** Latreille, 1804, type *quinquecinctus* = [*Hoplisus* in the sense of recent authors].
Subgenus **Agraptus** Wesmael, 1852, type *concinnus* = [*Arpactus* in the sense of recent authors].

Whether these be reckoned as genera, subgenera or identical groups is a question of taxonomy, not of nomenclature, and is open to debate.

n. HYPSICERAEUS Morice and Durrant, 1914 = [*Ceropales* Latr., 1804, *nec* Latr., 1796].

TYPE : [*Evania*] *maculata* Fabr. = [*Ceropales*] *maculata* (Fabr.) Latr. = *Hypsiceraeus maculata* (Fabr.) M. and D. By original designation.

III. 21. ALYSSON Jurine, 1801 [= *Alyson* auctorum].

TYPE : [*Pompilus*] *spinosus* Panzer = *Alysson spinosus* (Panzer). By designation of Morice and Durrant (1914 : 406).

o. [ALYSON Jurine, 1807] = *Alysson* Jurine, 1801.

TYPE : *Alysson spinosus* (Panzer) Jurine. Genus monobasic.

Alysson Jurine, 1801, and *Alyson* Jurine, 1807, must be considered as potentially different genera.* With this in mind the determination of the types becomes a simple matter, and allows us to retain the names in their long-accustomed sense, substituting *Alysson* for *Alyson*.

Were we to look upon *Alysson* and *Alyson* as being only one name and therefore attempt to determine the type on the basis of the three species originally included in *Alysson* and of subsequent attempts at type designation for *Alyson*, the matter would become much more complex, and I must confess that I would feel at a loss to solve certain questions which would arise, but which need not be detailed. It is enough to point out that the method employed, under this premise, by Morice and Durrant does not suffice,

* International Code of Zoological Nomenclature, Art. 36, Recommendations.

since it is again an elimination method, and not within the provisions of Article 30 of the International Code.

III. 22. NYSSON Latr., 1796.

TYPE: [*Mellinus*] *tricinctus* Fabr. = [*Crabro*] *spinosus* Fabr. = *Nysson spinosus* (Fabr.) Jurine. By designation of Latreille (1810 : 438).

This is as given by Morice and Durrant. The genus must date, however, from 1796.*

It is to be hoped that authors will agree to the suggestion of Morice and Durrant that the form "*Nysso*" was a misprint, and continue to use the spelling "*Nysson*" as Latreille himself subsequently spelled it.

p. PALARUS Latreille, 1802.

TYPE: [*Tiphia flavipes* Fabr., 1793 = *Palarus rufipes* Latr., 1811] (not *Crabro flavipes* Fabr., 1781 = *Palarus flavipes* [Fabr.] Latr.) = [*Tiphia*] *variegata* Fabr., 1781 = *Palarus variegata* (Fabr.) Turner, 1909. Genus monobasic.

Morice and Durrant seem to have overlooked the fact that Latreille (1802 : 336), instead of describing *Palarus* without exponent, erected it to receive "La tiphie flavipède de Fabricius," the characters of which he discusses at some length, promising to give the generic characters at greater length at a later date. This promise he redeems in the 13th volume (1805 : 296), where he also adds three other species to the genus, and states that *Gonius* of Jurine (a *nomen nudum*) is identical.

I cannot see the reason for suppressing *flavipes* = [*Crabro flavipes* Fabr., 1781] in favour of *auriginosus* Eversmann, 1849. The species *flavipes* was based on *Crabro flavipes* of Fabricius, 1781, and is different from *Tiphia flavipes* of Fabricius, 1793. When the latter was brought into the genus (by Latreille in 1811) its name was properly changed to *rufipes*. What Panzer meant by *flavipes* has nothing to do with the question. Latreille, however, specifically cites *Philanthus flavipes* of Panzer as a synonym of the former, and the species figured by Coquebert of the latter.

Tiphia variegata Fabr. has priority, however, over

* Opinion 46, International Commission on Zoological Nomenclature.

T. flavipes. Schulz, who has examined the types, is authority for their identity.*

III. 27. CRABRO Geoffrey, 1762 (*nec* Fabricius, 1775)= *Cimbex* Oliv.].

Type: *Crabro humeralis* Fourcroy. By present designation.

Geoffroy described *Crabro* for three species, not given uninominal names, but fully described and one of them figured. These three species are: (1) [*Tenthredo*] *lutea* L., (2) *Crabro humeralis* Fourcroy, and (3) [*Tenthredo*] *connata* Schrank, the three known to modern authors under those specific names as species of *Cimbex* Oliv.

Geoffroy's usage was binary but not binominal. It was uninominal for generic names, and these must be accepted under the code.† The type must be chosen from the three included species, which, although uninominal names were not cited, are recognisable, and one of which (*lutea* L.)

* The Reverend Mr. Morice has written me as follows, and I am quite willing to accept the synonymy as he suggests it, as I have no personal knowledge of the species or their types:

"I think, however, that the synonymy as you give it is still not quite right. If Schulz has really seen the types of *Tiphia flavipes* and *Tiphia variegata*, I am puzzled, and think he must have made a mistake.

The following, so far as I can make out, are the facts—

"*Tiphia variegata* Fabricius (Type in British Museum, seen by me)

= *Crabro flavipes* Fabricius.

= *Philanthus flavipes* Panzer (*nec* Fabricius *teste* Latreille).

= *Palarus auriginosus* Eversm.

The only European *Palarus*, commonly known as '*flavipes*' hitherto."

"*Philanthus flavipes* Fabricius (*teste* Latreille) figured by Coquebert

= *Tiphia flavipes* Fabricius.

= *Palarus rufipes* Latreille, 1811.

= *Palarus humeralis* Dufour.

A species of Algeria and Morocco commonly known as '*humeralis*.'"

(F. D. Morice).

According to this synonymy the type of the genus, *Tiphia flavipes*, is the Algerian species *humeralis* auctorum, and apparently the name '*flavipes*' is valid.

† The case is exactly parallel with that of Gronow's Zoophylacii, etc., 1763. Opinion 20 of the International Commission on Zoological Nomenclature is summarised: "Gronow, 1763, is binary, though not consistently binominal. Article 25 demands that an author be binary, and Article 2 demands that generic names be uninominal. Under these articles Gronow's genera are to be accepted as complying with the conditions prescribed by the Code to render a name available under the Code."

was already a described and properly named species.* The type must be selected from among these three. The selections of a type for *Crabro* by Lamarck (1801), Latreille (1810), Curtis (1837), and Westwood (1840) refer to *Crabro* F., 1775, not to *Crabro* Geoffroy, and designate a species not included by Geoffroy. No type seems to have been specified for *Crabro* Geoffroy; and one is therefore here chosen. All three of the original species are congeneric.

The circumstance is a most unfortunate one in that it requires the substitution of the name *Crabro* for the well-known *Cimbex*, both names involving the families with which they are associated. But there seems to be no recourse, as *Crabro* F., which has been accepted by all modern writers, is an absolute homonym of *Crabro* Geoffroy.

I had intended to make *lutea* L. type, but the Rev. Mr. Morice suggests to me that it would be better to select *humeralis*, since that species is known for certain, whereas it is doubtful, according to him, that it can ever be settled whether *lutea* L. was the species now commonly called *lutea* or merely the yellow bodied form (♀) of what we know as *femorata*. The suggestion is a happy one and I am glad to accept it.

q. THYREOPUS Lep. = [*Crabro* F., 1775, *nec* Geoffr., 1762].

Type : [*Vespa*] *cribraria* L. = *Thyreopus cribrarius* (L.) Lep. By designation of Westwood (1840 : 80).

This may be considered a subgenus of *Solenius* and is isogenotypic with [*Crabro* Fabr. *nec* Geoffroy].

r. SOLENIUS St. F. and Br., 1834 = *Solenius auctt.* + *Crabro s.s.* of recent authors, *nec* Geoffr.]

Type : [*Sphex*] *vaga* L. = *Solenius vagus* (L.) St. F. and Br. By designation of Westwood (1840 : 80).

Crabro in its modern usage being invalid, it is necessary to decide with what name it shall be replaced. Saint

* Should any one, disagreeing with this, maintain that the genus has the status of genera described without included species, since the three species were not properly named, the end result will be identical, for the first author to include named species which came under the original generic definition (see Opinion 46) was Fourcroy, who in reprinting or re-editing Geoffroy included his three species of *Crabro*, with others, under the names *Crabro maculatus*, *C. humeralis* and *C. lunulatus*.

Fargeau and Brullé (1834) were the first to divide the genus *Crabro* (sense of Fabricius) into several subgenera. The first of these was the restricted genus *Crabro*,* containing *fossorius* (L.) with others. The second was *Solenius* containing *vagus* (L.) and others. Kohl, whose works stand out as the most scholarly that have been produced upon the Sphecoidea, recognises four subgenera and ten species groups of *Crabro*. Of the latter, the last (which he terms *Crabro* Kohl *s. str.*) contains both of the genera *Crabro* and *Solenius* of St. Fargeau and Brullé. In other words, Kohl does not even consider them sufficiently distinct to merit the rank of species group.

While accepting some subgenera of [*Crabro*], my personal judgment is against distinguishing between the group of which *fossorius* may be taken as typical and that having *vagus* as type. I therefore propose to unite them under the subgeneric name *Solenius*. I will leave it to some one whose judgment may differ from mine to do what I am wholly unwilling to do, that is to propose another name for *Crabro* auctorum as distinguished from *Solenius*, if that step must ever be taken.

Rohwer (1916 : 664) has used *Solenius* to replace *Crabro* of recent authors, not *Crabro* in the sense of Fabricius.

s. [CRABRO Fabricius, 1775, *nec* Geoffroy, 1762] = (*Thyreopus* St. Farg. and Brullé, 1834) with status of a subgenus of *Solenius*.

Type : [*Vespa*] *cribraria* L. = [*Crabro*] *cribrarius* (L.) Fabr. = *Thyreopus cribrarius* (L.) St. Farg. and Br. = *Solenius* (*Thyreopus*) *cribrarius* (L.).

The Family and Subfamily Names.

The International Code provides (Art. 5) that the name of a family or subfamily is to be changed when the name of its type genus is changed. It, however, is silent upon the nature of the change which is to be effected. Three courses are open : (1) To base the new name upon the changed name of the original type genus. (2) To use as the type genus for the new family name the contained genus

* St. Fargeau and Brullé were incorrect in restricting *Crabro* to the group containing *fossorius*, as the type of *Crabro* Fabricius had already been fixed as *cribraria*, but it is in their sense that the genus *Crabro* has been known to all modern authors.

which has been earliest used as the basis of a plural name, that is for a name of a group higher than genus. (3) To use as genotype the oldest contained genus within the family as limited by the author.* The author cannot too vigorously express his dissension from the school that adheres to the third practice, the acceptance of which will result in a perpetual overturning of family names, with each varying concept of family limits. The second course is advisable if the group in question is left without a type genus. But if the name of the type genus changes without the genus itself going outside of the family group with which it had been previously associated, it would seem the fairest interpretation of the code to make the change in family name correspond, in other words to change not the type genus, but its name only. The genus name *Crabro* Fabr. *nec* Geoffroy changing to *Thyreopus*, *Thyreopus* remains as much type of the family as when it was called *Crabro*.†

Family THYREOPIDAE = [*Crabronidae* auctores].

Subfamily *Thyreopinae* = { *Crabroninae*, *Lindeniinae*, *Thyreopinae*, *Rhopalinae* } sense of Ashmead.

Genus **Thyreopus.** Type: *cribraria* = *Thyreopus* auctorum = [*Crabro* Fabr.].

,, **Solenius.** Type: *vagus* = [*Crabro* auctorum] united with *Solenius* auctorum.

and others.

Family CRABRONIDAE = [*Cimbicidae* auctorum].

Genus **Crabro** Geoffr. Type *humeralis* = [*Cimbex* auctorum].

* Applied to the present case this third method would fix upon *Rhopalum* as type genus, with *Rhopalinae* and *Rhopalidae* in consequence.

† The case would be quite different if *Crabro* had not been a homonym, but had been wrongly applied to the group that we have known as *Crabronidae*. In other words, if the type species of *Crabro* Fabr. were a sawfly instead of a Sphegid. In that case the *family* and its name would not theoretically change, but simply be applied in its true sense, as a group of sawflies and its formerly incorrectly associated Sphegid members would be removed from it. The latter would be left without a type genus.

t. PEMPHREDON Latr., 1796 = [*Cemonus* Jurine, 1801].

TYPE: [*Crabro*] *lugubris* Fabr. = [*Sphex* (*Crabro*) *unicolor* Panzer, 1798] = *Pemphredon lugubris* (Fabr.) = [*Cemonus unicolor* Panzer, 1806].

The synonymy I accept on the authority of Morice and Durrant, but Opinion 46 of the International Commission makes it necessary to reverse them in regard to which name, *Pemphredon* or *Cemonus*, has priority.

III. 29. OXYBELUS Latr., 1796.

The conclusions concerning *Oxybelus* need no change, except that it must be ascribed to Latreille and date from 1796.*

III. 32. ANDRENA Fabr., 1775.

TYPE: [*Apis*] *cineraria* L. = *Andrena cineraria* (L.) Latr. By designation of Latreille (1810 : 332).

Unless Lamarck (1801) is accepted as designating genotypes † *cineraria* and not *succincta* must be the type of *Andrena*. This is satisfactory, since it involves no change and *succincta* is a dubious species.

Colletes Latreille may be a synonym. Its type, the only originally included species, is *succincta* L., which, as Morice and Durrant point out, is probably congeneric with *cineraria*, but may not be. According to Opinion 65 of the International Commission on Zoological Nomenclature these authors are not warranted in making *Colletes glutinans* Cuv. type of *Colletes* on the basis that Latreille misdetermined *succincta* L., unless the special case is brought before the Commission and action to that effect taken.

III. 33. LASIUS Jur. = [*Anthophora* auctt.].

The discussion of *Lasius* and the genera involved with it has been taken up since Morice and Durrant (1914 : 421–423) by Forel (1916 : 460), Mayr (1916 : 53–56), Wheeler (1916 : 168–173), and again by Morice and Durrant (1916 : 440–442). I have nothing further to add to this discussion. Morice and Durrant (1914 : 421–423) seem to be correct in considering *Lasius* Fabr., 1804, a homonym of *Lasius* Jurine, 1801, and that the latter is *Anthophora* auctt.

* Opinion 46 of the International Commission on Zoological Nomenclature.

† See the previous discussion of this paper on page 52.

III. 38. MUTILLA L., 1758.

TYPE: *Mutilla europaea* L. By designation of Latreille (1810: 314) and possibly of Lamarck (1801: 268).

Blumenbach's * (1779: 386) citation of *occidentalis* is not to be regarded as type fixation under the code.*

III. 40. CYNIPS L., 1758 = [*Diplolepis* Geoffrey, 1802] = [*Rhodites* Hartig, 1840].

TYPE: [*Diplolepis bedeguaris* Fab.] = *Cynips rosae* L. By designation of Latreille (1810: 436).

If it is decided that Lamarck (1801) is to be accepted as establishing genotypes,† then the conclusions of Morice and Durrant, rather than those given here, are correct. In that case *Cynips* will replace *Dryophanta* Foerster, or *Diplolepis* Geoffroy as incorrectly used by Kieffer in Das Tierreich.

Multinominal specific names are used by Geoffroy (1802: 310, 311) in connection with the six species that he originally placed in *Diplolepis*. The first of these he definitely fixes by citing as a synonym *Ichneumon bedeguaris*. Since the other five have no definite status given them, the case is the same as though the genus had been established upon a single species, *bedeguaris*, which is therefore type.

u. [CYNIPS *auctt.*]

Whether Morice and Durrant or my own conclusions are correct concerning *Cynips*, that genus as employed by Kieffer in "Das Tierreich" and by other modern authors is left without a name.

III. 48. PSILUS Jurine, 1801 = [*Bethylus* auctorum].

TYPE: [*Tiphia*] *cenoptera* Panz. = *Psilus cenoptera* (Panz.) Jurine. Monobasic.

v. BETHYLUS Latr., 1802 = [*Dryinus* Latr. and auctt. ?].

TYPE: [*Tiphia*] *hemiptera* Fabr. = *Bethylus hemipterus* (Fabr.) Latr. Genus monobasic.

Tiphia hemiptera Fabr. is not a recognizable species at present. Dalle Torre lists it as a *Dryinus*, but Kieffer in the "Genera Insectorum" refers it with a doubt to *Bethylus*

* See discussion of this paper on page 52.
† See previous discussion on page 52.

auctorum. If it ever proves to be congeneric with *formicarius*, *Bethylus* will have to replace *Dryinus*. At present the name, and with it the family name *Bethylidae*, had better be suppressed.

w. DRYINUS Latr., 1805. = *Bethylus* Latr., 1802?

TYPE: *Dryinus formicarius* Latr. Genus Monobasic.

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III. *A Migration of Yellow Butterflies* (Catopsilia statira) *in Trinidad*. By C. B. Williams, M.A., F.E.S.

[Read March 5th, 1919.]

Plates VI–X.

Introduction.

In a recent number of the Transactions of the Entomological Society (1917, p. 154) I described several migrations of yellow butterflies in British Guiana, most of the records relating to *Callidryas eubule.* In October of this year I have been again fortunate enough to witness a migration of butterflies of a different species, this time in the Island of Trinidad, and on a scale larger than anything I had previously seen. The migration lasted more or less continually for nearly three weeks, and many millions of butterflies must have passed over the western half of the Island, to which district most of my records refer. With the kind assistance of a number of friends and correspondents I was able to collect over two hundred separate records of the one migration, and the results of these are given below.

Even with this large number of records, no claim can be made to completeness, and data are sadly lacking for the eastern half of the Island, which is thinly populated.

Description of Locality.

Trinidad is an Island situated just north of the mouth of the Orinoco River, and is about fifty miles in a north to south direction, and about seventy miles in extreme width. At both the north-western and south-western corners a long promontory runs out towards the mainland of Venezuela. The north-western corner is about fifteen miles from Venezuela, but the gap is partly bridged by a series of islands, and the greatest open sea space is about eight miles. At the south-western corner the distance to the mainland is only about seven miles.

Three ranges of hills run from east to west across the Island, that along the northern coast rising in places to over three thousand feet above sea-level; the central and southern ranges, however, are much lower, seldom rising above a few hundred feet. There is no accurate map of the contours of the Island, but the first small map on Fig. I shows approximately the positions of these three ranges.

The climate of the Island is tropical, average day temperature above 80°, and the year is divided into one wet and one dry season. In general the dry season lasts from the middle of January to the middle of May, and the wet season from June to December.

The average yearly rainfall is about 65 inches, of which August averages 9·8 inches and September 7·2 inches. There is occasionally a spell of dry weather about September, forming what is known as the "Indian summer," and it should be noted that in the present year (1918) this has been particularly well marked. During the six weeks previous to the migration to be described below the weather had been unusually dry, many localities recording less than three inches for September, and in the extreme south-west scarcely any rain fell for six weeks.

The prevailing wind is the east or north-easterly trade wind.

Methods of Recording.

It has been thought unnecessary to give in detail the numerous records which were collected. Instead they have been transferred to the accompanying series of maps by a system of arrows, crosses, and circles representing, respectively, movements, abundance, or absence of the butterflies.

By referring to the maps for the 19th September to the 12th October the course of the migration day by day can be easily followed. On the larger map (Pl. X) all the records have been combined, and in addition two or three added which do not appear on the first series; these being records in which the locality and direction was given but the exact date could not be ascertained.

The signs used on the maps are as follows:—

(1) *Arrow with one head*: Very slight migration, one or two per minute within sight of the observer. Only noticeable with special care. Probably not recorded except by skilled observer.

(2) *Arrow with two heads*: Three or four butterflies per minute passing across one hundred yards line; easily noticeable to a skilled observer, and probably seen by any

average person who is on the look out; most obvious in large open spaces.

(3) *Arrow with three heads*: Distinct migration anything from ten to two or three hundred per minute crossing a hundred yards line—obvious to any ordinary person. Probably recorded by a naturalist.

(4) *Arrow with four heads*: Thick clouds of butterflies—thousands in a small space—"several with one sweep of the net"—"like snow storm"—"motor-cars held up"—gets into the local newspapers.

(5) *The series of crosses* with one, two, three and four bars represents the same scale of abundance as the arrows, but denotes that the insects were at rest or fluttering round and not moving regularly in one direction.

(6) *The circle* indicates that no butterflies were seen either moving or at rest by a reliable observer.

(7) *Circle with enclosed cross* indicates that the butterflies, if present, were not in sufficient numbers to attract attention. They are used chiefly in the case of non-entomological correspondents reporting that nothing unusual was happening in their district.

It must be absolutely understood that the blank on the maps does *not* indicate an absence of butterflies, but merely an absence of records.

These signs have been found so convenient in the present case that it is hoped that future observers will adopt some similar method of expressing their results.

The Migration.

Following the series of maps on Plates VI–IX the course of migration will be seen as follows:—

At the end of August the butterflies were reported in large numbers settling on the roads in the south-eastern part of the Island. Between this date and the third week in September no records were obtained except that on the 10th September a correspondent drove through part of the district and saw nothing unusual.

On the 19th and 20th September they are reported in numbers at rest and fluttering round in the north-eastern district, and the following day they are again abundant in the south-east (when a few were doubtfully moving northward). They had on this day started to move across the northern half of the Island at the southern edge of the northern range.

By the 22nd September the migration across the northern district had begun in earnest, and in one locality a motor-car had to stop and put down its side curtains owing to the enormous numbers of butterflies which interfered with the view of the driver.

On the 23rd they were reported in smaller numbers from the same district, and on the 24th they had reached the eastern coast in small numbers at Port of Spain (see Plate X for localities).

The movement continued in increasing intensity past Port of Spain, and on the 27th September had become a striking phenomenon. On this day they were crossing the open Savannah in Port of Spain about mid-day at a density of up to two or three hundred per minute across a distance of one hundred yards. On the same day and on the following they were seen crossing the sea over the Island of Patos near the Venezuelan coast, and undoubtedly were reaching the mainland of Venezuela.

The 28th and 29th September were marked by rains in the northern district, and the migration fell off suddenly and became apparently much confused. On both these days a few were recorded in the fine intervals, flying in an opposite direction (eastward), but not in any large numbers, and from the 30th to the 4th October small numbers were seen flying in various directions chiefly west or south-west. Between the 5th and 7th none were recorded, on the 8th, 9th, and 10th a few were recorded flying in a southerly direction, and on the 12th October a number were seen flying over the sea in a south-westerly direction. Attention should also be drawn to the offshoot migration, in a southerly direction, from the main stream just east of Port of Spain from the 27th September to 1st October. On the first of these days they were reported as appearing suddenly in unprecedented numbers in the cocoa groves a little to the south of this.

While this migration was passing across the northern half of the Island, chiefly at the southern edge of the northern range of hills, a similar stream was also moving across the southern district in the same direction. There is, however, no record of movement here until the 26th September, which is four days after the start of the migration in the north. Migrating butterflies were recorded in great numbers, particularly in the western half of the south coast, at Palo-Seco and Erin, and in a few days the flight had become general across the south-eastern district of the Island, reaching its height in the San Fernando district about the 30th September, and continuing in gradually reduced numbers until the 4th October, and in a few localities as late as the 12th October. The most remarkable feature of this southern flight was that in the Cedros district, which is on the northern edge of the south-western promontory near its end (see Plate X); the butterflies were flying continually and in large numbers towards the east approximately from the 26th September to the 2nd October, while at La Brea a little further north-east few were seen until the 4th October, when they were flying in numbers in the usual westerly direction.

Unfortunately there are no records for the sea passage between Trinidad and Venezuela at this point, and it is impossible to say if the butterflies went across here, as in the north, or not; but from the available facts it would appear that part, at least, on reaching the south-western extremity turned to the north and then eastwards along the coast. On the 1st of October they were seen flying in small numbers in a north-westerly direction across the sea north of this coast. These records although puzzling and contradictory are confirmed by several observers, and also by a record of a previous migration in the same district, when the butterflies flew in an easterly direction for several days (see later). During the whole period of these migrations across the northern and southern parts of the Island the east-central portion was quite free of any unusual flights.

Species Represented.

It has been mentioned above that the butterfly which was mainly responsible for this migration was not *Callidryas eubule*, which has many times been recorded as migrating, but *Catopsilia statira*, a less-known species differing from the former in that the basal portion of the wings of the male are of a more intense yellow than the outer portion.

This butterfly is, as a rule, not so common in Trinidad as *Callidryas eubule*, and Sir Norman Lamont, to whom I am indebted for the identification, had previously only taken it on a few occasions in the southern part of the Island. W. J. Kaye in his Catalogue of the Lepidoptera Rhopalocera of Trinidad (Trans. Ent. Soc. 1904, p. 205) says that it is locally very common but not general. W. Potter, a young local naturalist, says that he sees it nearly every year, and has already seen it migrating (see below). Kaye (*l.c.*) gives the known distribution as Guiana, Brazil, Peru, Ecuador, Columbia, Panama, St. Lucia. The species has previously been recorded as migrating in Brazil by Goeldi (first printed in German in "Die Schweiz "(Zurich), 1900, vol. iv, p. 441–445, reprinted in Portuguese (? with additions) in Boletin do Museu Goeldi (Para-Brazil), iv, Dec. 1904, p. 309–316, Fig. I, II), and also by Bates and Spruce (quoted in above). My notes below are taken from the Portuguese edition of Goeldi's paper.

Catopsilia statira formed, with only occasional exceptions, the whole of the migrating bands of butterflies on the present migration. At Port of Spain, on the 27th September, I noticed that about 1 in 100 or less were a smaller whitish species, of which, however, no specimens were caught. Near Arima (further east) on the same day J. B. Rorer records that about 1 in 40 were *Callidryas philea*, a larger orange species. On the 24th September in the Caura valley in the northern range C. M. Roach records that about "1 in 40 were a larger orange species" (probably also *Callidryas philea*). At Port of Spain Mr. T. I. Potter caught one *Callidryas eubule* among many *Catopsilia statira*, but it is possible that this was fluttering round flowers and not taking part in the general migration.

Origin and Destination of Flight.

Unless the butterflies came over to the eastern or south-eastern coast of Trinidad from Venezuela (a possible occurrence, of which, however, we have no proof owing to the absence of records from this coast), it seems likely that the swarms originated in the forests of the south-eastern and north-eastern districts of the Island.

It will be noted that they were reported as abundant in the south-eastern district as early as the end of August, and it is just possible that the flight at the end of September consisted of the progeny of these. I have no data for the life-history of *Catopsilia statira*, but according to Mr. W. Buthn *Callidryas eubule*, which is closely related, has a larval stage of ten days and a pupal stage of seven, so that a complete cycle could no doubt be passed through in a month.

A slight confirmation of this is that the specimens captured were all in very good condition as if comparatively newly emerged. But as nothing is known as to the length of adult life, or of the egg-stage, or of the time taken for a specimen to become worn, this must be taken as a possible suggestion and not as a proved occurrence.

At the other end of their flight we have definite proof of their passage over to Venezuela via Patos on the north-west, and there can be little doubt that they also crossed at the south-western corner, where only a few miles separate the Island from the mainland. We have here, however, the confusing records of easterly flights at Cedros already referred to, but in view of the million of butterflies which passed, and of the fact that there was no general abundance of them a week or two afterwards, it is certain that the greater number must have left the Island.

There were in all seven records of flight over the sea. One on the extreme north coast, where a few were flying about a hundred yards from the shore and parallel to the coast (25. ix); one record off the north coast of the south-western promontory (1. x.), and the remainder between the north-western promontory and Venezuela on various dates.

It might perhaps be mentioned here that a resident of Patos Island reported that he had seen butterflies flying towards Trinidad, but I cannot place too much reliance on this record. It has been added to Plate X, with a query.

Speed of Flight.

The flight of butterflies on migration is always very distinct from that of those flying casually. The most noticeable characteristics are the speed and the fixity of direction. In a previous account of migration of *Callidryas eubule* in British Guiana (*l.c.*, p. 159) I estimated the rate as from twelve to sixteen miles per hour (across the wind). Several correspondents in the present case remark on the speed of flight being quite unprecedented. Fortunately an opportunity occurred to get accurate data. At Port of Spain on the 27th September the butterflies happened to be flying directly down a foot-ball field on the Savannah, the length of which was found to be 110 yards. With a stop-watch eleven butterflies were timed from one end of the field to the other by three different observers (including myself) and the following results were obtained: 12, 14, 13, 12, 13, 13, 13, 12, 14, 14, 15 seconds. This gives an average of 13·2 seconds, or 17 miles an hour.

At this rate, and in the direction they were flying, they could have reached the mainland of Venezuela two hours after leaving Port of Spain.

Relation of Flight to Wind.

It is natural that the result just obtained would be affected by the strength of the wind (at this particular time they were flying with a light wind), and it is also necessary to take into consideration the relation between the direction of the wind and that of the migration.

Wind records are kept at Port of Spain, but unfortunately the records for the 27th of September, the day the butterflies were timed, were sent away before I could obtain them. The average wind velocity at Port of Spain between 9 a.m. and 4 p.m. from the 1st to 7th October was 8 miles per hour, and as my notes record that the wind at that time was slight it was probably below this figure.

The prevailing wind in Trinidad is from the east, and as this migration was towards the west it might be thought that the wind determined the direction. In British Guiana, however, for *Callidryas eubule* it was found that the usual direction was across the wind, and there are enough individual exceptions in the present case to leave no doubt that the direction of the wind, although contributory, is not the determining factor of the direction of flight.

The following cases may be quoted :—

4.x.18. Port of Spain—no wind, flight N.W. (A. Hombersley).

27.ix.18. Guiaco—wind N.E., flight N.W. (J. B. Rorer).

12.x.18. At sea off Gasparee—"endeavouring to fly west, but owing to strong N.W. wind (15–20 m.p.h.) actual course was between S. and S.S.W." (C. P. Milne).

1.x.18. San Fernando—flying N. against the wind (P. Crato).

5.x.18. Macqueripe—"flew seaward and were blown back by the force of the wind" (local newspaper).

Mr. J. A. Bullbrook further points out that the wind cannot be the conclusive factor in the direction of flight, as when flying in hilly country they continue in the same direction down the shaded leeward side of a hill as they were flying when ascending the windward side, and that on both sides they keep about the same distance from the tops of the trees.

I can from my own observation confirm this interesting note.

Direction and Reversal of Flight.

E. Goeldi, in his account of the butterfly migration in Brazil (Bol., p. 313) comments on the contradictory reports of the direction of flight in various previous accounts of migration, and states that he has discovered the solution, which is that there is a reversal of direction during the day. In the case he describes the butterflies were flying along a branch of the River Amazon from north to south during the morning and from south to north during the afternoon, the reversal being quite regular each day. There is no reason to doubt for a moment his observations, and I have noticed a somewhat similar occurrence in the migration of a Hesperid butterfly in Panama, which I hope to describe later, but in the migration of *Catopsilia statira* at present under consideration there is no evidence to prove that this was happening.

It must be admitted that throughout the migration there were heavy rains nearly every afternoon, and usually the migration for the day ceased when these began, but on the few fine afternoons, and occasionally after the rains, the direction of flight when recorded was nearly always similar to the regular direction of the morning.

The flight for the day usually started at 9.30 a.m. or even a little later, but I have several records as early as 8 a.m. and in two cases at 7 a.m. There is slight evidence of change of direction one day at San Fernando (1.x.), when the flight was towards the north-west in the morning and towards the south-west in the afternoon after the rains, but this could scarcely be classed as a reversal of direction. On the other hand, the flights from west to east that are recorded from Port of Spain district on the 28th, 29th, 30th September, and 2nd and 3rd October, do not appear to have been in any way connected with the time of day.

In cases where the migration is very thin and the butterflies are only passing at intervals, the direction of flight of one butterfly is not likely to influence directly that of another. But when the flight is more dense this may happen, and the following observation may be of interest in this connection.

On the 27th September the butterflies were passing at the rate of 50 to 100 per minute across a hundred yards line over the Savannah in Port of Spain about 1 p.m. I went out with a net in order to catch specimens for the determination of the species and the sex proportions. The butterflies were flying so fast that they were not easy to catch, and many more escaped than were captured. I then noticed that any butterfly narrowly missed was put off its direction by the excitement and flew off wildly in any direction. Other butterflies close at hand meeting this butterfly flying out of the general order would in turn become confused and sometimes follow it in its new direction. So that after several misses in succession I was surrounded by a number of butterflies flying in all directions. If I stopped attempting to catch specimens these would gradually pass away, and the regular direction of flight would be resumed.

Proportion of Sexes.

The following actual figures were obtained for catches :—

Port of Spain, end of Sept.	5 females,	1 male	(T. I. Potter).
Port of Spain, 27th Sept. .	9 ,,	10 males	(C. B. W.).
Palmisti (S. of San F'do), 30th Sept. . .	5 ,,	4 ,,	(Norman Lamont).
La Brea, 4th Oct. . .	6 ,,	4 ,,	(Dr. Rodriguez).

From these it might be supposed that the sexes were in more or less equal proportions, but I am not convinced that this was so in the actual flights. All the above records suffer from the fact that the females are much more easy to catch than the males, and in addition, in certain cases, I believe the specimens were caught not actually on migration, but stopping to flutter around flowers on the way. It is quite likely that this habit would be found more in the females, with eggs to mature, than in the males.

At the time I collected the nineteen specimens mentioned above I found that I could, with difficulty, distinguish the females from the males in flight, and estimated the proportion as approximately 1 female to 10 males.

Density of Migration and Effects of Sunshine.

It will be seen from the records in the maps that the numbers passing varied from two or three occasional specimens to a cloud so dense as to interfere with the progress of a motor-car. Perhaps an even better idea of their occasional abundance is obtained from one record in which they were stated to be passing over a house in the country in such immense numbers that the turkeys in the garden looked up at them and gobbled in consternation !

More usual than this was an open order in which the butterflies hurried past, each individual more or less equally separated from its neighbours, some close to the ground, some as high as twenty feet, but by far the greater number at from 4 to 10 feet from the ground or other surface (sea, or tree-tops) over which they were flying.

The flight was almost always in bright sunshine, and whenever a cloud passed over the sun there was an immediate drop in the numbers passing. As the butterflies were not flying at the same speed as the cloud shadows, flying faster than the wind when with it, and often across it or against it, it is difficult to understand the rapid reduction. The same effect was noticed in the case of *Callidryas eubule* in British Guiana.

It is possible that in the absence of the sun the individuals fly more slowly or flutter round waiting for the sun to reappear, so that fewer would cross a given line in the same time. If this were so, there should be a rush of those individuals held up, on the return of the sun. No detailed observations were made on this point at the time, but I do not recollect any effect of this type.

Food-Plants.

The food-plant of *Catopsilia statira* is not definitely known in Trinidad. It is almost certainly some forest leguminous tree, and W. Potter says that he believes it to be a species of *Cassia* or *Mimosa*. Goeldi (*l.c.*, p. 315) describes a forest tree, *Vouapa acaciaefolia*, Baillon, or *Macrolobium acaciaefolium*, Bentham, as a possible food-plant in Brazil, as he had observed numerous butterflies leaving the general migration and fluttering round this tree (see below).

While on migration the majority of the butterflies do not stop to visit flowers which they pass on the way, but occasional individuals (mostly females) may do so, and between the movements they are abundant flying round the flowers of *Hibiscus*, Pommearack (*Eugenia malaccensis*), *Eupatorium odoratum*, Black sage (*Lantana* sp.), Guimauve or Wild Ochroe (*Malacra capitata*), and many others.

Resting in Patches on the Ground.

As in many previously recorded migrations the adult butterflies, when not migrating, were frequently found resting in large patches on the roads. Most of the records from the south-eastern portion of the island are of such patches disturbed by passing cars. The groups may contain from a hundred or less to several thousand individuals, and are described in some records as appearing in the distance like large patches of yellow-green grass.

The butterflies are sometimes congregated round moist patches on the road, but in other cases the spots they have chosen do not appear on casual observation to differ in any way from the rest of the road. It may be that it is only the gregarious habit of the butterfly that has led them to congregate, but it is more likely that the patches chosen are where urine from animals passing along the road has recently dried up, and that the butterflies are obtaining some kind of nutriment from the dried salts (in this connection see discussion in Proc. Ent. Soc. London, 1917, p. lxxvii).

Previous Migrations of Yellow Butterflies in Trinidad.

It might be convenient to add here for completeness a few records I have obtained of previous migrations in Trinidad. It must be noted that in these cases no specimens are available for comparison, so that it cannot be said for certain whether the species was *Catopsilia statira* or *Callidryas eubule*.

(1) Mr. Guy Gray, living at Matura on the east coast, adds to his records of the present migration—" I have seen these butterflies, I think, every year, but not at the same time."

(2) Walter Potter states that *Catopsilia statira* swarms nearly every year somewhere in the Island.

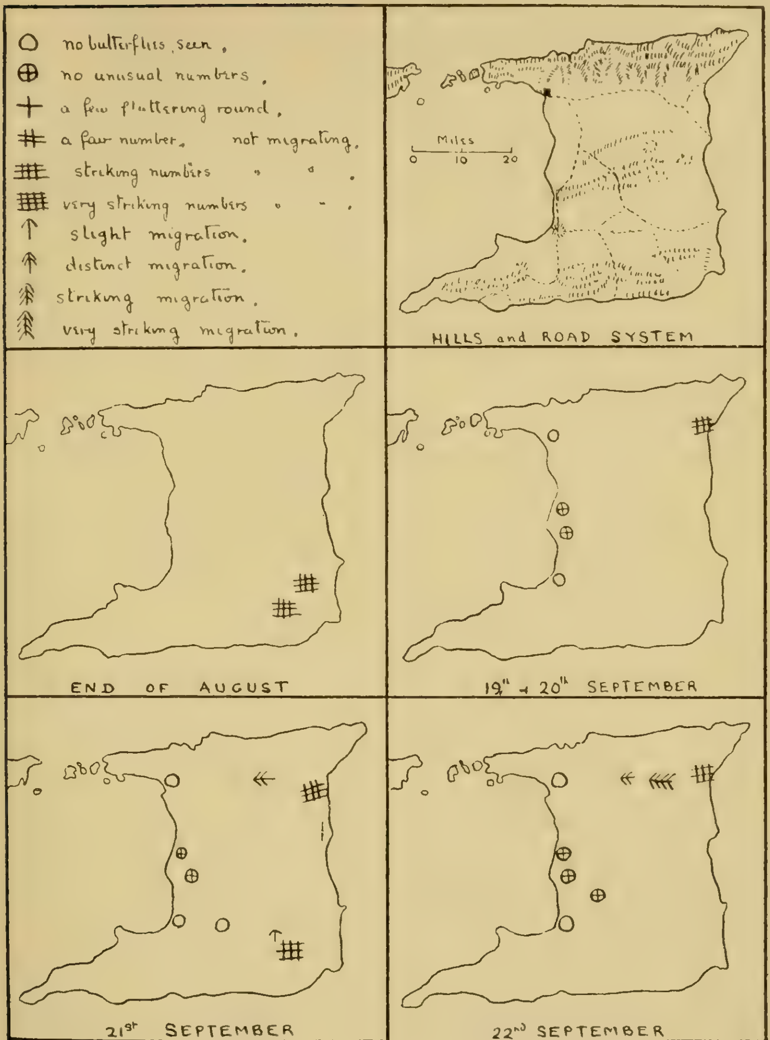
(3) Cecil Rostant of Moruga (south coast) in reply to an inquiry for information on the present migration replied that they were flying " in the usual direction." Later he explained that this was from east to west, and that they flew in this direction nearly every year in his district.

(4) W. Buthn of the Department of Agriculture states that he saw small numbers of yellow butterflies flying towards the east in Port of Spain in 1916 about August.

(5) Mr. T. I. Potter reports a large swarm of probably *Catopsilia statira* flying over the Savannah in Port of Spain in 1915 from east to west. They were not so common as the present (1918) migration, nor did they last so long.

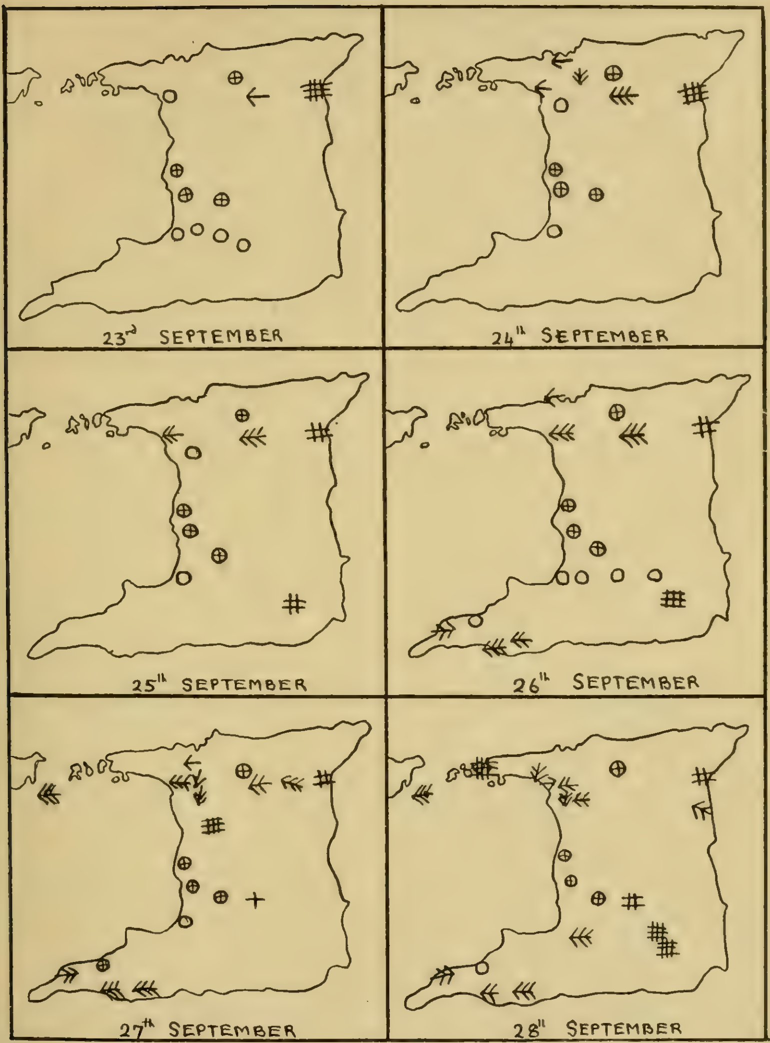
(6) Mr. Roebottom reports that at Cedros (south-western promontory) in 1916 yellow butterflies were flying towards the east for about four days in large numbers. He is not sure of the month, but thinks that it was towards the end of the dry season (April or May) as the local explanation of the flight was that the butterflies were looking for water.

Note.—Since the above was written Mr. W. Potter tells me that he has seen *Catopsilia statira* ovipositing on the leaves of " Bois Mulàtre " (*Pentaclethra filamentosa*), which is a common leguminous forest tree in Trinidad.



C. B. Williams, del. Sun Engraving Co., Ltd.

A MIGRATION OF *CATOPSILIA STATIRA* IN TRINIDAD.



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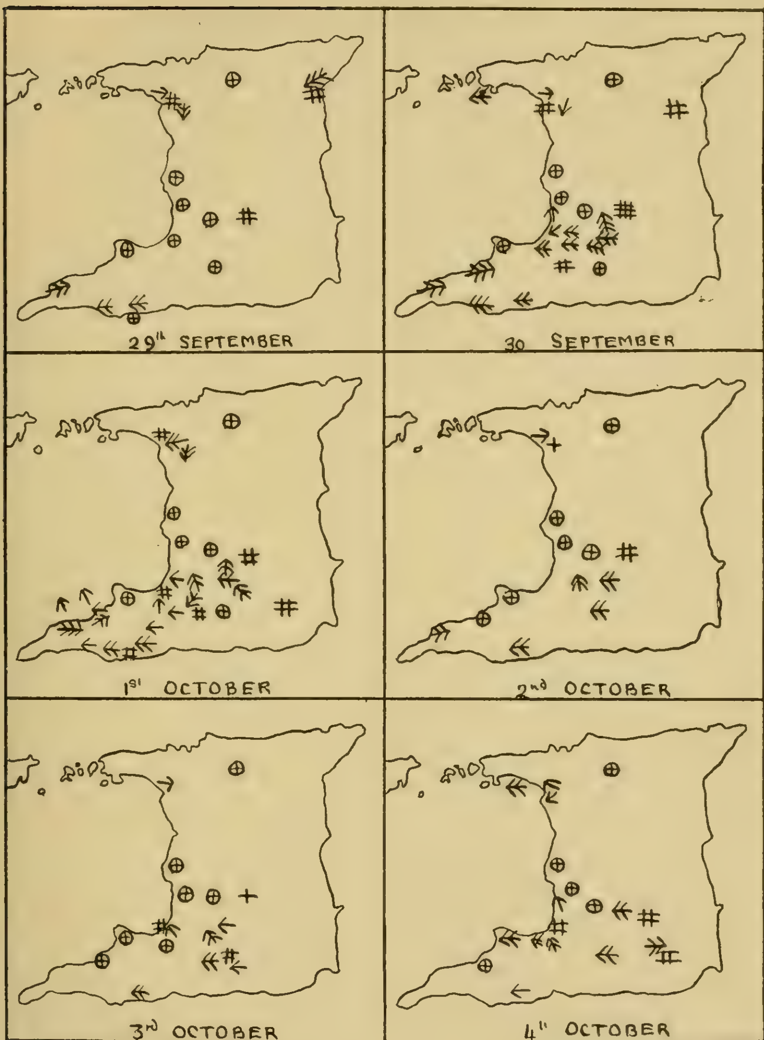
A MIGRATION OF *CATOPSILIA STATIRA* IN TRINIDAD.



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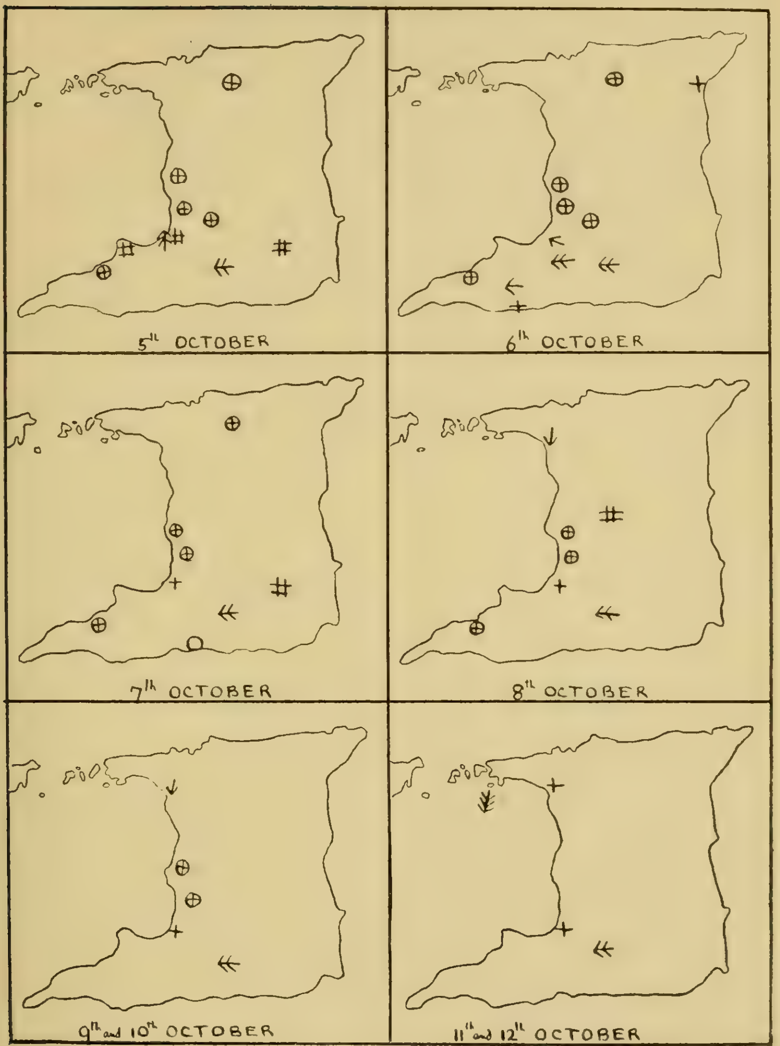
A MIGRATION OF *CATOPSILIA STATIRA* IN TRINIDAD.



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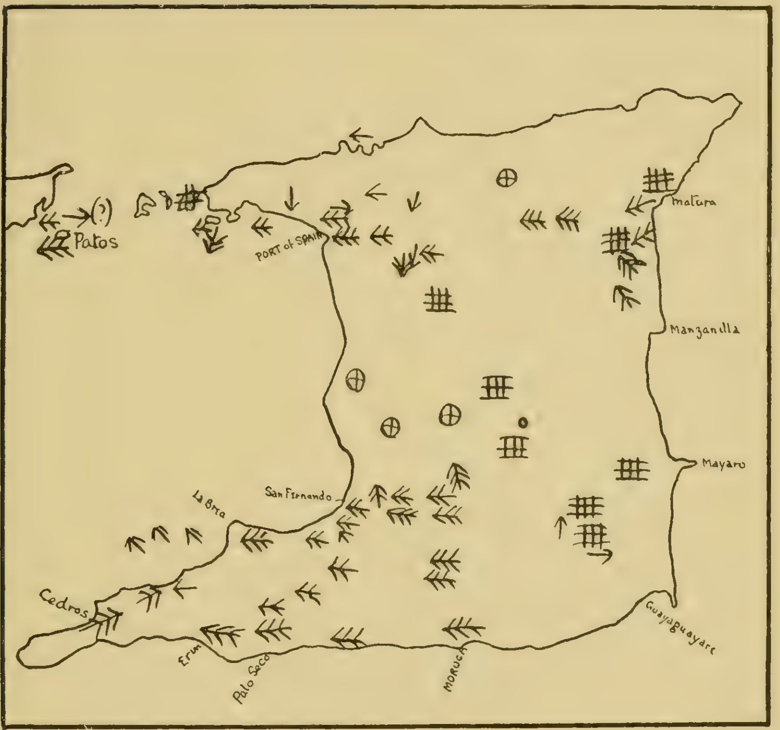
A MIGRATION OF *CATOPSILIA STATIRA* IN TRINIDAD.



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A MIGRATION OF *CATOPSILIA STATIRA* IN TRINIDAD.

IV. *Note on Bonelli's "Tableau Synoptique."* By H. E. Andrewes.

[Read March 5, 1919.]

In 1810 Bonelli published in the "Mémoires" of the Académie Impériale de Sciences de Turin the first part of his "Observations Entomologiques," the second part following in 1813. Both parts referred exclusively to the family of the Carabidae, and various new genera and species were described. In addition there was a large "Tableau Synoptique," which differentiated the then known genera, and included a number of new ones. Among the latter are many common European genera, and Bonelli has always been credited with the authorship of such as appeared for the first time in the "Tableau."

Desiring to consult this work, I examined at the Natural History Museum the volumes of "Mémoires" of the Turin Academy containing the two parts of the "Observations Entomologiques," but to my surprise was unable to find it. Mr. C. Davies Sherborn of the "Index Animalium," whom I consulted, advised me to examine the other copies of the "Mémoires" to be found in London, viz. a copy at the British Museum (Bloomsbury), and copies in the Libraries of the Royal and Linnaean Societies. The latter I was enabled to see through the courtesy of the respective Librarians, and the former I saw in the Reading Room. None of them contained any trace of the "Tableau." Mr. Sherborn was then kind enough to write to Prof. C. F. Parona of the Royal Academy of Turin, who wrote in reply that the volumes in the Library of the Academy were also without any copy, but that Bonelli's own copy of the "Tableau" was in the Royal Zoological Museum. Count Salvadori, the Director of the Museum, has had the goodness to have a MS. copy prepared, together with a copy of the plate, and its accompanying explanation. These he has sent to Mr. Sherborn, and they are now preserved in vol. xx of the "Mémoires" of the Turin Academy (containing the second part of Bonelli's paper) in the Library of the British Museum (Nat. Hist.) for future reference. We are very much indebted both to

Prof. Parona and Count Salvadori for their very kind help.

On examining various works of reference, I find that E. F. Germar reviewed both parts of Bonelli's paper in the Magazin der Entomologie. In vol. ii, 1817, p. 302, he mentions all the genera, and evidently had before him a copy of the "Tableau." W. Engelmann in Bibliotheca Historico-naturalis, i, 1846, p. 524, mentions Bonelli's work in two parts: "avec un grand tableau et 4 pl." This, however, refers to a separate, and J. V. Carus and W. Engelmann in Bibliotheca Zoologica 1861, p. 479, which refers to the original volume of "Mémoires," mention Bonelli's paper only, without any indication of its being accompanied by "Tableau" or plates. H. A. Hagen in Bibliotheca Entomologica 1862, gives the reference to Bonelli's papers, and adds, "Ich habe die von Engelmann p. 524 citirten 4 Tafeln u. 1 Tableau nicht gesehen."

From the above it seems clear that the "Tableau Synoptique" was never published, but that copies of it were distributed by Bonelli along with the separates of his paper in or about 1813. I have not myself seen an original separate, but, in addition to the copy in the Museum at Turin, there is one in the Library of Mr. T. G. Sloane, in Australia, and no doubt other copies are in existence in Continental Libraries. The four plates mentioned above do not appear to have had any existence, but one plate was produced, though not published, and copies of this were probably distributed by Bonelli along with the "Tableau."

On the "Tableau" itself—or rather the MS. copy—I have but little comment to make. Bonelli puts a star against certain genera, and explains in a note that each of these is "Genus novum aut cujus caracteres elaborantur." There is no star, however, against either *Agonum* or *Anchomenus*, which have hitherto been attributed to Bonelli (in Tabl. Synopt.) and to which I can find no earlier reference. There is also a blank space for an unnamed genus formed for *Carabus impressus*, F.: this would, I suppose, be *Diplochila*, Brullé (= *Rhembus*, Dej., nom. praeocc.), and why Bonelli failed to give it a name I do not know. The genus *Taphria* is attributed to Bonelli both by Agassiz and by Gemminger and Harold (Munich Catalogue), but these attributions are erroneous, the actual author being Dejean (Spec. Gen. iii, 1828, p. 84).

I give below a list of the new genera characterised in the " Tableau," and the names of the authors to whom I think they should in future be attributed. I do not profess, however, to have made an exhaustive search through the literature of the period, and there may prove to be earlier authors for some of them than those I have quoted. Some of these genera are now only synonyms, but the great majority are still in general use. One genus only disappears, viz. *Demetrias*, which should be replaced by *Risophilus*, Leach (" Brewster's Edinburgh Encyclopedia," ix, part 1, 1815, Entomology, p. 81), a genus formed expressly for *Carabus atricapillus*, L. The genus *Laemostenus* (*Laemosthenes*) was quite supplanted by Dejean's *Pristonychus* (Spec. Gen. iii, 1828, p. 43), and I do not at present know of an earlier reference than the one I have given.

I am very much indebted to Mr. C. Davies Sherborn for the interest he has taken in this inquiry, and take this opportunity of thanking him for his assistance.

The genera in question are as under: I give them in alphabetical order.

Abax, Stephens, Ill. Brit. Ent. i, 1827, 67 and 124.
Agonum, Stephens, *l.c.*, 85 and 182.
Amara, Stephens, *l.c.*, 67 and 126.
Anchomenus, Stephens, *l.c.*, 67 and 81.
Aptinus, Latr. and Dejean, Hist. Nat. and Iconogr. des Col. d'Europe, 1822, 97.
Blethisa, Dejean, Spec. Gen. des Col. ii, 1826, 265.
Calathus, Stephens, *l.c.*, 67 and 97.
Callistus, Dejean, *l.c.*, ii, 1826, 295.
Cephalotes, Dejean, *l.c.*, iii, 1828, 426.
Chlaenius, Dejean, *l.c.*, ii, 1826, 297.
Demetrias, Latr. and Dej., *l.c.*, 169.
Dinodes, Dejean, *l.c.*, ii, 1826, 371.
Ditomus, Dejean, *l.c.*, i, 1825, 437.
Dolichus, Dejean, *l.c.*, iii, 1828, 36.
Dromius, Latr. and Dejean, *l.c.*, 175.
Dyschirius, Stephens, *l.c.*, 37 and 40.
Epomis, Dejean, *l.c.*, ii, 1826, 368.
Laemostenus (*Laemosthenes*), Schaufuss, Mon. Bearb. der Sphodr. Sitzungsb. Ges. Isis, 1864, 121.
Lamprias, Dejean, *l.c.*, i, 1825, 253.
Melanius, Dejean, *l.c.*, iii, 1828, 204.
Molops, Dejean, *l.c.*, iii, 1828, 205.

Oodes, Dejean, *l.c.*, ii, 1826, 374.
Pelor, Dejean, *l.c.*, iii, 1828, 437.
Percus, Dejean, *l.c.*, iii, 1828, 205.
Platynus, Stephens, *l.c.*, 67 and 83.
Platysma, Stephens, *l.c.*, 67 and 124.
Poecilus, Stephens, *l.c.*, 67 and 108.
Polystichus, Latr. and Dejean, *l.c.*, 123.
Pterostichus, Stephens, *l.c.*, 67 and 120.

Note.—I have just received a letter (June, 1919) from Mr. T. G. Sloane. He tells me that his copy of the "Observations Entomologiques" (with the Tableau attached) formerly belonged to Lacordaire; it bears the following note in Lacordaire's handwriting: "Cet examplaire a appartenu à Olivier et a été acheté, f. 14, à sa vente en 1847. Il l'avait reçu de Bonelli, comme indique la suscription en tête de la seconde partie." This quite confirms my view that the "Tableau" was annexed to the separates of his work which Bonelli distributed among his entomological friends.

V. *Notes on the Ancestry of the* Diptera, Hemiptera *and other Insects related to the* Neuroptera.* By G. Chester Crampton, Ph.D. Communicated by G. T. Bethune-Baker, F.L.S., F.Z.S.

[Read March 5th, 1919.]

The greater part of winged insects now living may be grouped into two principal sections, one of which, the so-called Plecopteradelphia, or Plecopteron "brotherhood," contains the lower insects more closely related to the Plecoptera—such as the Blattoid superorder (Blattidae, Mantidae, Isoptera, Zoraptera, etc.), the Orthopteroid superorder (saltatorial Orthoptera, Phasmidae, Grylloblattidae, etc.), and the Plecopteroid superorder (Plecoptera, Embiidae, Dermaptera, Coleoptera, etc.), together with their fossil relatives; while the second section, the so-called Neuropteradelphia, or Neuropteron "brotherhood," contains the higher insects, more closely related to the Neuroptera—such as the Psocidæ, Mallophaga, Pediculidae, Hemiptera, Hymenoptera, Diptera, Mecoptera, Trichoptera, Lepidoptera, Neuroptera, etc., with their fossil relatives. In the following discussion the two sections described above may be referred to simply as the Plecopteron section (or group) and the Neuropteron section (or group).

It would be extremely difficult to find any features peculiar to all of the members of one section, and not occurring in any members of the other section; but it may be said of most of the insects belonging to the Plecopteron section, that their mouthparts are usually strongly mandibulate and well developed; while in the insects belonging to the Neuropteron section, the mouthparts of many are slender and greatly modified. In many of the insects of the Plecopteron group there is a marked tendency toward the reduction (and, in some cases, of a thickening) of the fore-wings; while in the insects of the Neuropteron

* Contribution from the Entomological Laboratory of the Massachusetts Agricultural College, Amherst, Mass.

section the fore-wings are frequently better developed than the hind ones. Long cerci (and in the males of some, styli also) are present in many of the insects belonging to the Plecopteron section; while in the insects belonging to the Neuropteron section they are wanting or vestigial as a rule, and in the latter insects the plates bearing the cerci ("paraprocts" or parapodial plates) are usually greatly modified or united with the terminal segments of the abdomen; while in the insects of the Plecopteron group they are usually distinct and well developed. Gonopod-like (*i. e.* forceps-like) genitalia are never found in the males of the Plecopteron section thus far examined, while this type of genitalia does occur in the males of some of the Neuropteron section. The type of metamorphosis (or lack thereof) exhibited by a group of insects is a matter of minor importance in the study of relationships, since in some families of insects such, for example, as the Coccidae, the males undergo a metamorphosis while the females of the same species do not. It may be stated, however, that with the exception of the Coleoptera, etc., the insects belonging to the Plecopteron section do not exhibit a marked metamorphosis; while many of the insects of the Neuropteron section (excepting the Psocidae, Hemiptera, etc.) exhibit a marked tendency in this direction.

So little is known of the anatomical details of the extinct fossil insects called Palaeodictyoptera (which have departed but little from the ancestral condition of winged insects in general) that it is impossible to determine their closest affinities. I believe, however, that the very ancient though somewhat aberrant orders Plectoptera (Ephemerida) and Odonata, among recent insects, are more closely related to certain Palaeodictyoptera than they are to either the Neuropteron section or the Plecopteron section, and I would therefore provisionally include the Plectoptera (Ephemerida) and the Odonata with the Palaeodictyoptera (and related fossil forms) in a third section of winged insects called the PLECTOPTERADELPHIA or Ephemerid "brotherhood," which will be referred to as the Ephemerid section, or group, in the following discussion.

In most (if not all) of the members of the Ephemerid section the wings cannot be folded along the abdomen (a very primitive condition), and the wing venation has departed but little from the original condition in many members of this group. Indications of a shifting of the radial sector recently described in the Ephemerida (Morgan, 1912, Ann. Ent. Soc. Amer., 1912, p. 89) point to a rather close relationship to the Odonata, in whose wing venation a similar condition occurs, although it is unknown among other insects. In both Odonata and Ephemerida the antennae are usually much reduced, and they do not appear to be very large in most of the Palaeodictyoptera. The tarsi are composed of not over three segments in many of the insects of this section. Many of these insects have well-developed cerci (Bull. Brooklyn Ent. Soc., vol. 13, p. 49), although the cerci of certain Odonata have been otherwise interpreted by some investigators. In certain Ephemerid and Odonatan nymphs traces of a median unpaired terminal abdominal filament may be retained, and the abdominal segments are usually well developed in these insects. Paranota, or lateral expansions of the tergal region (Jour. N.Y. Ent. Soc., vol. 24, p. 1) occur on the abdominal segments, particularly those near the end of the abdomen, in certain immature Odonata and Ephemerida, and are occasionally retained on the last abdominal segments of the adult also. These and many of the characters mentioned above do not occur in all of the members of the Ephemerid section, nor are they characteristic of the members of this section alone, so that the only character peculiar to this group of insects and occurring in most of its members, is their inability to fold their wings flat along the abdomen.

Fig. 1.

Certain insects belonging to each of the sections mentioned above (*i. e.* the Ephemerid, Plecopteron, and Neuropteron sections) may occupy a position anatomically intermediate between the members of their own and of the other sections. The three sections may thus have a certain amount of "territory" in common, yet each taken separately forms a well-defined group in itself. If this were to be represented graphically, the three sections would be represented as three intersecting circles (Fig. 1) each of which taken separately forms a distinct well-defined division; yet in the area of overlapping they have a certain amount of territory in common. It would perhaps have been more exact to represent these three groups as three intersecting spheres rather than as circles drawn in one plane; but the figure in question will serve well enough to illustrate the points under discussion.

The circle representing the Ephemerid group has been represented as though somewhat lower than that of the Plecopteron group, since certain Palaeodictyopteron members of the Ephemerid section are somewhat more primitive than the lowest representatives of the Plecopteron section. On the other hand, some members of the Ephemerid group may occupy a position extending up even into the territory of the Neuropteron group (as shown in the figure), since they have much in common with the lowest members of the Neuropteron section. As far as the more direct ancestors of the Neuropteron section are concerned, however, I would provisionally consider the Plecopteron section as more nearly representing their *immediate* ancestors, while the Ephemerid section may represent the common stock from which both the Plecopteron and Neuropteron sections are *ultimately* to be derived. On this account, the circle representing the Plecopteron group has been represented as though intermediate between the other two, in the figure.

Tillyard, 1917 (Biology of Dragonflies), emphasises the resemblance between the Protascalaphine Neuropteron *Stilbopteryx* and the Odonata, not only in appearance, but even in its mode of flight, etc., and it must be admitted that the Neuroptera are in many respects extremely like the Odonata and their allies, the Ephemerida. Handlirsch, 1906 (Die Fossilen Insekten), has also pointed out the marked resemblance of the Neuroptera to certain fossil Palaeodictyoptera, so that when one considers the Neuroptera alone, there is considerable evidence for regarding the Ephemerid section (*i. e.* the Ephemerida, Odonata, and Palaeodictyoptera) as more nearly representing the ancestral group giving rise to the insects related to the Neuroptera. The Psocidae, however, must be considered also in such a phylogenetic study, since they also occupy a position near the base of the lines of descent of the insects related to the Neuroptera, as is shown in Fig. 2; and a study of the affinities of the Psocidae is of no less importance than those of the Neuroptera, in attempting to determine the ancestry of the insects in question. Now the Psocidae exhibit undeniable affinities with the Coleoptera, Dermaptera, Embiidae and Plecoptera, which constitute the Plecopteroid superorder (Jour. N.Y. Ent. Soc., vol. 25, 1917, p. 230), and, since the Neuroptera also exhibit many features in common with the Embiid and Plecopteron members of this same Plecopteroid superorder, I am inclined to consider that, taken as a whole (and not merely considering the Neuroptera alone), the lines of descent of the insects of the Neuropteron section would lead back to the Plecopteron section more directly, and ultimately

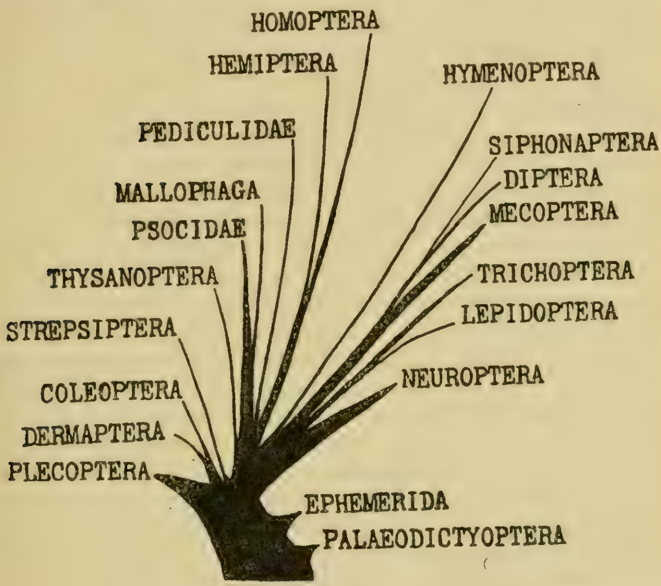

Fig. 2.

through or with them, to ancestors resembling the insects of the Ephemerid section. On this account, I have represented the Palaeodictyoptera and Ephemerida as occupying positions near the base of the common stem in Fig. 2, while the Plecoptera and their allies are shown somewhat nearer to the point where the lines of descent of the insects related to the Psocidae and Neuroptera have branched off.

It should be borne in mind that the diagram of the lines of descent shown in Fig. 2 is intended merely to aid in visualising the relative positions of the insects in question, and it does not accurately represent the actual interrelationships of these insects, since it would require a figure of three dimensions to show that one line of descent is in some cases intermediate between several others. Furthermore, it would make too complicated a figure to attempt to include in the diagram all of the lines of descent of the insects related to the ancestors of the Psocidae and the Neuroptera, so that but a few of these have been included in the diagram.

Among the most important of the insects omitted from the diagram shown in Fig. 2 are those comprising the Blattoid superorder (*i. e.* the Blattidae, Mantidae, Isoptera, Zoraptera and their fossil relatives), whose lines of development may be thought of as extending in a plane perpendicular to that containing the lines of descent of the Psocidae and Neuroptera. Now certain Mantidae, such as *Mantoida luteola*, are very Neuropteron-like, and certain Isoptera resemble the lower Psocidae, such as *Archipsocus*, very strongly, so that it is quite possible that the Blattoid superorder, to which these Mantids, Isoptera, etc., belong, more nearly represents the group ancestral to the Neuroptera than the Plecopteroid superorder does. Indeed, the Isoptera have even been classed with the "Neuroptera" by some entomologists who were apparently impressed with their Neuropteron-like appearance. On the other hand, the Embiid and Plecopteron representatives of the Plecopteroid superorder have likewise been classed as "Neuroptera" by some entomologists who were apparently impressed with the Neuropterous affinities of these insects, and when one takes into consideration the close relationship of the Psocidae to the Coleoptera, Dermaptera, Embiidae and Plecoptera (*i. e.* the Plecopteroid superorder) in addition to the marked resemblance of the Neuroptera to certain of these insects, there are very good reasons for considering the Plecopteroid superorder rather than the Blattoid superorder as more nearly representing the group which gave rise to the lines of descent of the insects related to the Psocidae and Neuroptera. In the foregoing discussion it should be clearly understood that the Plecopteron *section*, which includes the Blattoid, Orthopteroid and Plecopteroid superorders, is a more inclusive designation than the Plecopteroid *superorder*, which constitutes merely a portion of the insects included in the Plecopteron section.

It is perhaps a rather unfortunate choice to begin the discussion of the ancestry and interrelationships of the insects related to the Neuroptera, with the consideration of such a highly aberrant and anomalous group as the Strepsiptera are, especially since their closest affinities are still a matter of considerable speculation. I feel, however, that the Strepsiptera occupy a position intermediate between the members of the Plecopteroid superorder, on the one hand (*i. e.* the Coleoptera, Dermaptera, etc.), and the insects grouped about the Neuroptera on the other. In order to bring out this fact, it was necessary to represent the Strepsipteron line of development in Fig. 2, as though branching off near the base of the Psocid-Neuropteron stem, although in reality the Strepsiptera are a strongly aberrant group structurally much higher than the Psocidae and Neuroptera. The line of development of the Strepsiptera should be thought of as though extending in a plane perpendicular to that of the lines of descent of the Psocidae and Neuroptera, since the Strepsiptera appear to occupy a position intermediate between the Coleoptera, on the one hand, and the insects related to the Neuroptera and Psocidae on the other. Pierce, 1909 (Smithsonian Bull. 66), is inclined to regard them as more nearly related to the Dipteron group of the insects allied to the Neuroptera, and Latreille, 1809 (Genera Crust. et Insect., vol. 4), at first placed them with the Diptera also. Haeckel, 1896, would group them with the Neuropterous insects. Rossi, 1793 (Bull. Soc. Philom., vol. 1), thought that they were related to *Ichneumon* among the Hymenoptera, while Gegenbauer, 1859 (Grundz. vergl. Anat., first edition), considers that their closest affinities are with the Trichoptera (as does Gerstaecker), and Shuckard, 1840, places them between the Forficulidae and Phryganidae. Most investigators, however, agree in placing them among or next to the Coleoptera. In previous papers I have called attention to certain resemblances between the Strepsiptera and the Psocidae with the Hemipteroid insects, and I still believe that there are many points of resemblance between the Strepsiptera and the insects related to the Psocidae and Hemiptera (*sensu lato*), so that, provisionally at least, we may regard the Strepsiptera as occupying a position intermediate between the Coleoptera, etc., on the one hand, and the Psocidae and Hemiptera on the other, although the Strepsiptera likewise exhibit some marked affinities with the Neuropteroid insects as well.

The Thysanoptera are another strongly aberrant order related to the Psocidae, and to the Hemiptera (with the Homoptera). They have likewise carried over in their line of development some of the characters occurring in certain representatives of the saltatorial Orthoptera, and in the Forficulid representatives of the Plecopteroid superorder. We thus have another threefold resemblance which makes it rather difficult to determine the closest affinities of the insects in question; but the generally accepted opinion that the Thysanoptera are rather closely related to the Hemiptera (*sensu lato*) appears to be well founded. Boerner, 1904 (Zool. Anzeiger, Bd. 28, p. 511), has pointed out the resemblance of the parts of the head of Thysanoptera to those of Psocidae and Hemiptera (*sensu lato*), and the evidence furnished by a study of the head region is borne out by that of other parts of the body as well. On the other hand, Hood, 1915 (Proc. Biol. Soc. Washington, 28, p. 53), regards the Thysanoptera as "Orthopteroid" insects, following Handlirsch, 1909 (Die fossilen Insekten), who derives both Thysanoptera and Dermaptera from forms related to the saltatorial Orthoptera such as the "Locustids" and Gryllids. According to Hinds, 1902 (Proc. U.S. Nat. Museum, vol. 26, p. 79), "about 1828, through the anatomical studies of Straus-Duerckheim and Latreille, sufficient evidence was obtained to lead Latreille to separate the Thysanoptera from the Hemiptera and place them among the Orthoptera," and Jordan, 1888 (Zeit. Wiss. Zool., Bd. xlvii, p. 541), thought that the Thysanoptera should be classed "according to their immersed germ band and their larval form in the line of the Orthoptera, Homoptera, Hemiptera, wherein they should be placed according to their anatomy and biology." Jordan also states that "if we collect the Mallophaga, Psocidae and Termitidae as Corrodentia with Brauer, then we must place Thysanoptera in the system between Corrodentia and Hemiptera" (*teste* Hinds, 1902), and in this respect his views are not essentially different from those here given. According to Jordan, some of his predecessors have regarded the Thysanoptera as related to the Odonata, but there does not seem to be much evidence to support this view.

As was mentioned above, the Strepsiptera and Thysanoptera are highly aberrant insects whose closest affinities are extremely difficult to determine. On the other hand, the Psocidae, together with the Neuroptera, furnish us with the intermediate links connecting the higher insects, such as the Hemiptera, Diptera, etc., with the lower forms, and the study of such primitive Psocidae as *Archipsocus*, for example, is of the utmost importance in attempting to determine the ancestry of the higher insects here discussed. Brauer, as was stated in the preceding paragraph, groups the Mallophaga, Psocidae and Isoptera together as Corrodentia, and Enderlein, 1903 (Zool. Anzeiger, 26, p. 423; see also Palaeontographia, 1911, Bd. 58, p. 279), apparently influenced by Brauer, groups the Psocidae, Mallophaga, Isoptera and Embiidae in the single order Corrodentia, to which Escherich, 1914 (Handw. buch d. Naturw.), would add the Pediculidae also. All of the foregoing investigators agree in regarding the Isoptera as quite like the ancestors of the Psocidae; and Handlirsch, 1909 (*l.c.*), would derive the Psocidae, together with the Isoptera, from Blattoid ancestors (as does Mjoberg), thus agreeing with them in substance. On the other hand, Kolbe, 1901 (Arch. f. Naturg. lxvii, Beigeft, p. 89), was apparently impressed with the marked affinities between the Psocidae and the Dermaptera (Forficulids) with the Coleoptera, although he is mistaken in believing that the Dermaptera and Coleoptera could be derived from ancestors like the Psocidae, since the Dermaptera are much more primitive than the Psocidae are.

In a measure, all of the views cited above are correct, since the Psocidae were doubtless descended from ancestors resembling the Plecopteroid superorder and would therefore naturally have certain features in common with the Plecopterous, Embiid, Forficulid, and Coleopterous representatives of this superorder. Similarly, since the Isoptera were also very probably descended from ancestors resembling the same Plecopterous superorder, it is not surprising that both Psocidae and Isoptera should have certain points in common with each other and with certain members of the ancestral Plecopteroid superorder, having taken over in their lines of descent certain similar features from their common heritage. On the other hand, when we take all of the anatomical details into consideration, the closest affinities of the Isoptera are seen to be with the Blattoid superorder (Blattidae, Mantidae, Isoptera and Zoraptera), and the closest affinities of the Embiidae are with the Plecopteroid superorder (Plecoptera, Embiidae, Forficulidae, and Coleoptera), while the closest affinities of the Psocidae appear to be with the insects grouped about the Neuroptera, with which they are connected by intermediate forms. The Isoptera, Embiidae and Psocidae cannot therefore be grouped together, since they belong to three divergent lines of descent; but, since these divergent lines of descent had a common origin, the lowest representatives of each would naturally have preserved many features in common with the other two. In deriving the Psocidae from ancestors related to the Embiidae and other members of the Plecopteroid superorder, I would not minimise the very evident affinities between the Psocidae and Isoptera, since subsequent investigation may prove that the ancestors of the Psocidae are much closer to the Isoptera than they are to the Embiidae, Dermaptera, etc. Provisionally, however, I would regard their ancestors as somewhat more closely allied to the Embiidae, Dermaptera, Coleoptera, and the other members of the Plecopteroid superorder.

As was mentioned above, Brauer emphasised the relationship of the Mallophaga to the Psocidae, and placed them both in the order Corrodentia; but he was doubtless incorrect in including the Isoptera in this order also. Packard, 1887 (Amer. Phil. Soc. 1887, p. 264), places the Mallophaga in the order "Platyptera," which includes the Plecoptera and Embiidae in addition to the other insects mentioned above; but this grouping contains too many discordant elements. Kellogg, 1902 (Psyche, vol. 9, p. 339), and others have emphasised the remarkable resemblance between the Mallophaga and the Psocidae, and there can be but little doubt that the Mallophaga are very closely related to the Psocidae and to the Pediculidae as well, so that there can be no serious objection to the view that the Mallophaga arose from ancestors very like the Psocidae as shown in the diagram of the lines of descent of these insects.

The Pediculidae (also called Suctoria, Anopleura, or Siphunculata) are undoubtedly closely related to the Mallophaga, as has been pointed out by Cummings, 1910 (Ann. Mag. Nat. Hist., vol. 15, p. 256), Mjoberg, 1910 (Arkiv f. Zoologi), and many others, following Leach, 1817. Enderlein, 1904 (Zool. Anz., vol. 28, p. 121), emphasises the relationship of the Pediculidae to both the Mallophaga on the one side and the Hemiptera on the other, and indeed, most of the earlier writers placed the

Pediculidae with the Hemiptera (*sensu lato*). Since the Pediculidae have many points in common with both Mallophaga and Hemiptera (with the Homoptera), their line of descent has been represented in the diagram as though intermediate between that of the Mallophaga (with the Psocidae) and the Hemiptera (with the Homoptera).

The Hemiptera and Homoptera are extremely closely related, and are usually grouped in a single order; but there are very good grounds for considering that the insects so classed should be divided into at least two orders—the Hemiptera (*sensu stricto*) and the Homoptera —although the further division of the Homoptera into other orders by Handlirsch, 1909 (Die Fossilen Insekten), is doubtless too extreme.

In discussing a paper by Osborn, 1894 (Proc. Ent. Soc., Washington, vol. 3, p. 190), on the phylogeny of the Hemiptera, Ashmead suggests that the "Pediculidae are the oldest forms representing the stem from which sprang the Homoptera in one direction and the Heteroptera in another." Most of those who group the Pediculidae with the Hemiptera, however, regard them as "degenerate" Hemipteroid insects. Paul Meyer, 1876, who derives the Hemiptera (with the Homoptera), together with the Pediculidae and Mallophaga, from a "Protohemipteron" stem apparently paved the way for the modern view of the interrelationships of the Hemiptera, Pediculidae, Mallophaga, etc., expressed by Enderlein, 1904 (Zool. Anz., Bd. 28, p. 121), and particularly by Boerner, 1904 (Zool. Anz., Bd. 27, p. 511), who groups the Psocidae, Mallophaga, Pediculidae, Thysanoptera and Hemiptera (with the Homoptera) in a section which he calls the "Acercaria." Handlirsch, 1909 (*l.c.*), however, following certain earlier investigators, is more impressed with the Neuropteroid affinities of the Hemiptera (and Homoptera) as exhibited by such fossil forms as *Eugereon boeckingi* described by Dohrn, 1867 (Stett. Ent. Zeit., Bd. 28, p. 145), although Kirkaldy, 1910 (Proc. Hawaiian Ent. Soc., vol. ii, p. 117), thinks that *Eugereon* is not "even a Hemipteroid insect" but is "a Neuropteroid insect of a kind that has no representatives in modern times, that has become extinct, forming an order or suborder of its own." In several papers I have called attention to the Neuropteroid character of the thorax of such lower

Homoptera as *Cicada* (see also Taylor, 1918, Ann. Ent. Soc. America, vol. 11, p. 225), and if *Eugereon* is really a Hemipteroid insect, it would certainly point to a very close relationship between the ancient Hemiptera and the Neuroptera. Furthermore, the nature of the mouth-parts (*e. g.* union of labial palpi, etc.), head, and other structures in the Hemiptera, are quite suggestive of the condition occurring in insects descended from Neuroptera-like forbears—such as the Mecoptera and their relatives the Diptera, and there are evidences of a relationship to the lower Lepidoptera also (which are members of this group), so that there are very good grounds for considering that the Hemiptera are related to the Mecoptera and other insects descended from Neuroptera-like forbears. McLeay, 1821–1825, apparently realised the affinities between the Hemiptera and certain of the members of the Neuropteroid superorder, for, according to Handlirsch, in articles published in vol. 2 of the Horae Ent., and vol. 14 of the Linn. Trans., McLeay groups the Homoptera, Hemiptera, Siphonaptera, Diptera and Lepidoptera together as " Haustellata "—a grouping adopted by Agassiz, 1851 (Classif. of Insects from Embryol. Data), and in part by Haeckel, 1866 (Generelle Morphologie), who places the Hemiptera, Homoptera, Pediculidae, Diptera and Lepidoptera in his subclass " Sugentia." Kolbe, 1884 (Berl. Ent. Zeit., Bd. 28, p. 169), regards the Hemiptera as a " neotypic offshoot " of the " Orthoptera," while, as far back as 1831, Latreille, in his Cours d'Entomologie, classes the Coleoptera, Dermaptera, Orthoptera and Hemiptera in the group called Elythroptera (or Elytroptera of Dana, 1864), on the basis of the thickening of the fore-wings. Schoch (Schw. Ent., Bd. 7) derives the Hemiptera from forms related to the Odonata.

There are many other groupings of the Hemiptera, but the ones which appear to be the most in accord with the facts of comparative anatomy are those which place the Hemiptera with the insects grouped about the Neuroptera or the Psocidae. While the Hemiptera (with the Homoptera) exhibit undeniable affinities with the Neuroptera and their allies, it is likewise quite evident that the Hemiptera are no less closely related to the Psocidae and their allies, and provisionally, at least, I would regard them as somewhat more closely related to the Psocidae and their allies than to the members of the Neuropteroid superorder. The lines of descent of the Hemiptera and Homoptera have therefore been represented in the diagram as though occupying a position intermediate between the insects grouped about the Neuroptera and those grouped about the Psocidae, being slightly nearer the latter than the former.

The Hymenoptera are here treated as though constituting a single order; but there are some grounds for considering the sawfly group, or chalastogastrous Hymenoptera (including the suborder Idiogastra of Rohwer, 1917, Proc. Ent. Soc. Washington, vol. 19, p. 92) as a distinct order, called Prohymenoptera by Crampton, 1916 (Ent. News, vol. 27, p. 303), or Bomboptera by MacLeay, 1829 (applied to the "Uroceridae" alone). Rohwer, 1917 (*l.c.*), however, points out the annectant character of the Oryssoid sawflies between the Siricoid members of the sawflies and the Braconids, etc., among the higher Hymenoptera, maintaining that this connection between the two groups unites them into one homogeneous order. When one has examined such "synthetic" types as the Micropterygidae, Zoraptera, Grylloblattids, Isoptera, etc., which combine in themselves characters common to several other orders of insects, it is at once apparent that the existence of these connecting forms does not invalidate the distinct orders which they serve to connect (and indeed, at one time, all of the orders must have been connected by such intermediate forms), so that Rohwer's objection to the division of the Hymenoptera on this score, does not hold good. For the sake of convenience, however, they are treated as a single order in the present discussion.

Ashmead, 1895 (Proc. Ent. Soc., Washington, vol. 3, p. 330), has summarised the different views as to the relationships of the Hymenoptera, as follows: "Latreille placed it (the order Hymenoptera) between the Neuroptera and the Lepidoptera, regarding *Phryganea* and *Termes* as forming the link between them, considering the long-tongue bees as approaching nearest to the Lepidoptera. MacLeay, on the other hand, placed the Hymenoptera between the Coleoptera (with which they are supposed to be connected by the osculant order Strepsiptera) and the Trichoptera, the Tenthredinidae being considered as Trichopterous and the Uroceridae as forming an osculant order Bomboptera, between Trichoptera and Hymenoptera, which last order is reduced to the species possessing apodal larvae. . . . Packard, 1863 (Boston Jour. Nat. Hist., 7, p. 591), in his paper entitled 'On Synthetic Types in Insects,' says that the Coleoptera, Hemiptera, Orthoptera and Neuroptera seem bound together by affinities such as those that unite by themselves the bees, moths and flies, and to the latter, or what he considers the higher series, he has since applied the term Metabola, and to the former Heterometabola. . . . Packard also believes the Hymenoptera are descendant from the Lepidoptera." In his diagram of the lines of descent of the orders of insects, Ashmead (*l.c.*) derives both Lepidoptera and Hymenoptera from a Trichopteroid stem. Schoch, 1884 (Schw. Ent., Bd. 7), derives the Hymenoptera, Lepidoptera, and Diptera from Neuroptera. Paul Meyer, 1876, thinks that the Hymenoptera are closely related to the Orthoptera. Sajo, 1908 (Prometheus, Bd. 19, p. 705), thinks that the Hymenoptera are very closely allied to the Coleoptera, and Handlirsch (Fossilen Insekten) is apparently of the same opinion, since he derives both Hymenoptera and Coleoptera from forms related to the Protoblattoidea, suggesting that the Mantidae are intermediate between the Protoblattoidea and the Hymenoptera. In previous papers I have pointed out the resemblance between certain adult sawflies and the Mecoptera such as *Panorpodes*, *Merope*, etc., and a further study has convinced me that the sawflies are quite closely related to the Mecoptera, as well as to the Psocidae, occupying a position intermediate between the two groups, but being a little more closely related to the Mecoptera than to the members of the other group. I find that others have also noted the resemblance between the Hymenoptera and Mecoptera, for Ashmead, 1895 (Proc. Ent. Soc. Wash., 3, p. 331), states that "the larvae of the Mecoptera also approach close to the Hymenoptera, and the peculiar rostrate head of the imagoes of this order is frequently reproduced among the parasitic species *Agathis*, *Cremnops*, etc.," and Kolbe, 1884 (Berl. Ent. Zeit., 28, p. 169), calls attention to the presence in both Hymenoptera and Panorpidae of "primitive biting mouthparts, similar wing venation, and similar formation of the thoracic segments" in the adults, and the similar caterpillar-like larvae present in both orders. The larvae of sawflies which I have examined (Crampton, 1918, Proc. Ent. Soc., Washington, 20, p. 59) "resemble those of the Panorpids in having retained the lateral cervical plates"; but in certain other respects, the sawfly larvae are more similar to Lepidopterous larvae.

The venation of the wings of certain sawflies, particularly in the anal region, is strongly suggestive of the condition occurring in the wings of some of the more primitive Psocidae, and I find indications of a relationship between the two in certain features of the head and thorax (especially the tergal region). On the other hand, the nature of the male genitalia of the sawflies is surprisingly like the genitalia of male Mecoptera, the shape of the head and the nature of the mouthparts, etc., are much more similar in the sawflies and Mecoptera, and on the whole the closest affinities of the Hymenoptera appear to be with the Mecoptera and other insects grouped about the Neuroptera. I have therefore represented the Hymenoptera in the diagram as a very primitive group occupying a position somewhat intermediate between the insects grouped about the Psocidae and those grouped about the Neuroptera, with their strongest affinities on the side of the Neuropteroid forms such as the Mecoptera. The similarity between the wing veins of the Diptera and sawflies pointed out by MacGillivray, 1906 (Proc. U.S. Nat. Museum, 29), and others would thus be readily explained by the fact that Diptera are descended from Mecoptera-like forbears, and if the sawflies resemble Mecoptera, they would naturally be similar in some respects to the Diptera also. In the same way, the resemblances between the Hymenoptera and the Trichoptera or Lepidoptera might be explained as the result of their mutual relationship to the Mecoptera. In some respects the Hymenoptera are quite like the Neuroptera, and the latter group may possibly represent the ancestral forms from which the Hymenoptera were derived; but it is more probable that the ancestors of the Hymenoptera were very primitive forms occupying a position intermediate between the Neuroptera and the Psocidae.

Most modern investigators agree in regarding the Siphonaptera, Suctoria, or Aphaniptera as the descendants of forms very like the Diptera; and their ancestors were probably quite similar to the Dipteron family Phoridae. The Siphonaptera have therefore been represented in the diagram as a lateral branch of the main Dipteron line of development, although as Packard, 1895 (Proc. Boston Soc. Nat. Hist., 26, p. 354), states, "they must have diverged from the ancestral Dipterous stem before the existing forms of Diptera had become so extremely specialised as we now find them to be." According to Packard (*l.c.*) Haliday considered the fleas as "a group of Diptera allied to the Mycetophilidae"; . . . "those who regarded them (the fleas) as Diptera were Roesel, Oken, Straus-Duerckheim, Burmeister, Haliday, Newman, Walker, von Siebold, with many German entomologists, and J. Wagner (1889). They were regarded as Hemiptera by Fabricius and by Illiger. . . . The fleas were placed by MacLeay and by Balbiani between the Diptera and Hemiptera; by Leach between the Hemiptera and Lepidoptera; by Dugès between the Hymenoptera and Diptera; and by Brauer they are given a position between the Diptera and Coleoptera." Brues, 1901 (American Naturalist, 35, p. 336), discusses the relationship of fleas to Phoridae, and Dahl, 1897 (Zool. Anz., 20, p. 409), describes a Phorid, *Puliciphora*, which he considers annectant between the Phorids and fleas, although Wandolleck, 1898 (Zool. Anz. and Wiss. Rundschau), takes exception to Dahl's statements on the subject.

The Diptera are undoubtedly as closely related to the Mecoptera as to any other order of insects, and the Mecoptera have apparently departed as little as any living forms from the type ancestral to the Diptera, so that the Dipteron line of development has been represented in the diagram as though merging with that of the Mecoptera, as we trace them both back to their common Neuroptera-like ancestors. As was mentioned in previous papers, I find in such Neuroptera as *Nemoptera*, many features suggesting the presence of tendencies in the Neuropteron stem which are later to find opportunity for fuller expression in the development of the Dipteron type of insects. Among these may be mentioned the tendency toward the formation of the elongate type of head in *Nemoptera*, the reduction of the hind-wings in this insect (which if carried a little further would result in the production of a halter-like structure), and the character of the genitalia in males of *Nemoptera*. On the other hand, the resemblance between the lower Diptera such as the Tipuloid forms and the *Bittacus*-like representatives of the Mecoptera is very striking and extends even to the more minute details, the head and mouthparts, thoracic sclerites, and genitalia being very similar in the two groups—and

I have even found a genital structure in the males of the Tipulid *Pachyrhina macrophallus* described by Dietz, 1918 (Trans. Amer. Ent. Soc., 44, p. 105), strongly suggestive of the coiled spring-like structure in the genitalia of males of *Bittacus*. The resemblance between the genitalia of the males of both groups has been pointed out in a paper published in Psyche, 1918, vol. 25, p. 55, and the evolution of the head types in Neuroptera, Mecoptera and Diptera has been traced in a paper published in the Annals Ent. Soc. America, 1918, vol. 10, p. 337. As was pointed out in the paper on the evolution of the head types in Diptera, etc., the Trichoptera have retained certain features suggestive of the ancestors of the Diptera (and Packard, 1883, derives the Diptera from them); but this may possibly be explained as the result of the relationship of both Diptera and Trichoptera to the Mecoptera, since the Diptera and Trichoptera were in all probability descended from ancestors not unlike the Mecoptera (or from the Neuroptera-like ancestors of the Mecoptera). Similarly, since the Lepidoptera were descended from ancestors resembling those of the Trichoptera and Mecoptera, they therefore might also carry over certain characters in common with the Diptera, which are derived from a similar ancestry. I would thus account for the resemblances of the Lepidoptera, Trichoptera, Hymenoptera, etc., to the Diptera, as the result of their common or mutual relationship to the Mecoptera (or the Neuropteroid ancestors of the Mecoptera). If it should prove to be the case that the Homoptera (and Hemiptera) are more closely related to the Mecoptera and other Neuropteroid insects than to the Psocidae and their allies, the slight resemblance of the Hemiptera to the Diptera might in the same way be explained as the result of their mutual relationship to the Mecoptera. At present, however, I do not think that the Homoptera are very closely related to the Diptera, while the Lepidoptera do show some unmistakable resemblances to the Diptera, as is also the case with the Trichoptera, and to some extent, the Hymenoptera also.

Whether the ancestors of the Diptera would have been placed in the order Mecoptera by systematists, or whether they were Neuroptera-like forms giving rise to both the Dipteron and Mecopteron lines of descent, I cannot say; but it is quite evident that the Mecopteron line of descent has paralleled that of the Diptera more closely and for a further distance than has that of any other order, and the Mecoptera have apparently departed but little from the ancestral condition of the Diptera. Handlirsch derives both Diptera and Lepidoptera from a common Mecopteron stock, and also derives the Trichoptera from the same stem which he traces back to the fossil Megasecoptera. Many of the older entomologists grouped the Diptera with the Strepsiptera on account of the presence in both of only two wings, although the wings are borne on different segments of the thorax in the two groups of insects. Dana, 1864, places the Hymenoptera, Diptera and Siphonaptera in his division "Apipiens" (of his "Ctenoptera") corresponding to the "Metabola" of Packard 1863–1870, who in 1883 added the Lepidoptera to the group and called them all "Euglossata"; while Schoch, 1884, calls the Diptera, Lepidoptera and Hymenoptera, "Zygothoraca." Haeckel, 1866, groups the Hemiptera (*sensu lato*), Pediculidae, Lepidoptera, and Diptera together as "Sugentia," and derives the Diptera from Hemiptera, while Ashmead, 1895, derives the Diptera in part from the Hemiptera (Homoptera) and partly from the Mecoptera. Smith, 1897 (Science, N.S. 2, vol. 5, p. 671), groups the Hymenoptera, Siphonaptera, Diptera, Mecoptera, Lepidoptera, Trichoptera, Odonata and Ephemeridae together—a grouping which is quite like that here accepted if the Odonata and Ephemeridae were omitted, and the Neuroptera substituted in their place. Boerner, 1904 (Zool. Anz., 27, p. 532), groups together the Mecoptera, Diptera, Siphonaptera and Hymenoptera in the section "Cercophora" of the Holometabola, and with the exception of his including the Coleoptera among the insects related to the Neuroptera, his derivation of the lines of descent of the insects in question is essentially similar to that here given. Formerly I suggested that the Nycteribiid Diptera have departed widely from the other Diptera, and that their Braulid relatives have departed sufficiently far to be classed in a distinct order (Ent. News, 27, p. 302); but this view is too extreme, for the pupiparous Diptera are connected with the remainder of the order by intermediate forms, and should be included with them in the homogeneous order Diptera, since the winged forms are evidently Diptera. It is rather interesting to note in this connection, that one hundred years ago Leach, 1817 (Zool. Misc., vol. 3), had proposed to place the Pupipara in a separate order called Omaloptera (or the Homaloptera of Westwood, 1839).

The grouping of the Mecoptera with the Neuroptera by the earlier entomologists was apparently well founded, since the Neuroptera certainly seem to represent as nearly as any living forms, the ancestral type from which the Mecoptera were derived. The group Planipennia contains the types approaching as closely as any Neuroptera to the ancestral Mecoptera, and such Neuroptera as *Nymphes* (and in some respects the Ithoniidae also) have retained certain features very suggestive of Mecopteron affinities, although I have always felt that the Nemopteridae are very like some of the ancestors of the Mecoptera—especially those in which the head had begun to take on the elongate form. Handlirsch (*l.c.*) derives the Mecoptera from the fossil Megasecoptera. Lameere, 1908 (Ann. Soc. Ent. Belgique, 52, p. 139), agrees with Handlirsch in this derivation of the Mecoptera, and there is much to be said in favour of this view. Lameere would derive the Neuroptera as well as the Mecoptera (and their allies) from the Megasecoptera, instead of deriving the Neuroptera from the Palaeodictyoptera as Handlirsch does (although the Megasecoptera are themselves derived from Palaedictyopterous forbears), and Lameere's view would more nearly harmonise with the evident relationship of the Mecoptera to the Neuroptera, both groups being evidently descended from common ancestors, from which the Neuroptera have departed much less than the Mecoptera have. Since the fossil forms (with the exception of the Palaeodictyoptera) are not represented in the diagram, the line of development of the Mecoptera has been drawn as though extending back to the common Neuropteron stem. The Mecoptera form an extremely important group from the standpoint of phylogeny, since their line of descent is paralleled by, or is approached by those of so many other Neuropteroid insects, and it is to be hoped that the researches of Dr. Tillyard,* who has an extensive knowledge of the insects in question and who also has access to the most primitive

* Since writing the above, I have received from Dr. Tillyard a separate of a paper on the "Panorpoid Complex" (Proc. Linn. Soc. N.S.W., xliii, 1918, p. 265) in which he states that "the origin of the Panorpoidea from the Megasecoptera is not supported by a single piece of evidence worth considering," although he does not attempt to determine the ultimate ancestry of the Mecoptera.

representatives of the Mecoptera and their allies, will soon definitely determine the ultimate affinities of these insects.

The Trichoptera are extremely closely related to the Neuroptera, and were classed with them by the earlier entomologists. On the other hand, the Trichoptera are quite closely related to the Mecoptera also, and are derived from the Mecopteron stem by Handlirsch 1909 (*l.c.*) who, strange to say, represents the Dipteron line of descent as though branching off from the same stem at a lower point, whereas the Trichoptera are morphologically more primitive than the Diptera and have retained certain features which were probably present in the ancestors of the Diptera. Packard, 1883 (Third Rpt. U.S. Ent. Commission, p. 295), who derives the Diptera from the Trichoptera, groups the Mecoptera, Trichoptera and Neuroptera together in his order "Neuroptera," and traces the Trichopteron line of development to a Mecopteron stem, thus agreeing with Handlirsch's derivation of the Trichoptera. On the basis of the character of the ovaries, Emery groups the Trichoptera with the Coleoptera Adephaga, Neuroptera, Mecoptera, Lepidoptera, Diptera and Hymenoptera as "Metabola ovariis meroisticis" (*teste* Handlirsch), thus essentially agreeing with the view here expressed, save that the Coleoptera are not included with these insects. Sharp, 1889, according to Handlirsch, designates the insects called "Metabola ovariis meroisticis" by Emery, as the "Endopterygota," on the basis of the internal formation of the wings. Boerner, 1904 (*l.c.*), groups the Trichoptera, Lepidoptera, Neuroptera, Coleoptera and Strepsiptera together as the section "Proctanura" of his Holometabola. Leach, 1817, with his usual keenness of insight links together the Trichoptera and Lepidoptera in a group to which Haeckel, 1896, applies the term "Sorbentia" (one of his six "legions"). As was mentioned above, the Trichoptera are very closely related to the Neuroptera on the one hand, and to the Mecoptera on the other, and were probably descended from the Neuroptera-like ancestors which gave rise to the Mecoptera. They are undoubtedly very closely related to the Lepidoptera; but do not seem to have much in common with the Homoptera, with which Dana, 1864, groups them in his division "Amplipens" of the group "Ctenoptera."

The Lepidoptera are related to the Trichoptera, Neuroptera and Mecoptera; but their strongest affinities are apparently with the Trichoptera, as Leach, 1817, pointed out a hundred years ago. Speyer, 1839 (Oken's Isis, 1839, p. 94), suggested that the Micropterygids form a transitional group leading to the Trichoptera, and later in 1870 (Stettin. Ent. Zeitung, 1870, p. 202) he carried the comparison between the two groups still further. Chapman, 1893 (Trans. Ent. Soc. London, 1893, p. 255), calls attention to the huge mandibles of the pupa of *Micropteryx purpurella* (originally figured by Stainton in the Entomologist's Annual) which certainly resemble those of certain Trichopterous pupae, and on p. 569 of the Trans. Ent. Soc. London, 1896, Chapman * says, "I believe Dr. Sharp quite agrees with me in assimilating the Phryganeidae and Micropterygidae together as being, though somewhat far apart, still nearer together than either is to the Neuroptera on the one hand, or to the Lepidoptera on the other. I believe he sets more value on their Neuropterous than on their Lepidopterous affinities, whilst I take rather the contrary view, regarding the lower Adelidae as being very probably directly derived from the Micropteryges." Comstock, 1918 (The Wings of Insects, pp. 307, 313, 317), is so deeply impressed with the Trichopterous affinities of the Micropterygidae, that he removes them from the Lepidoptera and places them in the Trichoptera as a suborder of the latter group; but the Lepidopterous structures present on the Micropterygidae clearly indicate that they belong in the order Lepidoptera. Koletani, 1858 (Wien Ent. Monatschr., 2, p. 381), considers that the "aquatic" Lepidopteron *Acentropus niveus* is annectant between the Trichoptera and Lepidoptera, and since such Trichoptera as *Plectrotarsus gravenhorsti* have actually developed a *coiled proboscis* (!) like that of certain Lepidoptera one can hardly ignore the close relationship between the Lepidoptera and Trichoptera. Since the Trichoptera have remained more primitive than the Lepidoptera, although accompanying the latter insects for a considerable distance along the same developmental road, they may be considered as near as any living forms to the ancestors of the Lepidoptera. While emphasising the similarity between the wings of Lepidoptera and Trichoptera, Kellogg, 1895 (Amer. Naturalist, 29, p. 718), calls

* Dr. Tillyard informs me that Chapman places the *Micropteryx*-like forms in an order distinct from the Lepidoptera, called the Zeugloptera, in a later publication; but I have been unable to locate the reference.

attention to the resemblance of the wings of the Mecoptera to those of Lepidoptera, and Tillyard, 1918 (Ent. News, 29, p. 90), states that "the result of the study of five genera of the family Micropterygidae (*s.l.*, including the Eriocraniidae) is that I find them all to be, not of the jugate type of the Hepialidae, but of a more primitive jugo-frenate type, in which the wing-coupling apparatus closely resembles that of the Planipennia, Megaloptera and Mecoptera." Tillyard has also called attention to the resemblance between certain Australian Hepialid Lepidoptera and the Ithoniid Neuroptera.

As was the case with the Diptera in which it is extremely difficult to determine whether their line of development branched off from that of the Mecoptera (to which they are so closely related) or whether it extends parallel to that of the Mecoptera back to the Neuroptera-like ancestors giving rise to both Mecoptera and Diptera, so with the Lepidoptera, it is extremely difficult to determine whether their line of development branches off from that of the Trichoptera (to which they are extremely closely related), or extends parallel with the Trichopteron line of development back to the Neuroptera-like ancestors of both Lepidoptera and Trichoptera. This much, however, is true, that the Neuroptera have departed the least of any living insects from the ancestral condition of those forms giving rise to the lines of development of the Mecoptera, Trichoptera, Lepidoptera, etc. Packard, 1883 (*l.c.*), would derive the Lepidoptera from the Diptera, which in turn are derived from Trichoptera and these from Mecoptera, thus ultimately deriving them all from a common stock not unlike the Mecoptera. In this respect, his views are somewhat like those of Handlirsch (*l.c.*), who derives the Trichoptera, Lepidoptera, Diptera, etc., from the Mecopteron stem, which he traces back to Megasecopterous ancestors. Lameere, 1908 (Ann. Soc. Ent. Belgique, 52, p. 139), says, "I am completely in accord with Handlirsch with regard to the composition of this systematic unity (Handlirsch's group 'Panorpoidea') comprising the Mecoptera, Trichoptera, Lepidoptera, Siphonaptera and Diptera" (Lameere, however, uses other terms for these orders), and "I consider with Handlirsch, that this first group of the Holometabola is descended from the Megasecoptera." It is difficult to understand, however, why neither Handlirsch nor Lameere include the Neuroptera also among the

"Panorpoid" insects, especially since Lameere would derive the Neuroptera from the same Megasecopterous stem with the "Panorpoid" insects.

Handlirsch, 1909 (*l.c.*), suggests that the order Neuroptera should be divided into at least three orders, the Megaloptera (Sialidae and Chauliodidae), the "Raphidoidea," and the true Neuroptera. Of these he makes a subclass "Neuropteroidea" of equal value with his subclass Orthopteroidea containing such widely divergent forms as the Acridiidae, Forficulidae, Thysanoptera, etc., or with his Blattaeiformia, which includes such markedly differing forms as the Mantidae, Psocidae, Pediculidae, etc. Lameere, 1908, p. 141, says, "I am perfectly in accord with Handlirsch with regard to the composition of this systematic unity (the Neuropteroidea) formed of the Megaloptera, Raphidoidea and Neuroptera properly speaking (*i. e.* the Hemerobiiformia), and it is evidently the Megaloptera which exhibit the most archaic characters of the group," so that he evidently accepts Handlirsch's division of the order Neuroptera into these three orders. On page 297 of the Ent. News, vol. 27, 1916, I suggested that in addition to Handlirsch's subdivisions, the Neuroptera Planipennia might be further divided into a Mantispid group, a Myrmeleonid group, a Chrysopid group, and a Nemopterid group—the latter leading to the Mecoptera, with which they are united by Navas, 1905, in his book on the insects found in the neighbourhood of Madrid. If the Neuroptera were split into three distinct orders as Handlirsch has done, these groups might be regarded as suborders of the reduced order Neuroptera, with the exception of the Nemopteridae which are extremely closely related to the Chrysopid or Hemerobiid forms. Neither these subdivisions of the Planipennia nor Handlirsch's subdivisions of the Neuroptera are as distinct from one another as the Mecoptera are from the Neuroptera, however, and a rather extensive study of the thoracic sclerites of a number of types from Handlirsch's three orders of "Neuropteroidea" has revealed such a marked uniformity of structure in all three, that I have become convinced that these insects constitute but a single order, the Neuroptera. On the other hand, the sclerites of the Mecoptera and Trichoptera are sufficiently different from those of the Neuroptera to justify placing them in distinct orders, and since the thoracic sclerites have proven to be extremely "conservative" structures varying but little within an order, I think that the evidence they offer is of the utmost importance for any phylogenetic study.

With regard to the origin of the Neuroptera, Handlirsch would derive them directly from the Palaeodictyoptera, while Lameere is inclined to derive the Neuroptera from Megasecoptera, and would also derive the other holometabolous insects such as the Hymenoptera and Coleoptera from the same source. The resemblance between the larvae of the Coleoptera and those of the Neuroptera is very marked (Proc. Ent. Soc. Washington, vol. 20, p. 58), and, superficially at least, such primitive Coleoptera as *Calopteron* appear quite like certain Neuroptera; but a study of the structural details of the Coleoptera would point to a closer relationship with the Dermaptera and other members of the Plecopteroid superorder, and such resemblances as occur between the Coleoptera on the one hand, and the Psocidae and Neuroptera on the other, might possibly be explained as the result of the retention in each of certain features inherited from a common Plecopteroid ancestry.

As was stated at the beginning of the paper, I am inclined to regard the Neuroptera as the descendants of ancestors more directly related to the members of the Plecopteroid superorder; but ultimately descended from forbears related to the Ephemerid group, which contains the Palaeodictyoptera. Tillyard, 1917 (Biology of Dragonflies, p. 8), is inclined to consider that the Neuroptera are somewhat closely connected with the Odonata by the "very ancient Protascalaphine genus *Stilbopteryx*." Haeckel, 1866 (Gen. Morphol.), derives the Neuroptera from "Pseudoneuroptera," and many of the older writers grouped the Neuroptera with the Odonata and Ephemerida. Thus Clairville, 1798 (Ent. Helvet.), according to Handlirsch, includes the Odonata, Ephemerida, Plecoptera, and the Neuroptera, together with the Mecoptera, Trichoptera, etc., under the designation Dictyoptera—a designation applied by Brullé, 1832, to the Odonata, Ephemerida, and Plecoptera, and by Leach, 1817 (Zool. Misc., 3), to the Blattidae and Mantidae. There are considerable grounds for considering that the Ephemerida are quite closely related to the Neuroptera and that the Odonata are also quite closely related to them; but the closest affinities of the Neuroptera are with the insects whose lines of descent are shown in Fig. 2.

Certain of the earlier entomologists (*e. g.* Latreille, 1831, Newman, 1834, etc.), and more recently Banks, are inclined to include the Isoptera with the Neuroptera. The Mantidae (which belong in the same superorder with the Isoptera) also show some affinities with the Neuroptera; but I am inclined to interpret these resemblances as the result of the retention of certain primitive features inherited from the common Plecopteroid ancestry from which were derived the Isoptera, Mantidae, etc., on the one hand, and the Neuroptera, with their allies, on the other. Through this Plecopteroid ancestry, the line of development of the Neuroptera leads back ultimately to forbears related to the Palaeodictyoptera, and other insects belonging to the Ephemerid group (in which the Megasecoptera might also be included). The relationship of the Neuroptera to the Mecoptera certainly seems very much closer than would be indicated by Handlirsch's deriving the Mecoptera from Megasecoptera while deriving the Neuroptera from Palaeodictyoptera; and the facts of comparative anatomy (not based upon the study of wings alone) would certainly appear to be more in harmony with the derivation shown in Fig. 2, in which the lines of descent of the Mecoptera and their allies are represented as quickly merging with that of the Neuroptera, which soon unites with the main stem of the Psocidae and their allies to form a main Neuropterous group stem. This in turn merges with the lines of development of the Plecopteroid forms, which are later joined by the lines of development of the Megasecoptera, Palaeodictyoptera and other insects belonging to the Ephemerid group.

It may be mentioned in closing, that the insects related to the Neuroptera fall into two superorders, each of which contains some insects very closely allied to certain members of the other superorder; but each group is fairly well defined. Of these insects, the Neuroptera, Lepidoptera, Trichoptera, Mecoptera, Diptera, Siphonaptera and the Hymenoptera (together with their fossil relatives) may be grouped in a superorder called the PANNEUROPTERA (Psyche, vol. 25, 1918, p. 55), characterised in general by the retention of five segments in the tarsi, the division of the mesothoracic coxae by an approximately vertical suture (which is present in the lower representatives of the Diptera, despite the frequent statements to the contrary—see Crampton and Hasey, 1915, "The Basal Segments of the

Leg in Insects," Zool. Jahrb., Abt. Anat., 39, pp. 1–26), the internal development of the wings, complete metamorphosis, etc.; while the Psocidae, Mallophaga, Pediculidae, Hemiptera and Homoptera, with their fossil relatives (and possibly including the Thysanoptera also) may be grouped in a second superorder called the PANHOMOPTERA (Psyche, *l.c.*), characterised in general by the reduction of the number of tarsal segments to not more than three, no division of the mesothoracic coxae (save in rare instances), external development of the wings, and practically no marked metamorphosis. There are some exceptions; but for the most part, these characters hold good for the more primitive representatives of each group.

VI. *On the types of Oriental* Carabidae *in the British Museum, and in the Hope Department of the Oxford University Museum.* By H. E. Andrewes.

[Read May 7th, 1919.]

By the term "Oriental Carabidae" I mean the species inhabiting India and South-Eastern Asia, including all the adjacent islands; the great majority, however, of those I shall deal with in this paper come from three well-defined areas, viz. Java (Macleay), Nepal (Hope), and Ceylon (Walker).

In going through the literature of the subject I have been much struck by the fact that the chief writers on it have been very imperfectly acquainted with the types —fairly numerous in the aggregate—which are in the British Museum and at Oxford. The reasons for this are not far to seek, for the descriptions of Hope and Walker rarely exceed a couple of lines, and as a means of identifying a species are of no value whatever. Macleay's descriptions, though a little fuller, are also very short. Consequently, entomologists, desiring to discuss the work of these authors, could only do so effectively by examining the actual types. Very few appear to have thought it worth while to do this, though Hope and Motchulsky examined the Fabrician types and published their observations. Schaum and Chaudoir both also saw the British Museum collections, but they relate next to nothing of what they saw there.

When H. W. Bates was writing his paper on the Carabidae collected by Mr. George Lewis in Ceylon, he was obliged to take note of Walker's work, though he evidently did so with reluctance. Walker's types are consequently better known than Hope's or Macleay's, though there still remains a good deal to clear up about them.

I propose to give a list of all the types I have been able to see, author by author, giving the synonymy where the species have been redescribed by later writers, and additional descriptions where they seem necessary. Such descriptions, however, are necessarily confined to characters which are readily visible, for no dissection is possible;

unfortunately the important mouth-parts are often obscured by dirt or gum, and antennae, palpi, tarsi, etc., are not infrequently wanting. I have tried to give fairly full references, and always quote the page of the works referred to: I mention this because some of the older writers gave numbers to their species, and quoted these numbers instead of the pages. In the case of each species I give the modern genus, followed where necessary by the original genus in a parenthesis.

I must express my thanks to Dr. Gahan for the courtesy extended to me in the Entomological Department at the British Museum, to Dr. Marshall for much valued help on nomenclature and many other matters, to Mr. J. H. Durrant and Mr. C. Davies Sherborn for assistance with ancient entomological literature and handwriting, and last but not least to Mr. G. J. Arrow, who has been unremitting in aiding me to solve the various problems encountered in dealing with the older types. My grateful thanks are also due to my old friend Prof. E. B. Poulton, who has been kind enough not only to afford me access to the collections in the Hope Department of the Oxford University Museum, but also to bring types up to London so that I might examine them at leisure and compare them with other material.

I. *Types in the British Museum.*

Linnaeus.

Pheropsophus (Carabus) bimaculatus (Mant. Ins. 1771, 532). The type of this, the only Oriental species among the Carabidae described by Linnaeus is in the Museum of the Linnaean Society, where, through the courtesy of Dr. Daydon Jackson, I was enabled to see it. It is a well-known species, calling for no special comment. I believe it to be confined to the southern half of India, with Ceylon. A single specimen in the British Museum is labelled "Nepal," and Mr. Lesne (Miss. Pavie 1904, Col. 79) records the species from Laos: in each case, however, further evidence seems to be required.

Fabricius.

Fabricius in his various works published descriptions of insects in a great many different collections, so that the types of the species described are widely spread. Among the more important collections I may mention those of

Lund, Sehestedt, Banks, and Hunter; the two former are now in the University Museum at Copenhagen, the Banks Collection is in the British Museum, and the Hunter Collection in the Glasgow University Museum. The collection of Fabricius himself is in the Kiel University Museum. Among the Glasgow types there are none of Oriental Carabidae, so that my remarks will be confined to the specimens in the Banks Collection. These were seen by Hope (Col. Man. ii, 1838, 36–45), and lists are given of the Carabidae described by both Linnaeus and Fabricius, together with the localities, and the correct genera as known at that time. In his preface Hope says: "From my friend Dr. Erichson of Berlin I have lately received the offer of the loan of his Manuscripts on Fabrician Insects, in which are noted down many observations made during a careful examination of the Copenhagen Collections." I cannot, however, find any further reference to these notes in Hope's works, nor does Erichson appear to have published them. Schaum saw the Kiel and Copenhagen collections in 1845 and published some remarks on them. Neither he nor Erichson, however, give any intimation that they had examined the Banks Collection.

About ten years later Motchulsky made a tour including London, Kiel, and Copenhagen, where he examined the Linnaean and Fabrician types. The results of his examination will be found recorded at some length in his "Études Entomologiques" (vol. iv, 1855, 25–71). He seems also to have had the advantage of some notes made by Chevrolat during his residence at Kiel and Copenhagen.

Each of these authors has added something to our knowledge of the insects which Fabricius described, but there are still obscurities which, as far as the material in the Banks Collection goes, I shall do my best to remove. Accordingly I give below some notes on five Oriental species, and also—for special reasons—on a sixth species from West Africa.

1. **Anthia (Carabus) sexguttata** (Syst. Ent. 1775, 236). This well-known species, which seems to be confined to, and is also common throughout India, does not call for special comment. It has been redescribed by other entomologists under the following names, viz. *orientalis* (*Pachymorpha*) Hope (Col. Man. ii, 1838, 163, t. 3, f. 4), *indica* Chaud. (Bull. Mosc. 1861, ii, 562), and *elliptica* Motch. (Bull. Mosc. 1864, iii, 216), but these are at most

local forms. Some further remarks will be found under *A. orientalis* Hope.

2. **Luperca (Carabus) laevigata** (Spec. Ins. i, 1781, 304). The type of this species was not at first in evidence among the other Carabidae, but, knowing that it should be in the Banks Collection, I searched through some supplementary drawers and found it without much difficulty. The species was figured by Olivier (Ent. iii, 1795, 36, 7, t. 2, f. 18) under the name of *Scarites laevigatus*, and also by Lacordaire (Gen. Col. 1854, Atl. t. 6, f. 1). Dejean (Spec. Gen. v, 1831, 474) describes it under the name of *Enceladus laevigatus*. In Chaudoir's "Monographie des Siagonides" (Bull. Mosc. 1876, i, 74), it is redescribed as *Holoscelis laevigatus*. The species is well known, and, like the last, confined to India.

3. **Chlaenius (Carabus) cinctus** (Spec. Ins. i, 1781, 310). So far as my knowledge goes this species has never yet been correctly identified by any of the numerous writers who have referred to it, nor does Schaum or Motchulsky throw any light on the question.

The specimens taken by Mr. George Lewis in Ceylon, and determined by Bates (Ann. and Mag. of Nat. Hist. 5, xvii, 1886, 74) as *C. cinctus* Fab., agree well with the description of this species in Chaudoir's "Monographie des Chléniens" (Ann. Mus. Civ. Gen., 1876, 135), so that these two authors evidently mistook the same species for that described by Fabricius. Bates puts *C. pulcher* Nietn. (Journ. of the As. Soc. of Beng. v, 1856, 387) in synonymy: Chaudoir refers to *C. pulcher* in the index of his Monograph, but as there is no reference to the species on the page indicated, we are left in doubt as to his views. I think, however, this identification is probably correct, and in that case Nietner's name would stand for the wrongly identified species. Nietner's short description leaves some uncertainty, and I do not know where his types are to be found.

Other authors before Chaudoir's time redescribed the species, notably Herbst (Fuessly's Arch. v, 1784, 135, t. 29, f. 7), Olivier (Ent. iii, 1795, 35, 87, t. 3, f. 28)—who tells us that the species is found on the Coromandel Coast, and is very common in the southern departments of France—and Dejean (Spec. Gen. ii, 1826, 307). As there are several closely allied species, it is impossible to identify with any certainty those just mentioned until the type specimens are available for examination. Olivier evidently had two species before him.

The type of *C. cinctus* is stated to have come from Coromandel, and there is one other example in the British Museum Collection labelled "E. Indies." In the Hope Department at Oxford there are two examples, one labelled "Madras" and the other "*sykesi* Hope, Poonah": the latter label is in Hope's handwriting, a curious circumstance, as *cinctus* has no connection whatever with *sykesi*, the type of which is at Oxford.

Since Fabricius gave his brief description no other has been published and I therefore give a more detailed version, amplified here and there by reference to the other specimens.

Chlaenius cinctus Fab., ♂. Length 15 mill. Width 6 mill.

Head and prothorax green. Elytra black with faint green reflection. Labrum, palpi, antennae, legs (except trochanters, which are light brown, and coxae, which are dark brown), margin of elytra up to stria 8, epipleurae of elytra, and a narrow margin round the abdomen dull yellow. Underside black to very dark brown, iridescent, the margins of the ventral segments lighter brown. Pubescence greyish-yellow.

Front and vertex sparsely punctate, the latter more strongly at the sides behind; eyes moderately prominent. Prothorax not quite half as wide again as head, almost quadrate, slightly transverse, emarginate in front, almost straight behind, the sides rounded, sinuate before hind angles, and a little more contracted in front than behind, broadest a little before middle; front angles not much rounded, hind angles obtuse, but this is because the basal margin makes a slight bend forward on each side when near the angle; surface fairly flat, but declivous at front angles; puncturation strong especially over the basal third, not close, sparse on disk; reflexed border very narrow, a broad short shallow furrow near hind angles, transverse impressions nearly obsolete, central furrow very fine not reaching margins.

Elytra rather less than half as wide again as prothorax, nearly parallel, basal margin straight to base of fourth stria, then bending forwards to the shoulder, where it makes a very wide angle with the side margin, border narrow and only slightly sinuate near apex which is rounded; striae finely punctate-striate, intervals very faintly convex; the whole surface moderately punctate, the punctures laterally confluent, but not close enough to give the elytra an opaque appearance.

Metepisterna without furrow near outer margin; prosternal process faintly margined; underside punctate, rather closely along the sides of the ventral surface, more sparsely along its median line, on the prosternal process and the pro- and meso-episterna. Front femora without tooth; dilated joints of tarsi a little longer than wide, joint 1 elongate-triangular, 2 and 3 rectangular but contracted at base.

Surface of the body pubescent (type much rubbed), the pubescence being much closer on the elytra than on the head and thorax. Prosternal process glabrous between the coxae, with a tuft of erect hairs at the apex.

Closely allied to *C. chalcothorax* Wied., but less elongate, with side margins of thorax more distinctly sinuate before hind angles; head and thorax more, but elytra less closely punctured. Antennae of lighter colour.

4. **Pheropsophus (Brachinus) tripustulatus** (Ent. Syst. i, 1792, 145). Bygone generations of Entomologists have been much exercised over this species. The trouble was originated by Westermann, who sent a Javanese insect to Dejean as "the veritable *Brachinus tripustulatus* of Fabricius." Actually it was nothing of the kind, and Dejean, in describing it under the name of *Helluo tripustulatus* (Spec. Gen. i, 1825, 286), indicates his scepticism sufficiently clearly. Hope (Col. Man. ii, 1838, 101) remarks: "The specimens" [there seems to be only one] "in the Banksian Cabinet are decidedly of the genus *Pheropsophus*." Motchulsky (Et. Ent. 1855, 55) says: "D'après la Col. de Banks cette espèce est voisine du *Br. marginalis* Schönh., mais non un *Macrocheilus*, ainsi que c'est le cas pour l'exemplaire conservé dans la Col. de Copenhague." I gather from this that both he and Hope saw the type in the Banks Collection; also that in the Copenhagen Collection a *Macrochilus* figures as the Fabrician insect. No further effort seems to have been made to elucidate the matter, and among the specimens in the Banks Collection I found, indicated as "type?", three examples of the species at present known as *Macrochilus bensoni* Hope (but see under Olivier), the continental representative of Dejean's *Macrochilus* (*Helluo*) *tripustulatus*. On one of these examples is a note by the late C. O. Waterhouse dated 2. x. 1883: "These specimens were found in the Supplementary drawer at end of Banks Coll. with no label." The description, however, left little

doubt in my mind that the insect described by Fabricius was a *Pheropsophus*, and in going through the supplementary drawers again I discovered a specimen of that genus bearing the label "*tripustulatus*"—no doubt the type specimen from which the description was drawn up.

In the Transactions of 1901 Mr. G. J. Arrow reviewed the genus *Pheropsophus*, and described some new species. He also had the opportunity of comparing specimens in the British Museum Collection with some of Chaudoir's types. A specimen labelled "India (Bowring Coll.)" was found by Mr. Arrow, after comparison with the type, to be identical with Chaudoir's *P. amoenus* (Bull. Mosc. 1850, i, 78). This specimen agrees well with *tripustulatus*, which name accordingly replaces Chaudoir's. The type came from Siam; Chaudoir did not know the locality of his *P. amoenus*. I have not seen any other specimens.

5. **Craspedophorus (Carabus) angulatus.** I suppose few species have given rise to such a Comedy of Errors as this one. The specimen in the Banks Collection was originally described by Fabricius in Spec. Ins. i, 1781, 302, and the description reappeared in Mant. Ins. i, 1787, 197, and Ent. Syst. i, 1792, 148. In Syst. Eleuth. i, 1801, 203, the name reappears, but the insect is a totally different one. I am not sure that it has been identified with certainty, but there seems little doubt that it is the same thing as Dejean's *Pachytrachelus* (*Agonoderus*) *oblongus* (Spec. Gen. v, 1831, 813).

To add to the confusion another example of *angulatus* (1781) served as type for *Pimelia fasciata* (Spec. Ins. i, 1781, 318; Mant. Ins. i, 1787, 209; Ent. Syst. i, 1792, 104). I have not had the opportunity of seeing the type, but I see no reason to doubt the identity of the two species. (See further remarks under the next species *Craspedophorus reflexus*.)

Vigors next described the species (Zool. Journ. i, 1824, 537, t. 20, f. 1) under the name of *Panagaeus tomentosus*, and this name was subsequently adopted by Dejean (Spec. Gen. ii, 1826, 284, and v, 1831, 598) and Laferté (Ann. Soc. Ent. Fr. 1851, 220). The type specimen described by Vigors is in the British Museum collection.

It was left to Chaudoir, however, to render confusion worse confounded. He first of all described the genus *Epicosmus* (Bull. Mosc. 1846, iv, 512 (note)) expressly for this species. In his "Révision des espèces qui rentrent dans l'ancien genre *Panagaeus*" (Bull. Mosc. 1861, iv, 336) he changes Fabricius' *fasciata* to *bifasciata*, but the other references are correct, and we have *Epicosmus angulatus* Fab. = *Panagaeus tomentosus* Vig. = *Pimelia bifasciata* Fab.

Later on in his "Essai monographique sur les Panagéides" (Ann. Soc. Ent. Belg. xxi, 1878, 133), not only is the species allotted to a new genus, but the name of *angulatus* has disappeared and we have only *Eudema bifasciatum* Fab. = *Panagaeus tomentosus* Vig. Having thus eliminated the correct name and introduced an erroneous one, Chaudoir makes his own error the pretext for changing Castelnau's *Craspedophorus bifasciatus* into *C. castelnaui* Chaud. (Some remarks on Chaudoir's Monograph will be found under the next species.)

The species is common in South India, without apparently extending to Ceylon. There is an example in the British Museum labelled "Nepal," and two examples at Oxford labelled "Assam" and "Siam" respectively, but these indications seem to me doubtful.

6. **Craspedophorus (Carabus) reflexus.** Although this is an African species, it was described as coming from India, and references to it in entomological literature are so wide of the mark that I refer to it here. Before doing so I must say a few words to illustrate Chaudoir's remarkable proceedings when preparing his "Monographie sur les Panagéides" (Ann. Soc. Ent. Belg. xxi, 1878). *Panagaeus* was described by Latreille (Hist. Nat. Crust. et Ins. iii, 1802, 91) and was used for many years as the genus of most of the then known species of the group. Hope (Col. Man. ii, 1838, 165) described the genus *Craspedophorus* for Fabricius' *Cychrus reflexus*, and, although his reference to the species is erroneous, his description of the genus shows clearly that he had the type before him, and moreover he gives (t. 3, f. 1) a figure, which, except for the outline of the thorax, fairly represents it. Two years later Castelnau (Hist. Nat. Ins. i, 1840, 137) indicated rather than described his genus *Eudema* for *Panagaeus regalis* Gory (Ann. Soc. Ent. Fr. 1833, 213) from Senegal and *C. reflexus* Fab., which he makes a synonym of *P. nobilis* Dej. (Spec. Gen. v, 1831, 598) from the Cape of Good Hope; the two last-named species are quite different and probably it was *P. nobilis* he had before him. Chaudoir (Bull. Mosc. 1846, iv, 512 (note)) described his genus

Epicosmus for *P. tomentosus*, by which we must understand *Carabus angulatus* Fab. (1781). I need not go any further than this with the various genera included in the group.

With this material to work on, together with some more modern genera, Chaudoir hit upon the following ingenious expedient. "Pour éviter de créer des noms nouveaux, j'ai approprié à chacune des divisions que j'ai introduites dans les grands *Panagaeus* à tarses simples un de ceux qui ont déjà été proposés" (Mon. p. 90). Under this scheme of "appropriation" *Eudema* was attached to *angulatus* Fab. (1781) (under the guise of *bifasciatus*), *Craspedophorus* got the African species with a raised thoracic margin, while *Epicosmus* (the reference to which is misquoted by its author) got the Indian and African species with narrower thorax and without raised margin. These names do not seem to me to indicate more than divisions of one genus, which should bear Hope's name of *Craspedophorus*.

Coming now to the species, we find that Fabricius himself made an unfortunate blunder. *Carabus reflexus* was first described in Spec. Ins. i, 1781, 303, and the description is followed by the words "Coromandel, Mus. Dom. Banks." This is repeated in Mant. Ins. i, 1787, 197, and Ent. Syst. i, 1792, 147. In Syst. Eleuth. i, 1801, 166, the species is put under the genus *Cychrus*, and followed by two references: (1) *Carabus reflexus*, Ent. Syst. i, 1792, 147; (2) *Pimelia fasciata*, Ent. Syst. i, 1792, 104. We then read with surprise: "Habitat in Germania, Mus. Dom. Lund." Fabricius, as we learn from Hope (Col. Man. ii, 1838, 165), labelled another species *Carabus reflexus*; Hope proposed the name of *Panagaeus fabricii* for this, but did not describe it. The specimen (which belongs to Schaum's species *Craspedophorus* (*Isotarsus*) *mandarinus*, Ann. Soc. Ent. Fr. 1853, 436) is at Oxford, and Mr. Durrant identifies the Fabrician handwriting on the label. Fabricius had not therefore a very clear picture in his mind of his own species, and I think it almost certain that his memory was at fault again when he apparently identified a specimen in the Lund Collection as his own *C. reflexus*. Illiger (Mag. für Ins. i, 1802, 345) seems first to have drawn attention to the fact that "Germania" was an obvious mistake, and he tells us also that the specimen of *C. reflexus* in the Hellwig-Hoffmannsegg Collection came from Sierra Leone. The fact appears to be that *Cychrus reflexus* (1801) = *Pimelia fasciata* (1792) = *Carabus angulatus* (1781). Both Hope (Col. Man. ii, 1838, 66 and 92) and Schaum (Stett. Ent. Zeit. 1847, 42) go into the matter, though they do not bring out all the facts. Hope (l.c. 66) proposed the genus *Camptoderus* for *C. reflexus* Fab., but did not describe it; by the time he got to p. 165 he seems to have forgotten about this, and without explanation proposed and briefly described the genus *Craspedophorus* for the same insect. Motchulsky (Et. Ent. 1855, 69) went quite astray, and Mr. Alluaud, who has quite recently published descriptions of new African species of *Eudema* (Bull Soc. Ent. Fr. 1915, 152), has unfortunately followed him rather than Hope and Schaum.

I give a description of the species, but the type is defective. Fortunately there is in the British Museum Collection another example labelled "W. Africa," and this has enabled me to add some details which would otherwise have been wanting.

Craspedophorus reflexus Fab. Length 29 mill. Width 9 mill.

Elongate, prothorax roughly sculptured, with widely reflexed margins. Black, elytra with four transverse orange spots, the apical margin of the last joint of all the palpi yellow.

Head elongate, width 3·5 mill., labrum a little emarginate, clypeal suture invisible, middle of the head between the antennae raised, smooth, and polished, rugose and coarsely punctured in the frontal furrows and on the vertex. Mentum wide, with a short truncated tooth. Mandibles short and strong, hooked at the tip. Hope's figures for these parts (l.c. t. 3, f. 1*a* and 1*b*) are fairly good. Maxillae strongly curved at tip, elongate and very sharp. The type has lost all the palpi, but they are present in the second specimen and are very long. The ante-penultimate joint of the maxillaries is about as long as the first joint of the antennae, the penultimate joint of both pairs two-thirds of this length, and the apical joint three-quarters. The outer margin of the apical joint is three times as long as the inner one, and the apical margin is slightly hollowed out; this joint is almost identical in both maxillaries and labials. The type has lost all but the first joint of the antennae, but in the second specimen joint 3 = 1 + 2 = 4 + 5, but 1 is twice as long as 2, and 4 is very slightly shorter than 5.

The representation of the prothorax in Hope's figure is poor. Width 7 mill., length 5·5 mill.; front margin a little sinuate, hind margin straight (except at sides), more rounded than is shown in the figure, more contracted in front than behind, sinuate before hind angles; front angles rounded and hardly prominent, hind ones also rounded with a minute indentation at the angles; sides broadly reflexed, especially towards base; median furrow rather faint; the whole surface covered with large confluent punctures, giving it a very rough appearance.

Elytra long, nearly parallel, shoulders not very much rounded; border narrow, a little sinuate before apex; punctate-striate, striae deep, intervals convex and closely punctured, third interval with three punctures, 1 just before middle, 2 and 3 close together at about two-thirds from base; front orange spot narrow, transverse, at one-fourth from base, covering intervals 4–8 (in the type a little colour shows on 3), the colour on 6 extending furthest towards apex, and on 8 towards base, though in each case only a little way; hind spot at three-fourths, resembling front one, but colour extending furthest towards base on 6 (in the type hardly any colour is visible on 3 or 8). Episterna and sides of sterna and ventral surface very coarsely punctate, metepisterna rather longer than wide, median line of body finely but sparsely punctate and a little transversely rugose, prosternal process indistinctly bordered, front margin of ventral segments apparently not crenulate, a few large punctures on each side of last one, a little removed from margin.

I have compared the type with a specimen of *C. regalis* Gory (Ann. Soc. Ent. Fr. 1833, 213), to which it seems nearly related. The insect is smaller, the prothorax has not the *Lebia*-like produced base of *C. regalis*, the punctuation of the elytra is closer and finer, the yellow bands are narrower, extending inwards to stria 3 only, instead of to 1 in front and 2 behind as in *regalis*.

Olivier.

There is in the Banks Collection the type of a Carabid described by Olivier under the name of *Carabus trimaculatus*. It bears no locality label, and Olivier did not know where it came from. It is probably due to this fact that the species has been overlooked, and no references to it have, as far as I know, appeared in entomological literature.

Macrochilus (Carabus) trimaculatus (Enc. Méth. Ins. ii, 1790, 347, t. 179, f. 11; Ent. iii, 1795, 35, 88, t. 7, f. 85). An examination of this insect showed at once that it was identical with Hope's *Macrochilus bensoni* (Col. Man. ii, 1838, 166, t. 1, f. 5). As I shall discuss this species under the heading Hope, I will refer readers to my remarks there, and also to some remarks under Fabricius (*Pheropsophus tripustulatus*). Olivier's name being much older than Hope's must, of course, replace the latter.

Chaudoir has also described an Indian species under the name of *Macrochilus* (*Acanthogenius*) *trimaculatus* (Rev. et Mag. Zool. 1872, 171), and for this I propose the name of *M. chaudoiri*.

Kirby.

There are three of Kirby's types in the British Museum, and the descriptions of all of them appeared in the transactions of the Linnaean Society.

1. **Calosoma chinense** (Trans. Linn. Soc. xii, 1818, 379). Redescribed by Dejean (Spec. Gen. v, 1831, 563), and referred to by various authors. The species is a well-known one and appears to be common in China. Bates records it from Japan (Trans. Ent. Soc. 1883, 232), and also informs us (Entom. xxiii, 1890, 212) that it occurs as far North as the River Amur. Motchulsky's *C. aeneum* (Bull. Mosc. 1859, iv, 489) from the Amur may be the same species.

2. **Catascopus hardwicki** (Trans. Linn. Soc. xiv, 1825, 98, t. 3, f. 1). The type of this species, which is also the genotype, came from " India," and the only other example I have seen, which bears no locality-label, is in the Hope Collection, at Oxford. The locality from which the type came is a little mysterious. Kirby says : " The individual specimen here described being transfixed by the same peculiar pin which Major-Gen. Hardwicke used for all the small insects that he collected in India (many of which he gave to the late Mr. Marsham, at whose sale I purchased it), I think I am warranted in my conjecture that this was one of them." We know that Hope described a number of Carabidae taken by Gen. Hardwicke in Nepal, and there is some probability, therefore, that Kirby's specimen came from the same locality.

It was assumed by Dejean (Spec. Gen. i, 1825, 329) and by Schmidt-Goebel (Faun. Col. Birm. 1846, 81) that Kirby's species was identical with Wiedemann's *C.* (*Carabus*) *facialis* (Zool. Mag. i, 3, 1819, 165), which is far from being the case. Chaudoir in his two discourses on *Catascopus* (Berl. Ent. Zeit. 1861, pp. 116–23, and Rev. et

Mag. Zool. 1872, pp. 244–50) did not think it worth while to refer to the type of the genus. I give a detailed description, as Kirby's brief diagnosis appears to be the only one extant.

Catascopus hardwicki. Length 9 mill. Width: head 2·0, prothorax 1·75, elytra 3·25 mill.

Piceous, upper surface of head and prothorax dark blue, sides of elytra dark aeneous green, mouth-parts (except mandibles), femora, and trochanters brownish. Surface finely shagreened.

Head wide, shiny, finely rugose with faint puncturation, smooth on neck, bicarinate on each side, inner ridge running forward to end of clypeal suture, frontal margin almost straight in middle, with a fine short longitudinal incised line running backwards from its centre, its sides forming angular projections; clypeus smooth, emarginate, with a seta on each side, labrum porrect, rounded in front, with a small excision, eyes very prominent, mandibles strong, hooked at tip.

Prothorax a little wider than long, widest at a fourth from apex, slightly emarginate in front and bisinuate at base, sides bordered and reflexed, with pores at a third from apex and on hind angle (setae abraded), gently rounded in front, strongly and widely sinuate behind, front angles very little rounded, but not projecting, hind angles acute, projecting laterally, and a little reflexed, base bordered (except in middle); front transverse impression shallow, basal one deep, median line deep, forming elongate foveae at extremities, reaching base but not apex, basal foveae deep, rounded, close to hind angles; surface shiny with fine cross wrinkles and extremely fine scattered puncturation, the course of the front transverse impression finely rugose.

Elytra short, square, parallel, about three times as long as thorax, shoulders well marked, margin finely bordered, sinuate at a third from base, obliquely truncate at apex, truncature slightly emarginate, outer angle quite rounded, inner angle narrowly truncate, extreme apex fairly sharp; striae almost impunctate on disk, strongly punctured at sides, 3 with three punctures at a fifth, a half, and four-fifths from base respectively, a short striole between 1 and suture, intervals smooth, the three inner ones fairly flat, 4 raised at base and again in middle, leaving a depressed area at about a third from base, which extends on to the adjoining intervals, 5 and 6 narrower, the former carinate on its middle third, 7 very narrow, carinate throughout, a marginal series of large umbilicate punctures, interrupted in middle, one or two very long setae issuing from them (others probably abraded).

Underside (as far as it can be seen) smooth, prosternal process very finely bordered at apex, metepisterna elongate.

The elytra differ in colour from those of *C. facialis* Wied., and the size is much smaller, head with two carinae on each side (instead of one), front angles of prothorax less projecting, hind angles acute and projecting (instead of right), elytra shorter, fourth interval depressed near base, outer angles of apical truncature rounded instead of toothed.

3. **Hexagonia terminata** (Trans. Linn. Soc. xiv, 1825, 564). Kirby's genus was subsequently described by Dejean (Spec. Gen. v, 1831, 288) under the name of *Trigonodactyla.* It has been dealt with by numerous authors, the latest of whom, Commandant Dupuis, gives details of the genus and a list of the species and their synonymy (Gen. Ins. Hexagoniinae 1913, 2). In this list we read, "19 ? (Description insuffisante) *H. terminata* Kirby, etc.," from which the casual inquirer is left in some doubt whether the genotype belongs to the genus at all. Kirby's description is certainly a very poor one, as was pointed out by Schmidt-Goebel (Faun. Col. Birm. 1846, 50), who discusses both genus and species at some length. Lacordaire (Gen. Col. i, 1854, Atl. t. 3, f. 1) gives a figure alleged to be *Trigonodactyla terminata* Kirby; in the "Explication des planches," however, it appears correctly as *T. terminata* Dej. (= *terminalis* Mun. Cat.), an African species.

This type, like the last, was bought by Kirby at Marsham's sale, and, as it was pinned in the same way, he assumed—probably rightly—that it came from India. I have seen another example from Munshiganj (Bengal) in the Pusa Collection, and Mr. Vitalis de Salvaza has taken a third specimen at Vientiane in Laos.

I give below a fresh description of the species.

Hexagonia terminata, ♀. Length 9 mill. Width: head and prothorax 1·75, elytra 3·0 mill.

Piceous, basal two-thirds of elytra, epipleurae of elytra, first two joints of antennae, femora, trochanters, and apex of last ventral segment testaceous, margins of prothorax (narrowly), mandibles, middle of metasternum, abdomen, tibiae, and tarsi reddish-brown, joints 3–11 of antennae fuscous.

Head flat, wide, smooth, shiny, hexagonal, gradually contracted behind eyes for a distance about equal to their diameter, then sharply constricted into a narrow neck, which forms a peduncle; frontal impressions extending from mid-eye level to the front margin of clypeus, gradually contracted in front, and bounded outwardly by a ridge, area between them slightly depressed, clypeal suture well marked, front margin of clypeus faintly emarginate, a seta on each side, labrum truncate, 6-setose; a narrow furrow running along inner margin of eye, widening behind eye and turning obliquely inwards for a short distance, just beyond its termination a large shallow pore. (These pores are no doubt setiferous, as in other species, but the setae, as in the case of the front supra-orbital pores, have vanished). Mandibles small, sharp, eyes moderately prominent, front margin close to buccal fissure; antennae reaching base of thorax, setose from first third of joint 4, 2 very short, rest about equal, but 3 a little shorter and 4 a little longer than the rest.

Prothorax more or less hexagonal, flat, widest at two-fifths from apex, truncate in front and behind, front angles adjoining neck and quite inconspicuous, margin finely bordered, forming an obtuse angle a little before middle, strongly arcuate in front of this, straight behind, but sinuate near hind angle, which is right, a (presumably setiferous) pore at side angle, none visible at basal angle; transverse impressions obsolete, median line deep and wide, almost reaching extremities, basal foveae elongate, a ridge running inside border from near basal angle to near apex, leaving a more or less explanate area between it and margin (coloured red), widest opposite side angle; surface shiny, a little transverse striation at sides, some coarse confluent punctures on base and basal foveae.

Elytra parallel, rather flat, shiny, base bordered, border forming an angle over interval 5, shoulders evident but rounded, margin sinuate before apex, striae punctate-striate, a scutellary striole between 1 and suture, intervals flat, 3 with three punctures, one near base adjoining stria 3, second rather behind middle, and third not far from apex, both adjoining stria 2, 5 with a single puncture at a third from apex, marginal series interrupted in middle.

Underside smooth, prosternum and pro-episterna coarsely punctate except in middle, metasternum lightly punctate at sides, metepisterna very long and narrow, smooth, two pores at each side of last ventral segment a little removed from margin.

Compared with *H. bowringi* Schaum (Berl. Ent. Zeit. 1863, 73 and 433, t. 3, f. 3) from Penang, this species—in addition to its quite different coloration (*H. bowringi* being uniformly piceous)—has a narrower head, narrower frontal impressions, bounded by more obvious ridges, prothorax much narrower and less contracted behind, sides angular instead of rounded, surface less convex and less smooth; elytra rather flatter, but the pores on intervals 3 and 5 are identical.

Vigors.

One type only, viz.:—

Craspedophorus (Panagaeus) tomentosus (Zool. Journ. i, 1824, 537, t. 20, f. 1) = **C. (Carabus) angulatus** Fab. (1781).

This species has already been referred to among the Fabrician types.

W. S. Macleay.

Macleay's "Annulosa Javanica" and the first volume of Dejean's "Species Général des Coléoptères" both appeared in the year 1825, the former during the summer (though I have not been able to ascertain the month of publication) and the latter in September. Any doubts, however, regarding priority are set at rest by the mention of Macleay and the "Annulosa Javanica" in the "Table Alphabétique des Auteurs, etc.," at the commencement of Dejean's book. Macleay's work does not compare in magnitude with Dejean's; he goes into considerable detail, however, in describing his new genera, and, although the descriptions of species are often very short and imperfect, we have to thank him for making known many insects from Java, the entomological fauna of which must at that time have been almost unknown. It is unfortunate that the types of Carabidae which he described have been so little studied; I hope by my remarks to make them rather better known.

The collection of Coleoptera and other insects made by Dr. Horsfield in Java during the years 1812–1817, and described in part by Macleay, was deposited and remained for many years in the Museum of the East India Company. It was during this period that it was examined by Hope, who in his Coleopterist's Manual (Part II, 1838) gives a few references to Macleay's genera and species, and on plate 2 figures six of the latter with anatomical details. In 1860 it was removed to the British Museum, where it was certainly seen by Schaum and possibly by Chaudoir. References to the collection in entomological literature are few and generally take the form of guess-work. Even Bates was not exempt from this, though the collection was known to and occasionally examined by him.

I propose to go through Macleay's genera and species, offering such observations and additional descriptions as I think may be of use.

1. **Craspedophorus (Panagaeus) cereus.** The type is unique. No mention of the species seems to have been made until Chaudoir (Rev. et. Mag. Zool. 1869, 116) believed that he recognised it in a Javan specimen he had lately purchased. Nine years later, when he published his "Essai monographique sur les Panagéides" (Ann. Soc. Ent. Belg. xxi, 1878) all doubt had been resolved, and we find it figuring (l.c. 150) without query as "*Dischissus cereus* Macl." The fourth tarsal joint of Macleay's insect, however, is entire, and the genus to which it belongs is *Craspedophorus.* To prevent further confusion I suggest for Chaudoir's species the name of *D. chaudoiri.*

Craspedophorus cereus. Length 12 mill. Width 5 mill.

Black, each elytron with two yellow spots, extreme apex of palpi yellowish. Head square, coarsely punctured, middle of front and neck smooth, frontal foveae fairly deep; antennae long and slender, joint 1 = 3, 2 = about two-fifths of 1, the remainder about two-thirds of 1; maxillary palpi long and slender, labials shorter, terminal joint (for the genus) not much dilated.

Prothorax half as wide again as head, truncate at extremities, sides sharply rounded a little behind middle, where it is widest, with an extremely narrow margin—not reflexed; front angles contiguous to neck, hind angles obtuse but not rounded, with a minute indentation in the sides, just in front of them, forming a small right-angled tooth; surface a little convex in the middle, flat at sides, even more coarsely punctured than the head, transverse impressions obsolete, median line reaching margins, a fairly deep fovea on each side of the base, within which is a furrow reaching nearly to the middle of the prothorax.

Elytra half as wide again as prothorax, not very convex, a little dilated behind middle, margin sinuate near apex; striae well marked, finely punctured, intervals finely and moderately closely punctured, though leaving the surface rather shiny; front spot extending from stria 4 to margin and beyond it on to the epipleura, running a little obliquely towards the shoulder on intervals 8 and 9, extending furthest towards apex on 6 and 8, hind spot covering intervals 5–8, projecting a little towards base on 5 and 6, and towards apex on 7 and 8. Sterna and sides of first two ventral segments coarsely punctured, ventral surface generally finely punctured; metepisterna much longer than wide; front margin of ventral segments crenulate; fourth tarsal joint simple.

Allied to *C. bifasciatus* Cast.; head wider, antennae longer, prothorax flatter, less coarsely punctured, sides less sharply rounded, hind angles more evident, elytral spots extending inwards to stria 4 only.

2. **Chlaenius (Lissauchenius) rufifemoratus.** The species is figured on the plate (t. 1, f. 1). Put forward originally by Macleay as a subgenus of *Panagaeus*, *Lissauchenius* has now been merged in the genus *Chlaenius*. In his "Monographie des Chléniens" (Ann. Mus. Civ. Gen. 1876, 34) Chaudoir retains the name for a small group comprising Macleay's species and his own *C. medioguttatus* from India, characterised principally by the slender labial palpi with a widely dilated apical joint and an ovate prothorax. Macleay considered his insect very near *Chlaenius* (*Carabus*) *posticus* Fab. (Suppl. Ent. Syst. 1798, 57), a species hitherto not satisfactorily identified, though Chaudoir (Mon. 55) has some remarks on it. Wiedemann's *Panagaeus chalcocephalus* (Zool. Mag. ii, 1, 1823, 57), which Macleay also mentions, belongs almost certainly to Bates' genus *Pristomachaerus* (Trans. Ent. Soc. 1873, 323).

The type is unique. Chaudoir describes in his Monograph (p. 35) a specimen from Siam, which he regarded as belonging to Macleay's species. As I am not convinced of this, I think it best to give a detailed description.

Chlaenius rufifemoratus, ♂. Length 11 mill. Width 3·5 mill.

Black, head and thorax dark metallic green; elytra very dark blue with a moderately large yellow spot on each, the centre of which is at about three-fifths from base; femora (except apex) and hind trochanters red, apex of mandibles, first joint of antennae, labial palpi and apex of maxillary palpi more or less tinged with red.

Head shiny, long, contracted at neck, flat and smooth in front, with shallow foveae, some longitudinal wrinkles near eyes, and a narrow furrow along margins to behind eyes, vertex and sides of front finely and sparsely punctured; eyes rather prominent; labrum a little emarginate; antennae with joint 1 = 3, 4 a shade longer (remainder wanting); last joint of maxillary palpi slightly dilated to middle, then cylindrical to apex, which is obliquely truncate; penultimate joint of labial palpi compressed and slightly curved, apical joint nearly as long as penultimate, at base strongly but then gradually dilated, flattened, subtruncate, and rather hollowed out at apex.

Prothorax narrow, not much wider than head, elliptical with truncated ends, very little broader behind than in front, no sinuation before hind angle, side margins narrowly bordered, flattened out a little behind; all the angles obtuse but not rounded; surface shiny, fairly strongly but not closely punctate, more sparsely on disk, though more closely along median line, the last named fine and bounded by the transverse impressions, which are faint, basal foveae small but fairly deep, near hind angles.

Elytra rather more than half as wide again as prothorax, ovate, widest a little behind middle, shoulders strongly rounded, as also is the junction of the basal and side margins, the latter sinuate towards apex; striae deep, finely and closely punctured, intervals convex, shiny, rather finely but not closely punctate, pubescence abraded except at sides; the spot covers intervals 4–8, transverse, a little oblique (outwards and backwards), the colour on interval 6 projecting a little towards apex.

Underside shiny, prosternal process bordered, the whole of the sterna and episterna (except outer part of pro-episterna, and lower half of meso-episterna) rather coarsely but not closely punctate, first two or three ventral segments coarsely punctate at sides, the rest of the ventral surface finely and remotely punctate; metepisterna much longer than wide, sulcate along outer margin; margin of last ventral segment emarginate on each side, a deep setiferous puncture opposite the emargination, but some distance from the margin. Front femora (♂) toothed at base.

No doubt *C. rufifemoratus* is closely allied to *C. mediogut-tatus* Chaud., and *C. orbicollis* Chaud., but until the types of these two species are available I cannot attempt any comparison.

3. **Chlaenius cinctus.** Macleay identifies his species with *C. cinctus* Fab. (see above) and *C. xanthacrus* Wied. (Zool. Mag. ii, 1, 1823, 51), but it has little relationship with either—indeed Wiedemann's species, which was redescribed by Redtenbacher (Reis. Novar. ii, Col. 1867, 9) under the name of *Chlaenius hügeli*, is not a *Chlaenius* at all. Macleay's *C. cinctus* = *C. javanus* Chaud. (Bull. Mosc. 1856, iii, 229; Mon. 115), and I strongly suspect that this will prove to be identical with *C. circumdatus* Brullé (Silb. Rev. Ent. iii, 1835, 283). If so, the species has a wide range, extending from India and Ceylon to Indo-China, and south-wards to the large Malay islands. I have no records, how-ever, from China or Japan.

4. **Chlaenius apicalis.** In view of Wiedemann's *C. apicalis* (Zool. Mag. i, 3, 1819, 166) the name of Macleay's

species was changed by Gemminger and Harold to *C. mutatus* (Mun. Cat. 1868, 222). The description is so short that I give a fresh one.

Chlaenius mutatus Gemm. and Har. = **apicalis** Macl., ♂ ♀ (2 ex.). Length 15 mill. Width 5·5 mill.

Black, head green, thorax dull coppery-greenish at sides, apex of elytra, first joint of antennae, labrum, base of palpi, femora, tibiae, and hind trochanters yellowish, remaining joints of antennae, coxae, and tarsi brown.

Head longitudinally rugose at sides, smoother on vertex, neck coarsely punctured and a little constricted; labrum slightly emarginate; antennae with joint 1 short and tumid, half as long again as 2, 3 a little longer than 1 + 2, and about half as long again as the succeeding joints; palpi slender, last joint truncate.

Prothorax one-third as wide again as head, very little wider than long (wider in ♂ than ♀), widest at middle, equally contracted and truncate at extremities, uniformly rounded at sides without trace of sinuation before hind angle, all the angles moderately rounded, reflexed side border very narrow, a setiferous puncture at one-fourth from base; surface moderately convex, declivous towards front angles, finely and sparsely punctured, more strongly and closely towards base, which is longitudinally strigose in the middle, a short slight pubescence at sides; median line fine, not reaching margins, transverse impressions nearly obsolete, basal foveae rather shallow, rugosely punctured.

Elytra not very convex, nearly half as wide again as prothorax, widest a little behind middle, margin without angle at shoulder, slightly sinuate before apex, which is narrowly yellow, the colour extending forwards to a little beyond the sinuation; striae deep, minutely punctured, intervals moderately convex, finely shagreened, smooth but with a row of punctures with short setae on each side of the striae, the two outside intervals and the apical area more finely punctured and with a more evident pubescence.

Underside smooth, ventral surface minutely rugose at sides; prosternal process bordered; metepisterna and sides of metasternum with coarse shallow punctures, the former half as long again as wide and without external furrow. Front femora (♂) without tooth.

Closely allied to *C. cambodiensis* Bates. Head narrower, more coarsely sculptured, neck a little more constricted; thorax equally contracted at extremities, and more coarsely sculptured at base; elytral intervals more convex, apical yellow spot a little narrower, colour otherwise uniformly black.

5. **Chlaenius quadricolor.** This—one of the best-known species of Eastern *Chlaenius*—was originally described by Olivier (Enc. Méth. v, 1790, 344). Later on Dejean (Spec. Gen. ii, 1826, 339) described it under the name of *Chlaenius orientalis*, and Laferté (Ann. Soc. Ent. Fr. 1851, 263) as *Amblygenius chlaenioides.* Motchulsky's *Poeciloistus laevicollis* (Bull. Mosc. 1864, iv, 348) is probably the same thing. It is a common species in India and Ceylon, Bates records it from Bhamo, and Mr. Vitalis de Salvaza has taken it in Indo-China. I have seen no examples from the Malay region, except Java.

The *Chlaenius* (*Carabus*) *tenuicollis* Fab. (Syst. Eleuth. 1, 1801, 185) mentioned by Macleay is an African species.

6. **Chlaenius micans.** Macleay considered his specimen identical with *Carabus micans* Fab. (Ent. Syst. i, 1792, 151) and probably also with *Carabus analis* Oliv. Neither of these species has been satisfactorily identified, and I do not know at present where the types are, or even if they are in existence. In any case I think *C. analis*, which came from Senegal, may be excluded. Chaudoir (Mon. 62) thought *C. micans* Fab. might be the same thing as his *C. hamifer* (Bull. Mosc. 1856, iii, 209), but that *C. micans* Macl. (Mon. 52) was a different species; in this latter view I concur, though the evidence furnished by Fabricius' very brief description is inconclusive. With his original description no locality is given, but later on (Syst. Eleuth. i, 1801, 191) he mentions Bengal. As all the examples of Macleay's species which I have seen come from the Malay region, I redescribe it under the name of *C. macleayi.*

Chlaenius macleayi = **C. micans** Macl., ♂. Length 11 mill. Width 4 mill.

Black, head and thorax dark green, elytra black with greenish reflection, a comma-shaped spot at apex of elytra, two first joints of antennae, basal joint and apex of palpi, front margin of labrum, apex of ventral surface, legs (except coxae) reddish yellow; margin of thorax, coxae, and remaining joints of antennae and palpi brown.

Head finely punctured, nearly smooth in front with faint longitudinal striation near eyes, frontal foveae moderately deep, labrum truncate in front, eyes prominent; antennae reaching a little beyond base of thorax, joint 1 = 4, a little longer than 3, twice as long as 2; last joint of palpi not dilated.

Prothorax quadrate, one-third as wide again as head, a little more contracted in front than behind, truncate at extremities, rounded at sides, without trace of sinuation before hind angles, which, like the front angles, are rounded; sides finely bordered, with a seta near base; surface moderately convex, declivous towards front angles, fairly strongly but not closely punctate on disk, more closely at sides of base, an irregular row of punctures on each side of median line, which is very fine and does not reach the margins, faintly pubescent near hind angles; transverse impressions very slight, a short longitudinal furrow on each side of base, and rather distant from basal margin.

Elytra not very convex, width compared with prothorax as 5 to 3, margin rounded at shoulder, slightly sinuate before apex, striae fairly deep, punctured, intervals rather flat, very closely and finely punctate, the whole surface covered with a dense short greyish pubescence; apical spot covering apex and running back narrowly to the marginal sinuation, whence (leaving the margin) it extends backwards on intervals 6, 7, and 8, and in front sends an arm inwards to stria 3.

Underside smooth, shining, prosternal process faintly bordered at apex, a few punctures on middle of prosternum, metasternum with a few coarse punctures at sides, metepisterna nearly smooth, half as long again as wide, with a furrow along outer margin. Front femora (♂) without tooth.

The species is evidently extremely close to *C. bihamatus* Chaud., but is a little smaller than specimens in my collection which I identify with Chaudoir's species; the hind angles of prothorax more evident, surface rather more closely punctured, elytra darker, apical spot smaller.

In addition to the type there are specimens in the British Musuem Collection from Borneo, labelled "Sarawak," "Sanga-Sanga," and "Kuching." In these, the prothorax is more contracted behind than in the type, and the elytral spot is rather smaller—indeed, in one example it is reduced to only half the normal length, and does not nearly reach the apex. As the species is apparently a variable one,. it may prove that it is really identical with *C. bihamatus*, but this can only be settled when the type of the latter is available for comparison. As Chaudoir's description is a short one, I shall in any case have done no harm in giving a fuller one.

It may be worth while pointing out here that when *C. bihamatus* was described (Bull. Mosc. 1856, iii, 210) Chaudoir said he had received two examples taken by Capt. Boys in N. India, and another from Tranquebar; *C. hamifer* (l.c. 209) was said to come from Java. In the Monograph (Ann. Mus. Civ. Gen. 1876, 62) he tells us that he has two examples of *C. bihamatus* from Java and one from Hong-Kong, while *C. hamifer* now inhabits " toute la presqu'île Cisgangétique." It is evident to me that in 1856 he transposed the localities, but no word of this appears in the Monograph, where the necessary rectification is made.

7. **Chlaenius flaviguttatus** = **C. binotatus** Dej. (Spec. Gen. ii, 1826, 302). The species has hitherto been known under the latter name, for which Macleay's must be substituted. Chaudoir (Bull. Mosc. 1856, iii, 200) redescribed the species as *C. punctatus*, a name which Gemminger and Harold changed to *puncticeps* (Mun. Cat. 1868, 224). Castelnau (Notes on Australian Coleoptera, 1867, 62) again described it as *C. maculifer*. A form from the Philippine Islands, in which the spots at the apex of the elytra are much reduced, broken up into several small ones, or wanting altogether was described by Eschscholtz (Zool. Atl. v, 1833, 26, t. 25, f. 8) as *C. guttatus*.

The species is recorded from Java, Sumatra, and the Eastern Coast of Australia; the form *guttatus* from the Philippine Is., New Caledonia, and New Guinea.

8. **Catascopus elegans** = **C. facialis** Wied. (Zool. Mag. i, 3, 1819, 165). Macleay supposed his species to be the same as *Catascopus* (*Carabus*) *elegans* Fab. (Syst. Eleuth, i, 1801, 184) = *Catascopus* (*Elaphrus*) *elegans* Weber (Obs. Ent. 1801, 45), but he was mistaken. Wiedemann's *C. facialis* came from Bengal, and Dejean (Spec. Gen. i, 1825, 329) redescribed it, also from a Bengal specimen (*teste* Chaudoir, Bull. Mosc. 1850, ii, 352) sent to him by Westermann; later on (l.c. v, 1831, 452) he referred a Javanese specimen to the same species. After examining a large number of specimens from all parts of the East, I have come to the conclusion that *C. facialis* Wied., *C. elegans* Macl., *C. angulatus* Chaud. (Berl. Ent. Zeit. 1861, 117), and *C. oxygonus* Chaud. (l.c. 117) are all the same species. The colour is variable, blue predominating in India and a brassy tint in the Malay region; as a rule the prothorax has sharper hind angles, projecting a little laterally, in examples with a brassy colour, but there is no question of a local race, as there is little constancy in either of these characters. The species is very common throughout S.E. Asia and the Malay Archipelago.

9. **Pericallus (Catascopus) quadrimaculatus.** Macleay recognised that this species differed in several respects from

his *Catascopus elegans*, but it did not strike him that it belonged more properly to his own next succeeding genus. Castelnau redescribed it as *Catascopus quadrisignatus* (Ann. Soc. Ent. Fr. 1832, 392). Chaudoir proposed a new genus, *Coeloprosopus*, for the species (Bull. Mosc. 1842, iv, 840), but subsequently withdrew it (Berl. Ent. Zeit. 1861, 123). The descriptions of Macleay and Castelnau are both so short that I give a rather more detailed one.

Pericallus quadrimaculatus, ♂. Length 6.25 mill. Width 3 mill.

Head and prothorax metallic green, the former bluish on middle of front, elytra dull purple with greenish reflections, each with two yellow spots; femora (except apex), hind trochanters, and labrum red; first joint of antennae, base and apex of palpi and mouth parts generally, apex of femora, tibiae, and tarsi more or less reddish.

Head wide, finely and intricately wrinkled, longitudinally striated near eyes; eyes large and very prominent; antennae long and slender, joint 1 thick = 3, 4 a little shorter, 2 shortest of all, 5–11 equal in length and a little longer than 1.

Prothorax small, much narrower than head (with eyes), more or less quadrate, slightly transverse, a little emarginate in front, base truncate; sides rounded in front, then strongly sinuate, with a seta at one-third from apex and another at hind angle; hind angles acute and projecting laterally, median line fine, forming a fovea at junction with front transverse impression, which is faintly marked, and then just visible to front margin, more strongly marked towards base, hind transverse impression very deep, ending on each side in a deep fovea near basal angles; surface finely and transversely wrinkled, very finely punctate along front margin, basal area (between the transverse impression and the margin) relatively smooth.

Elytra rather more than twice as wide as prothorax, 4 mill. in length, shoulders very square, a little wider behind middle, apex widely and obliquely truncate, truncature a little emarginate with a small spine at both ends; striae deep, rather faintly punctured, intervals convex, smooth, and finely shagreened, third with 3 pores, 1 at a sixth from base, 2 at two-fifths, 3 at three-quarters, ninth with some large punctures bearing long setae, very noticeable at each end of the truncature; the front spot is small on intervals 4–6 and tapers outwards (in some examples the colour spreads on to 3 and 7), hind spot larger on 3–7 (sometimes 8), forming on 3–6 a more or less oval spot, the colour on 7 beginning and ending further towards apex, but overlapping that on 6. (If a series of specimens is examined the form of both spots is seen to be very variable.)

Underside more or less smooth, head finely rugose at sides, ventral surface finely but not closely punctate, the last segment with two setae on each side, emarginate in ♂; prosternal process bordered; metepisterna long and narrow. Front tarsi ♂ with first three joints a little dilated, biseriately squamose beneath.

A little smaller than *P. tetrastigma* Chaud. Apart from the quite different colour, *P. quadrimaculatus* has the head more strongly striated, prothorax shorter, elytra shorter, squarer at base, more widened out behind, with deeper striae, and hind spot generally much larger.

Most of the examples I have seen come, like the type, from Java, but I identify with the species examples in the British Museum taken by Doherty in Perak and Siam (Renong).

10. **Pericallus cicindeloides.** Figured on the plate (t. 1, f. 2). Brullé refers to it in Audouin and Brullé's Histoire Naturelle (Ins. iv, 1834, 230), and Commandant Dupuis (Ann. Soc. Ent. Belg. 1913, 82) gives a table including this species and its allies. Macleay thought his new genus was allied to *Sphodrus* Clairv., but this is not the case. There is a second specimen (♂) in the British Museum, also from Java. As there seems to be no detailed description extant, I give one as follows :—

Pericallus cicindeloides, ♀. Length 10 mill. Width 4 mill.

Very dark brown; head and prothorax (above and below) dark blue, shiny (neck a little brassy in the type); elytra (including epipleurae) violet-blue, opaque; clypeus black, labrum with red margin.

Head broad, smooth on neck, vertex, and middle of front, strongly longitudinally striated at sides, and more faintly on clypeus; eyes very prominent; joint 2 of antennae short, the rest nearly equal in length, 4 a little shorter.

Prothorax a little narrower than head, very nearly as long as wide, strongly emarginate in front, truncate behind; sides rounded in front, sinuate at some distance from hind angles, then straight to base, widely but not strongly reflexed, a (probably setiferous) puncture at one-third from apex and another at basal angle (but all the setae—if ever present—have disappeared on both specimens);

front angles porrect, only a little rounded, hind angles right, strongly reflexed; surface finely transversely wrinkled, front transverse impression obsolete in middle, forming a shallow furrow on each side, hind transverse impression deep, median line deep not reaching margins, an irregular furrow running forward on each side from the ends of the basal transverse impression and ending in a shallow fovea situated midway between the median line and the side margin, and at about one-third from apical margin.

Elytra twice as wide as thorax, and rather more than twice as long, short, widened behind, margin narrow but widened out in middle, truncate and emarginate at apex, with a tooth (not a spine) at each end of the truncature; surface finely shagreened, striae deep, finely crenulate, intervals raised, third with 3 pores, 1 near base, 2 just behind one-third from base, 3 at four-fifths, ninth with a few large (presumably setiferous) punctures, but the only seta visible (and that one on the second specimen) is close to the external angle of the truncature.

Underside smooth, shiny, head finely rugose at sides, prosternum and ventral surface finely and remotely punctate, prosternal process not bordered, metepisterna long and narrow, last ventral segment with two setae on each side, the outer one on margin, the inner one at some distance from margin. (Front tarsi in ♂ with three first joints slightly dilated, and biseriately squamose beneath.)

Closely allied to *P. longicollis* Chaud., but without spots on the elytra. Head wider, less constricted behind; prothorax wider, front angles more, hind angles less prominent, surface flatter with deeper impressions; elytra similar in shape, but the apical portion less pointed.

11. **Diplochila (Rhembus) polita.** Herbst's *Carabus indicus* (Fuessly's Archiv. V, ii, 1784, 138, t. 29, f. 11) seems to be the same species as Fabricius' *Carabus politus* (Ent. Syst. i, 1792, 146), and was so considered both by Macleay and Chaudoir (Bull. Mosc. 1852, i, 67). Herbst's name, however, has never come into general use, perhaps from some doubt about the identification, which I cannot at present resolve. Numerous references to the species will be found in entomological literature.

The genus *Rhembus*, under its French name, was first mentioned by Latreille (Hist. Nat. et Icon. Col. Eur. 1822, i, 85), but it was first described under its Latin name by Dejean (Spec. Gen. ii, 1826, 380). Meanwhile Germar had in 1824 applied the same name to a genus of Curculionidae, and Brullé's name of *Diplochila* (Audouin and Brullé's Hist.

Nat. Ins. iv, 1834, 407) now replaces it. (See Bedel, Cat. rais. des Col. du Nord de l'Afrique, 1897, 102 note (1).) Nietner's *Symphyus unicolor* (Ann. and Mag. of Nat. Hist. 3, ii, 1858, 180) from Ceylon is probably the same species, but I have not yet traced the type.

The species ranges from India to Indo-China, and southwards into Java.

12. **Dirotus subiridescens.** The genus is fully described by Macleay, who thought it not far from *Dolichus*, but it seems more closely allied to Bates' genus *Onycholabis* (Trans. Ent. Soc. 1873, 329). The description of the species is so short that I am giving a fresh one. In addition to the type (♂), there are two examples (♂♀) also from Java in the British Museum Collection, the ♀ taken by Dr. Horsfield, the ♂ ex coll. Bowring. I have seen no other specimens.

Dirotus subiridescens, ♂. Length (incl. mandibles) 9·5 mill. Width 4 mill.

Figured by Hope (Col. Man. ii, 1838, t. 2, f. 1): I shall refer to the figure in the course of the description.

Black, iridescent; maxillae, palpi, antennae (exc. joint 3), trochanters, tarsi, and apex of femora and tibiae red-brown (the palpi rather lighter than the other parts); mandibles, labrum, and joint 3 of antennae dark brown.

Head smooth, not so wide nor so deeply sunk in the prothorax as shown in the fig., with shallow foveae between the antennae, clypeus truncate, suture well marked, a setiferous pore near front angles, labrum slightly emarginate, with 6 setae, the outer ones longest; eyes rather flatter than shown in the fig., two supra-orbital pores, the hind one distant from eye and rather behind the hind margin of the eye; antennal joints approximately equal, except 2, which is half as long as the others, pubescent from middle of 4; mandibles and palpi very long, penultimate joint of labials distinctly longer than in fig., maxillae long (but shorter than mandibles) and hooked at tip, with a serrate inner margin (not shown in fig.), the teeth not very close together, buccal fissure very close to eye.

Prothorax a little wider than head, much more contracted at the extremities than in fig., truncate at base, a trifle emarginate at apex, front angles projecting a little, rather sharp, sides sinuate before base, hind angles right, side border very fine (apparently without setae); surface smooth, rather convex, declivous towards front angles, which are near to though they do not touch the neck, median line much finer than in fig., not quite reaching margins;

transverse impressions obsolete, slight longitudinal furrows near hind angles, basal area faintly punctate.

Elytra rather more than twice as wide as prothorax, rather square at shoulders, though widely rounded, parallel to three-fifths from base, then rounded to apex without sinuation; striae deep, smooth, a well-developed scutellary striole between 1 and suture, intervals convex, flatter on disk, third with 3 pores, 1 near base (adjoining stria 3), 2 and 3 not far from apex (adjoining stria 2), ninth with some large umbilicate pores, from which issue long setae (though these are largely abraded).

Underside smooth, shiny, prosternal process not bordered, metepisterna narrow, bordered along inner margin, a shallow furrow running along outer margin, ventral surface finely and remotely punctate, last segment with two setae on each side in ♂, a row of setiferous pores along hind margin in ♀. Tarsal joints smooth on upper surface; in the hind tarsi joint 1 = 5, 2 = two-thirds of 1 = 3 + 4. Front tarsi of ♂ with three feebly dilated joints, clothed beneath with scanty white filamentous scales. Fourth joint in all feet of both sexes with a thin curved membranous appendage on each side beneath, extending underneath from apex to rather more than half the length of joint 5. Claws simple.

As this is the only known species of the genus, I cannot compare it with any other, but I may say that superficially there is a strong likeness between it and Bates' *Pirantillus feae* (Ann. Mus. Civ. Gen. 1889, 109).

13. **Colpodes brunneus.** Figured in the plate (t. 1, f. 3). Macleay's specimen, the type of a vast genus, is the only example of the species I have seen. Macleay was quite right in associating his new genus with *Sphodrus* and *Anchomenus*. In his Monograph of the genus *Colpodes* (Ann. Soc. Ent. Fr. 1859, 359) Chaudoir just mentions the genotype, but in his subsequent and much more extended "Révision" (Ann. Soc. Ent. Fr. 1878) he ignores it altogether. Mr. Alluaud (Ann. Soc. Ent. Fr. 1916, 78) has recently drawn attention to Chaudoir's Observations on the genus (Mon. 292), which I think worth quoting, as an amusing instance of his methods: "On remarquera que j'assigne à mes *Colpodes* une dent un peu variable mais toujours bien distincte au fond de l'échancrure du menton tandis que Mac Leay dit du sien : *mentum sinu simplice ;* mais comme les insectes recueillis par Horsfield ne paraissent pas avoir été dans le meilleur état, il est fort possible que cet organe a été mal observé; si je me suis trompé, on

en sera quitte pour ne pas laisser le nom de *Colpodes* à l'espèce de Mac Leay." Fortunately the mentum has in reality a well-developed tooth, and Macleay may therefore rest at peace in his grave. Nothing further having been published regarding the species, I give a fresh description of it.

Colpodes brunneus, ♀. Length 12·5 mill. Width 4·5 mill.

Dark brown, palpi, antennae from joint 4, and tarsi a little lighter.

Head smooth, wide, rather tumid, with deep frontal foveae, which are longitudinally striate, some faint irregular surface markings on vertex, neck quite smooth, clypeus with a seta on each side, labrum a little emarginate; eyes very small and very prominent, antennae more than half as long as body, joint 3 a little longer than 4, slightly curved, a narrow ridge separating eye from buccal fissure; mandibles long, hooked at apex, mentum with a strong tooth in the emargination.

Prothorax one-third as wide again as head, contracted rather more in front than behind, front margin strongly, hind margin slightly emarginate; sides rather widely but not strongly reflexed, without visible setae, faintly sinuate before hind angles, which are obtuse but not much rounded, front angles porrect, only a little rounded; surface rather flat, with very faint transverse striation, transverse impressions moderately strong, bounding median line, which is not very deep and is interrupted in the middle (perhaps an individual peculiarity), hind transverse impression ending on each side in a shallow rounded fovea, from which a very shallow furrow runs parallel with the side up to the front margin.

Elytra long, parallel, half as wide again as thorax; basal margin bisinuate, side border narrow, slightly sinuate below shoulder and more strongly near apex, which is minutely dentate; striae moderately strong, faintly crenulate, a well-developed scutellary striole between 1 and suture, intervals smooth, flat on disk, more convex towards sides. Both elytra have pin-holes through them, but there are apparently three punctures on interval 3, viz. 1 at a fifth from base (adjoining stria 3), 2 just before middle (in middle of interval), and 3 at three-fourths (adjoining stria 2); the punctures on interval 9 widely interrupted in middle.

Underside smooth, shiny, prosternal process not bordered, metepisterna very long and narrow, surface a little uneven, sides of ventral surface minutely wrinkled, last segment with two setae on each side. Tibiae not grooved on outer side, upper surface of tarsi grooved on both sides, under surface clothed with dense yellow hairs, fourth joint bilobed on all feet, outer lobe longer in intermediate and hind pairs.

I do not know of any other species with which I can usefully compare this, the swollen head, small but very prominent eyes, and *Nebria*-like thorax giving it an appearance unlike that of the other species of the genus known to me.

14. **Lesticus (Omaseus) viridicollis.** A great stumbling-block to the entomologists of the early part of last century. Dejean (Spec. Gen. iii, 1828, 183) described a specimen which he supposed to belong to Macleay's species as *Trigonotoma viridicollis*: this, however, *teste* Chaudoir (Ann. Soc. Ent. Belg. xi, 1868, 151), belongs to a different genus and is identical with Brullé's *Trigonotoma indica* (Audouin and Brullé's Hist. Nat. Ins. iv, 1834, 333). Brullé also described a *Trigonotoma viridicollis* (l.c. 333, t. 12, f. 5), which he took for Macleay's species: this is identical with *Lesticus buqueti* Cast. (Et. Ent. 1834, 77). Some descriptive notes on the species have been made by Tchitcherin (Hor. Soc. Ent. Ross. xxxiv, 1900, 176). It is now fairly well known and seems to be confined to Java.

15. **Catadromus tenebrioides** Oliv. Described by Olivier (Enc. Méth. v, 1790, 324) and subsequently figured (Ent. iii, 1795, 35, 17, t. 6, f. 67), this species does not need further comment from me. I believe it to be confined to Java.

Macleay, in an "Observation," differentiates his genus from *Omaseus*, but thinks it allied to *Platysma* and *Broscus*. Without any near Eastern congeners, *Catadromus* is related to the two first-named genera, but far removed from *Broscus*.

16. **Dicoelindus felspaticus.** The species is figured in the plate (t. 1, f. 6), but has not hitherto attracted attention. Schaum (see Berl. Ent. Zeit. 1863, 86) examined this insect at the British Museum, and expressed the view that it belonged to the genus *Abacetus*. Chaudoir (Bull. Mosc. 1869, ii, 356) was sceptical about this, and quite rightly so.

Bates (Ann. and Mag. of Nat. Hist. 5, xvii, 1886, 145) described a Ceylon species taken by Mr. G. Lewis as ? *Lagarus impunctatus*, and six years later (Ann. Mus. Civ. Gen. 1892, 365) he formed the genus *Arsenoxenus* for a species taken by Mr. Fea in Burma, to which he gave the name of *A. harpaloides*. Tchitcherin (Hor. Soc. Ent.

Ross. xxxiv, 1900, 476) drew attention to the fact that Bates' Ceylon species also belonged to the genus *Arsenoxenus*, and expressed surprise that Bates should not have detected this. Actually Bates' genus is identical with Macleay's *Dicoelindus*, and his *A. harpaloides* with *D. felspaticus*.

Macleay thought his genus was connected through *Microcephalus* with *Dicoelus*; these are American genera, regarding which I can express no opinion. Bates says that his *Arsenoxenus* is allied to *Loxandrus*. No doubt *Dicoelindus* belongs to the group Pterostichini, but, as Bates points out, it differs from all members of that group in that the front tarsal joints of the ♂ are not dilated.

In addition to Java, I have records from Palon, Bhamo, Tharrawaddy, and Rangoon in Burma, Jorhat in Assam, and Dacca and Sahibganj in Bengal.

17. **Amblystomus (Trechus) convexus.** Macleay put this insect under *Trechus* with considerable doubt. He tells us that the unique specimen was even then (1825) in such a bad state that he was unable to examine it for fresh generic characters. The species is, I think, the only one belonging to the genus *Amblystomus* so far recorded from Java. I add what I can to Macleay's description.

Amblystomus convexus. Length 3·25 mill. Width: head ·75, thorax 1·00, elytra 1·50 mill.

Black, moderately shiny, mouth parts and legs reddish-brown.

Head wide, smooth, convex, frontal foveae shallow, clypeus emarginate, only slightly asymmetrical; eyes flat.

Prothorax transverse, widest before middle, a little emarginate in front, rounded behind, the sides of the base coming forward to meet the hind angles, which are obtuse; sides narrowly bordered, not sinuate behind; surface smooth, convex, rather flattened out near hind angles, transverse impressions fairly well marked, median line faint.

Elytra parallel, shoulders strongly marked, rounded behind without sinuation near apex, striae faint and very faintly punctate, obsolete at sides.

The species resembles in form the example of Motchulsky's *A.* (*Hispalis*) *fuscescens* (Et. Ent. 1858, 23) from F. Walker's Collection, now in the British Museum, but it is smaller and the hind angles of the thorax are less rounded.

18. **Gnathaphanus vulneripennis.** Macleay's genus has

been dealt with by Lacordaire (Gen. Col. i, 1854, 299), Chaudoir (Ann. Mus. Civ. Gen. xii, 1878, 503), and Mr. Sloane (Proc. Linn. Soc. N.S.W. 1898, 456); it was also redescribed by W. Macleay, jun., under the name of *Pachauchenius* (Trans. Ent. Soc. N.S.W. i, 1864, 117).

The species was figured by Hope (Col. Man. ii, 1838, t. 2, f. 2). Dejean described it (Spec. Gen. iv, 1829, 261) as *Harpalus subcostatus*, and Boheman (Eug. Res. Zool. Col. 1861, 10) as *Platymetopus melanarius*. It does not seem common anywhere, but has a wide range. My notes give the following localities:—Ceylon, Kanpa (Central Provinces), Dacca (Bengal), Sylhet, Burma, Indo-China, China, Philippine Is., Java, Borneo, and Celebes.

Macleay thought that *Harpalus thunbergi* Quens. (Schönh. Syn. i, 1806, 188 (note)) belonged to his genus *Gnathaphanus*, but it is actually placed in Dejean's genus *Platymetopus*.

19. **Gnathaphanus (Harpalus) punctilabris.** The type is a ♀, but there were in all 2 ♂♂ and 2 ♀♀ in Dr. Horsfield's Collection. Macleay did not realise that the species actually belonged to his own new genus. I think it extremely likely that Dejean's *Anisodactylus javanus* (Spec. Gen. iv, 1829, 146) will prove to be the same species. Walker subsequently redescribed it (Ann. and Mag. of Nat. Hist. 3, iii, 1859, 51) as *Harpalus dispellens*. Bates might have dispensed with the speculations he indulged in regarding the species (Ann. Mus. Civ. Gen. 1892, 327) by examining Macleay's type.

The species is very common, and widely spread throughout S.E. Asia, including the Philippine Is. and the Malay Archipelago. Both Macleay's and Walker's descriptions are very inadequate, and, although Dejean's is much fuller, I am not quite sure that his species is identical with Macleay's, so I have described it afresh.

Gnathaphanus punctilabris, ♀. Length 13 mill. Width: head 3·5, thorax 4·25, elytra 5·25 mill.

Black, mouth-parts a little reddish; surface dull (♂ rather more shiny).

Head convex, smooth, clypeal suture fine, but well marked, ending in a small fovea, from which a fine line runs obliquely backwards to the eye; clypeus with a setiferous puncture near the front angles; eyes moderately prominent, antennae reaching well beyond base of prothorax.

Prothorax flat, declivous towards front angles, moderately emarginate in front, truncate behind, widest before middle, sides narrowly bordered and gently rounded, with a large setiferous pore at one-third from apex, front angles a little, hind angles strongly rounded, though still quite evident; surface smooth, rather silky in appearance, transverse impressions faint, median line fine, reaching extremities, a large flat round finely-punctate fovea on each side of base, the puncturation extending vaguely along margin towards front angles.

Elytra square at shoulders, nearly parallel, sinuate before apex, striae sharply incised, finely crenulate, a scutellary striole between 1 and 2, intervals only slightly convex, smooth, but finely punctate close to apex, 3, 5, and 7 with a row of punctures, third with 7 or 8 punctures all adjoining stria 2, fifth with about 6 adjoining stria 5 in front and 4 near apex, seventh with about 6 adjoining stria 7 and all on the apical half of the elytra, ninth with a row of large umbilicate pores, setiferous near base and apex.

Underside shiny, smooth, prosternal process not bordered, with a few bristles at apex; metepisterna bordered at sides, much longer than wide; last ventral segment with two setae on each side at a little distance from margin (♀), with one seta only on each side, actually on the margin (♂).

Tarsi pubescent on upper surface, and densely clothed with hairs underneath; dilated joints of front tarsi in ♂ wide, contracted at base, joint 1 smaller and more triangular than the others, joint 2 largest; joint 5 with setae beneath.

The species is very closely allied to *G. acutipennis* Bates (Ann. Mus. Civ. Gen. 1892, 328) from India and Burma. Hind angles of thorax more evident, as are the pores on intervals 3 and 5 of the elytra (in *G. acutipennis* there are no pores on 7), and the sinuation at the apex is less deep. A point which Bates does not mention is that, whereas in *G. acutipennis* there are two marginal pores on the prothorax, one at a third from apex, the other at a fourth from base, *G. punctilabris* has only the front one.

20. **Platymetopus (Harpalus) punctulatus.** Macleay left this insect in the genus *Harpalus* because it was such a poor specimen that he could not determine the generic characters satisfactorily. The description being very inadequate, I give some further particulars.

Platymetopus punctulatus, ♂. Length 8 mill. Width 3·5 mill.

Very dark brown, with an aeneous tinge over the upper surface; legs (except coxae), base of antennae, and mouth parts red. The upper surface was no doubt closely pubescent, as in allied species, but this pubescence has largely worn away.

Head wide, very short, convex, closely and finely punctate throughout, frontal foveae shallow, eyes rather flat, antennae stout, reaching base of prothorax.

Prothorax transverse, about a third as wide again as head, rather flat, but declivous towards front angles, emarginate in front, nearly straight behind, widest a little before middle, sides gently rounded; front angles fairly sharp, hind angles obtuse but not rounded; surface rugose-punctate, punctures fine but with many coarser ones in addition, transverse impressions obsolete, median line sharply incised, but extending over less than a third of the length, and rather nearer base than apex, basal foveae wide and shallow.

Elytra about one-fourth as wide again as prothorax, sides gently rounded and sinuate before apex, punctate-striate, intervals flat, closely punctate, the odd ones a little wider than the even ones, ninth with large shallow punctures, more numerous towards apex.

Underside shiny, more finely and much less closely punctate than the upper surface, ventral surface with an elongate depression in middle near base, penultimate and antepenultimate segments finely bordered behind. Tarsi pubescent on upper surface; the front and intermediate tarsi ♂ are narrowly dilated, and apparently clothed with whitish scales, but their condition does not allow this to be seen at all clearly.

There is a second specimen in the British Museum Collection, also from Java, which I think belongs to the same species; in this there is a seta on the margin of the prothorax at one-third from apex, which is not visible in the type.

I have compared the type with a specimen taken by Mr. Lewis in Ceylon and determined (I think rightly) by Bates, as *P.* (*Ophonus*) *senilis* Nietn. (Journ. As. Soc. Bengal, 1857, ii, 150). The two species are very much alike, but the Javan insect is a little smaller, the front margin of the prothorax is less emarginate, and the angles therefore less evident, the surface is more rugose, especially on disk, and the median line much shorter (though this may be an individual peculiarity), the odd intervals of the elytra are relatively wider, and are not more convex than the even ones.

21. **Hypharpax (Amara) tricolor.** Macleay's three species

of *Amara* have nothing to do with that genus, which is a palaearctic one. His *A. tricolor* is the ♀ of *Hypharpax lateralis*, and I shall refer to it again under that species.

22. **Gnathaphanus (Amara) subolivaceus.**

23. **Gnathaphanus (Amara) subaeneus.**

There is one example of each species. I see no reason to doubt their identity, and I give a description below.

Gnathaphanus subolivaceus, ♂. Length 8 mill. Width: head 1·75, prothorax 2·75, elytra 3·25 mill.

Gnathaphanus subaeneus, ♂. Length 7 mill. Width: head 1·50, prothorax 2·25, elytra 2·75 mill.

Black-brown, upper surface dark aeneous, rather shiny; front margin of clypeus and of labrum, palpi, joint 1 of antennae, trochanters, tibiae (darker at apex), and tarsi reddish.

Head smooth, convex, clypeal suture fine, ending in a minute punctiform fovea, around which the surface is slightly depressed; eyes moderately prominent; antennae reaching just beyond base of prothorax.

Prothorax smooth, more or less quadrate, rather flat, a little emarginate in front, truncate behind, a little narrower in front than behind, all margins bordered, but the border is obsolete in the middle of front and hind margins; sides gently rounded, without sinuation, a (presumably setiferous) pore at one-third from apex, front angles rounded, inconspicuous, hind angles obtuse, a little rounded; surface smooth, transverse impressions and median line very faint, a shallow fovea on each side, which is minutely punctate.

Elytra rather short, with well-marked shoulders, margin obtusely angulate at shoulder, sinuate before apex; striae well marked, impunctate, a scutellary striole between 1 and 2, intervals flat on disk, more convex at sides, almost carinate near apex, 3 with two or three punctures near apex, the odd intervals (especially 3) wider near apex than the even ones, 9 with a row of large umbilicate punctures, interrupted in middle, and a few smaller ones mingled with them.

Underside smooth, prosternal process not bordered, a few stiff hairs at apex, metepisterna elongate, bordered, last ventral segment with one pore on each side close to margin. Tarsi pubescent on upper surface, clothed beneath with a dense brush of hairs; four dilated joints (♂) in both front and intermediate tarsi, joint 4 emarginate, joint 1 in front legs equal in length to the other joints, but a little narrower and more triangular, joint 1 in intermediate legs half as long again as the other joints, in hind legs 1 = 2 + 3;

front tibiae with two or three minute bristles on outer side close to apex.

G. subaenea differs only from *G. subolivacea* in being smaller, and in having a prothorax a little longer, a little narrower, and with hind angles a little less rounded. I cannot doubt, however, that the two species are identical.

Closely allied to *G. impressipennis* Cast., thorax narrower, basal foveae and median line much less marked; elytra rather more shiny, striae shallower, third interval only with punctures, and these only two or three in number towards apex.

24. **Dioryche torta.** Figured by Hope (Col. Man. ii, 1838, t. 2, f. 4), I think Macleay is probably right in supposing that *Carabus flavilabris* Fab. (Suppl. Ent. Syst. 1798, 59) belongs to this or an allied genus, though I do not know the Fabrician type. Hope took the same view (Col. Man. ii, 1838, 90). Motchulsky (Et. Ent. 1855, 43) put the species under the genus *Platymetopus*.

The specimen of *D. torta* is unique in the Museum collection, and as it is the type of a considerable genus, I have described it in some detail. I have in my collection a single specimen, also from Java, given to me by Mr. Sloane.

Dioryche torta, ♂. Length 7 mill. Width: head 1·50, prothorax 2·25, elytra 3·00 mill.

Black, shiny, upper surface brassy, labrum dark brown, palpi and legs yellow, antennae reddish.

Head wide, shiny, finely punctate, clypeus emarginate, leaving the basal membrane of the labrum exposed, clypeal suture fairly deep, ending in a punctiform fovea, from which a fine line runs obliquely backwards towards the eye; eyes rather flat, mandibles short and very strong.

Prothorax transverse, not very convex, declivous to front angles, rather strongly emarginate in front, nearly straight behind, widest before middle, sides rounded in front then quite straight to hind angles, finely bordered, the border extending a little way from each angle along the front and basal margins, a setiferous pore at a third from apex, front angles rather sharp though rounded, hind angles obtuse, not much rounded; surface shiny, finely but not closely punctate, front transverse impression very shallow, hind one rather deeper, median line fine extending between them, a large shallow fovea on each side of the base, which is more closely punctate than the general surface.

Elytra fairly short, with well-marked shoulders, at which the border is distinctly angled, margin strongly sinuate before apex; striae well marked, impunctate, a long scutellary striole between 1 and 2, intervals flat, narrow and convex towards apex, where the odd are a little wider than the even ones, very finely but not closely punctate, 3, 5, and 7 with a series of about 15 larger punctures, on 3 adjoining stria 2, on 5 adjoining stria 5, and on 7 adjoining stria 7, 8 a little carinate towards apex, 9 wide—especially behind where the sinuation occurs and where there are two or three very large punctures.

Underside smooth, shiny, prosternal process not bordered, metepisterna long and narrow with a furrow on inner side; last ventral segment with two setae on each side, both on the margin and widely distant from each other. Tarsi smooth on upper surface; front and intermediate tarsi (♂) with the first four joints narrowly dilated, and apparently clothed with scales beneath; I cannot, however, see this as clearly as, from his figure, Hope must have done.

In the fig. the ligula and labial palpi are badly done; the former is very narrow, with two bristles (one has disappeared), and it is enveloped by the paraglossae, which are glabrous, truncate in front, with the angles rounded. The penultimate joint of the labial palpi is plurisetose.

Platymetopus amoenus was described by Dejean (Spec. Gen. iv, 1829, 73) from Java, and Bates identified with it a number of specimens from Bengal and Burma, some of which are in my collection. These insects are evidently closely allied to *D. torta*, but I doubt their identity with it, and I am not convinced that Bates' determination is correct. I think probably *D. torta* = *P. amoenus*, and hope to elucidate this later on. Meanwhile I prefer to compare Macleay's species with *D.* (*Selenophorus*) *colombensis* Nietn. (Journ. As. Soc. Bengal, 1857, ii, 151). Size larger, colour very similar—though a little more coppery; head much larger compared with prothorax; latter a little more convex and much more roughly sculptured; elytra less elongate, striae deeper, intervals more strongly punctured.

As I have maintained both the genera *Platymetopus* and *Dioryche*, hitherto treated as synonyms, I ought perhaps to say a word or two about them. Lacordaire (Gen. Col. i, 1854, 300) made *Platymetopus* the genus and *Dioryche* (which he spells inaccurately *Dyoriche*) the synonym. Gemminger and Harold (Mun. Cat. 1868, 287) reversed this process, and in doing so aroused the ire of Bates (Trans. Ent. Soc. 1873, 271). I regard the genera as distinct, and am glad to find that Mr. T. G. Sloane takes the same view : I note, too, that Mr. Alluaud (Bull. Soc. Ent. Fr. 1917, 321) seems to have come to the same conclusion. The two genera have a very different appearance, but the head, the mandibles, mentum, palpi, etc., are very similar : on the other hand, there is a striking difference in the paraglossae, which does not seem hitherto to have attracted attention. I give a brief synopsis :—

Dioryche. Ligula small, bisetose, surrounded by the paraglossae, which are glabrous and just meet above it, at which point there is an indentation, their front margin truncate, the angles rounded; mentum edentate; penultimate joint of labial palpi plurisetose; upper surface brassy in colour, glabrous, elytra with seriate punctures on one or more of the odd intervals; upper surface of tarsi glabrous.

Platymetopus. Ligula, mentum, and labial palpi as in *Dioryche*. paraglossae with more rounded sides, from which project on each side 6 or 8 stiff bristles; upper surface very dark, densely pilose, elytral intervals without seriate punctures; upper surface of tarsi pilose.

Among the species originally included by Dejean in the genus *Platymetopus*, there is only one (*P. amoenus*) which belongs to *Dioryche*.

25. **Hyphaereon reflexus.** Hope figures this species (Col. Man. ii, 1838, t. 2, f. 5), but I can find no further references to either genus or species.

Macleay's account of his genus is incomplete, and I therefore give a few further details, though I have not been able to dissect the mouth-parts as I should like to have done.

Ligula of medium length, a little widened at apex, bisetose; paraglossae narrow, divergent, a little longer than ligula, which is free at apex; last joint of maxillary palpi tapering, rounded at apex, second and fourth joints equal, third a little shorter; last joint of labial palpi a little shorter than penultimate, which is plurisetose; mentum with a short rounded tooth (not acute, as in both description and illustration), at base of which are two setae; maxillae curved and sharply pointed, with a row of dense hairs on inner margin; mandibles long, curved, and pointed.

Hyphaereon reflexus, ♀. Length 7 mill. Width : head 1·3, prothorax 2·0, elytra 3·0 mill.

Pitch black, slightly iridescent; antennae (except 1st joint) brown; margins of labrum and clypeus, joint 1 of antennae, palpi, maxillae, mandibles (except apex), apex of elytra and abdomen, and legs reddish-yellow, femora rather lighter.

Head smooth, rather small, labrum truncate, with a few large scattered punctures, clypeus truncate, bisetose, suture very fine, frontal foveae deep, continued as a fine line towards the eye; eyes moderately convex, not reaching buccal fissure; antennae pubescent from middle of joint 3, joint 2 about half as long as 3, joint 3 = 1, the others a little shorter.

Prothorax transverse, widest a little before middle, emarginate in front, truncate behind, finely bordered throughout except in middle of front margin; sides rounded, more contracted in front than behind, narrowly but fairly strongly reflexed in front, more widely behind, a setiferous pore rather before middle, none at basal angle; front angles rounded, hind angles a little obtuse, with a minute sharp tooth at apex; disk smooth, convex, and highly polished, transverse impressions and basal foveae shallow, a fine median line hardly reaching base or apex, whole basal area densely punctate, middle of front margin finely punctate. Elytra smooth and glabrous, rather more than two and a half times as long as prothorax, nearly parallel, the border angled at shoulder and slightly sinuate near apex; striae well marked, impunctate, a scutellary striole between 1 and 2; intervals flat, more convex towards apex, a series of half a dozen small pores on third interval, adjoining stria 2.

Abdomen smooth, prosternal process not bordered, metepisterna not much longer than wide, smooth, bordered; ventral segments with a shallow basal impression on each side near margin, a seta on each side of median line, the two setae rather close together on last segment and a little removed from margin. Tarsi smooth on upper surface, joint 1 of front tarsi a little shorter than 2 + 3 + 4, hind tarsal joints long, 1 = 2 + 3.

In Hope's figure the head is too big and too wide, the eyes are too prominent, the prothorax is too much rounded both in front and behind, the reflexed margin—which should be specially indicated at the hind angles—is hardly noticeable; the apex of the elytra is a great deal too much rounded, and the whole of it appears to be of a uniform dull red tint. Actually the extreme hind margin is tinged with red, the colour extending backwards some little way along striae 7 and (especially) 8.

I know of no other insect to which I can profitably compare this one.

26. **Hypharpax lateralis**, ♂ = **H. (Harpalus) dentipes** Wied. (Zool. Mag. ii, 1, 1823, 54). Hope has given a figure of the ♂ (Col. Man. ii, 1838, t. 2, f. 3). It was no doubt the different appearance of the sexes, which led Macleay to describe the ♀ as *Amara tricolor* (see above). Redtenbacher described the species again (Reis. Novar. Zool. ii, Col. 1867, 14, t. 1, f. 7) under the name *Sagraemerus javanus*, and further remarks have been made on it by Dr. Veth (Tijds. v. Ent. liii, 1910, 305). The genus extends to Australia, and has been discussed by Chaudoir (Ann. Mus. Civ. Gen. xii, 1878, 496) and Mr. Sloane (Proc. Linn. Soc. N.S.W. 1898, 456). The species is apparently confined to Java.

27. **Anaulacus sericipennis.** Figured on the plate (t. 1, f. 4). Both this and the succeeding genus are very closely allied to Dejean's genus *Masoreus* (Spec. Gen. iii, 1828, 536): further remarks on it have been made by Schaum (Berl. Ent. Zeit. 1863, 76), and Chaudoir also discusses it in his "Étude monographique des Masoréides, etc." (Bull. Mosc. 1876, iii, 12 and 25). I have seen no other example of the species, of which I will give some further description.

Anaulacus sericipennis, ♀. Length 6 mill. Width: head, 1·3, prothorax 2·1, elytra 2·5 mill.

Black, shiny, surface of elytra opaque silky; two spots on each elytron, legs (exc. tarsi), palpi, and joint 1 of antennae yellow-red; border of prothorax, apex of abdomen, tarsi, rest of antennae and mouth-parts reddish.

Head wide, smooth, convex but flat on disk, clypeal suture very faint ending in a minute pore, clypeús a little emarginate in front, a setiferous pore at each front angle, frontal impressions obsolete, labrum 6-setose; eyes prominent, hemispherical, one supra-ocular pore; antennae short and compact, hardly reaching base of thorax, joint 1 stout, twice as long as 3, which is a little longer, while 2 is a little shorter than the remaining joints.

Prothorax rather more than twice as wide as long, flat, convex at sides, emarginate and a little bisinuate in front, basal margin gently rounded and bisinuate in middle; moderately contracted in front, very little behind, sides finely bordered, with half a dozen large pores within the border, from which issue long bristles, one of them being on the border exactly at the basal angle; surface smooth, transverse impressions obsolete, median line fine, some faint longitudinal wrinkles along base, a short fine impressed line on each side, nearer middle than side margin.

Elytra short, shoulders very square, base exactly equalling base of prothorax, obliquely truncate, almost rounded behind, the truncature (of each elytron) almost straight; striae obsolete, but visible on the coloured spots, where traces of punctures can be seen, sutural stria more evident towards apex, close to which is a setiferous umbilicate pore, while just in front of this stria 8 is for a short distance strongly impressed, interval 9 with a row of large umbilicate pores, interrupted in middle, no doubt setiferous, though nearly all the setae have vanished; surface very smooth and silky. Front spot larger than hind one, in the form of a short blunt spearhead, directed towards, but not quite reaching the shoulder, and extending to a little less than one-third from base, hind margin tridentate, not reaching either side margin or suture; hind spot about half the size of front one, transverse, extending over intervals 4–8, widest externally, projecting furthest forward on 6 and 8, and emarginate behind. I am not able to detect any pores on interval 3.

Underside smooth, prosternal process bordered between coxae, but only faintly at apex, which is glabrous; last ventral segment with a seta on each side, close to margin. Front tarsi with joint 1 = 2 + 3 + 4, intermediate tarsi with 1 shorter than 2 + 3 + 4, hind tarsi wanting; front tibiae with half a dozen stout spines on outer margin, intermediate and hind tibiae with a row of bristles on outer margin.

A good deal narrower than *A. fasciatus*, Schm.-Goeb. (Faun. Col. Birm. 1846, 89). Head and prothorax very similar, but in *A. fasciatus* the short sulci on each side of the base of the prothorax are broader and shallower; further there are only two setae along the border, one at a third from apex and one on the border at basal angle. In *A. fasciatus*, too, the elytra are wider, and the striation is more evident, while the yellow markings, which are not in the form of spots, cover the whole of the basal area and the sides of the apex.

28. **Aephnidius adelioides.** Figured on the plate (t. 1, f. 7). For further information consult Schaum (Berl. Ent. Zeit. 1863, 76) and Chaudoir (Bull. Mosc. 1876, iii, 11 and 15). The species is a common one and has a wide range; it was redescribed from Queensland by Mr. T. G. Sloane under the name of *Masoreus australis* (Proc. Linn. Soc. N.S.W. 1904, 535). I have records from all parts of the East, from India through S. China to Japan, and southwards through Indo-China and the Malay Archipelago to Australia.

29. **Coelostomus picipes.** Figured by Hope (Col. Man. ii, 1838, t. 2, f. 6). Nothing further has apparently been published regarding this genus or species, and as both names replace later ones, I must go into some detail.

Under the name of *Drimostoma striatocolle* (Spec. Gen. v, 1831, 747) Dejean described a species from Senegal, and identified with it another example he had received from the "Indes Orientales." A new species was described by Nietner from Ceylon (Ann. and Mag. of Nat. Hist. 3, ii, 1858, 178) as *Drimostoma ceylanicum*, and in the year following Motchulsky (Et. Ent. 1859, 34, t. 1, f. 6) described a new genus and species under the name of *Stomonaxus sculptipennis*. Two years later Boheman (Eug. Res. Zool. Col. 1861, 13) published his *Drimostoma rufipes* from China. In 1872 there appeared a memoir by Chaudoir entitled "Essai monographique sur les Drimostomides" (Ann. Soc. Ent. Belg. xv, 1872), in which *Stomonaxus* was admitted as a genus, and *striaticollis* Dej. appears (p. 13), accompanied by the following synonymy *D. rufipes* Boh., *D. marginale* Walk. (Ann. and Mag. of Nat. Hist. 3, iii, 1859, 51), *S. sculptipennis* ? Motch., and *D. ceylanicum* Nietn. Walker's species, as I shall mention later, belongs to quite a different genus. I think very likely *S. sculptipennis* Motch. = *D. ceylanicum* Nietn., and both may prove to be identical with *D. rufipes* Boh.; I have, however, no means at present of determining this. Bates (Trans. Ent. Soc. 1873, 283) records *S. striaticollis* from Japan, and later on from various other Eastern localities. Tchitcherin described *S. japonicus* (Hor. Soc. Ent. Ross. xxxii, 1898, 14) also from Japan, and two years later (l.c. xxxiv, 1900, 262) published a paper in which he pointed out (1) that Bates' Japanese *S. striaticollis* actually belonged to his *S. japonicus*; (2) that Dejean's *S. striaticollis* from Senegal differed from the Asiatic species, which in his view should bear the name *S. rufipes* Boh.

I find that Boheman's species (though I have not seen the type) is identical with Macleay's, so that a further, perhaps the final change to be made is the substitution of *Coelostomus* for *Stomonaxus* and *picipes* for *rufipes*.

The species is widely distributed throughout S.E. (Continental) Asia, but the type is the only specimen I have seen from the Malay Islands. Tchitcherin, however, records a local form from Borneo under the name of *Stomonaxus borneensis* (l.c. xxxii, 1898, 13, and xxxiv, 1900, 263). Chaudoir informs us (Col. Nov. i, 1883, 39) that the species occurs in Australia.

30. **Clivina sabulosa.** Putzeys did not know this species (Mon. des Clivina et genres voisins, Mém. Liège, ii, 1846, 577), but he rightly supposed (Révision générale des Clivinides, Ann. Soc. Ent. Belg. x, 1867, 119 (note)) that it belonged to his *lobata*-group. I have not been able to identify it with any other described species, so I give some further details.

Clivina sabulosa. Length 6 mill. Width 1·5 mill.

Brown, shiny, head and thorax a little darker than elytra, tip of mandibles black, palpi testaceous.

Head flat and smooth on vertex, a small shallow puncture in the middle, and a longitudinal furrow at each side near eye, bounded outwardly by a ridge, neck constricted, clypeal suture well marked, clypeus moderately emarginate, without any angle in the middle, surface a little uneven near angles, otherwise fairly smooth, the median portion of the clypeus is a little in advance of the rounded lateral parts, and separated from them by a deep notch, a smaller notch separating them on the other side from the frontal plates, frontal impressions very deep; labrum truncate, mandibles short and strong but acute, antennae not quite reaching base of prothorax, last 8 joints moniliform, surface of mentum very uneven, side lobes truncate in front.

Prothorax quadrate, a little wider than head, slightly narrower in front than behind, bordered at base and sides, the latter slightly sinuate, with a seta at one-third from apex, a small tooth with a second seta marking the hind angles, a strong groove running along the margin between the two setae; surface smooth, convex, some rather faint punctures on disk at each side, a furrow separating the general surface from the middle of the basal border.

Elytra elongate, about as wide as thorax, punctate-striate, with a long scutellary striole, intervals smooth, convex, 3 with four well-marked pores, 8 carinate at shoulder and apex; first three striae free at base, marginal channel carried round shoulder to base of 5, which joins 4, inner striae not continued to apex, a narrow smooth shiny space being left between their termination and the apical portion of stria 7.

Underside coarsely and confluently punctate, more coarsely on head, less so on ventral surface, which is smooth in the middle of the base, prosternum finely channelled in front of coxae, two setae, placed close together, on each side of margin of last ventral segment. Front femora strongly dilated, but (excluding the projecting trochanter) with only a small tooth on inner margin near apex; front tibiae sulcate, strongly digitate, but without any smaller teeth, though the margin is a little dilated behind the digitation, intermediate tibiae with a strong spine, at about one-third from apex.

I have compared the type with an example from Ceylon, determined by Bates as *C. elongatula* Nietn. (Journ. As. Soc. Beng. 1856, v, 390).

Macleay's species is very similar, but lighter in colour, the whole surface of the head much smoother, joint 2 of the antennae wider and longer, thorax less parallel, puncturation similar, but no transverse striation, elytra shorter.

31. **Scarites semicircularis.** Chaudoir was unable to identify Macleay's species (Mon. des Scaritides, Ann. Soc. Ent. Belg. xxiii, 1880, 127), but I feel no doubt that his own *S. subproductus* (Mon. 90) from Siam is the same species. I have seen no other specimen from Java, but Mr. Lesne (Miss. Pavie 1904, Col. 63) records the species from Cambodia, and Mr. Vitalis de Salvaza has in recent years taken it commonly in Tonkin, Laos, and Annam.

Macleay thought his species might be Wiedemann's *Scarites punctum* (Zool. Mag. ii, 1, 1823, 38), which comes from Bengal and not from Senegal as indicated; this seems very unlikely. I find that Wiedemann's description agrees very well with Chaudoir's *Distichus* (*Taeniolobus*) *puncticollis* (Bull. Mosc. 1855, i, 47), which ought in that case to take the name of *D. punctum* Wied.

32. **Distichus (Scarites) indus.** Identified by Macleay with Olivier's *Scarites indus* (Ent. iii, 36, 1795, 9, t. 1, f. 2). This was an error, as the insect belongs to Motchulsky's genus *Distichus* (Et. Ent. 1857, 96). No other *Distichus* is recorded from Java, and the nearest species seems to be Chaudoir's *D. dicaelus* (Mon. 52) from Singapore. Macleay's insect does not quite agree with Chaudoir's description, so I give a fresh one under the name of *D. macleayi*.

Distichus macleayi. Length (incl. mand.) 12 mill. Width 3 mill.

Black, shiny, base of antennae, palpi, and legs more or less dark red.

Head quadrate, with the front angles rounded, middle of front and a small area near front angles smooth, all the rest of the surface including the shallow frontal impressions longitudinally striate, a few punctures behind at sides, extending on to the neck, which is otherwise smooth; clypeus a little emarginate in middle, with two short teeth at the ends of the emargination, and two minute protuberances in the middle of it, labrum with 3 setae and a median tooth, mandibles large, flat, a little striate on upper surface, the inner carina running straight from base to apex; eyes small, enclosed behind by the genae, which project outwards to the same level as the eye, antennae short, almost moniliform, not reaching base of prothorax.

Prothorax a trifle wider than head, emarginate in front, widest just behind front angles, which are rather sharp and projecting, gradually narrowed to hind angles, which are faintly dentate; sides bordered, a seta at a fifth from apex and another at hind angle, basal margin bordered; front transverse impression deep, rather distant from margin, median line well marked, not reaching extremities, but joining the front impression; surface smooth, base finely rugose.

Elytra as wide as prothorax, parallel, dentate at shoulder, striae well marked, crenulate, no scutellary striole, intervals smooth, 3 with a large setiferous puncture at two-thirds from base and another close to apex, 8 and base finely and densely aciculate, marginal row of punctures close and uninterrupted.

Underside, except along median line, finely and densely punctate; paragenae both emarginate and dentate, prosternal process not bordered, metepisterna elongate, two setae on each side of last ventral segment; front tibiae with two extra denticulations, intermediate tibiae with a strong spur near apex.

Macleay's insect is evidently related to Chaudoir's *D. dicaelus*, of which I have not seen an example. The latter, however, is smaller, has a sharp prominent tooth at the hind angle of the prothorax, which is finely punctured instead of smooth, while the sides of the base are apparently punctured instead of rugose.

33. **Mochtherus (Dromius) tetraspilotus.** Macleay perceived that his insect did not accord very well with the genus *Dromius*. He thought it allied to *Carabus notulatus* F. (Syst. Eleuth. i, 1801, 201), a species now to be included in the genus *Craspedophorus*, and therefore far removed from *Dromius*. The genus *Mochtherus* is due to Schmidt-Goebel (Faun. Col. Birm. 1846, 76), and it is dealt with both by Bates (Ent. Month. Mag. vi, 1869, 71), and by Chaudoir in his "Mémoire sur les Coptodérides" (Ann. Soc. Ent. Belg. xii, 1869, 240). The species is widely

distributed and much described, as will be seen from the following synonymy :—

Dromius tetraspilotus Macl., Ann. Jav. 1825, 25.
Thyreopterus tetrasemus Dej., Spec. Gen. v. 1831, 448.
Mochtherus angulatus Schm.-Geob., Faun. Col. Birm. 1846, 76.
Panagaeus retractus Walk., Ann. and Mag. of Nat. Hist. 3, ii, 1858, 203.
Cyrtopterus quadrinotatus Motch., Bull. Mosc. 1861, i, 106.

It is spread over the whole of the Indo-Malay region, including Indo-China, and extends to Christmas Island; I have, however, seen no examples from China or Japan in the north, or from New Guinea or Australia in the south.

34. **Colpodes (Lamprias) ruficeps.** The species belongs to Macleay's own genus *Colpodes*, a circumstance he did not detect. Eschscholtz (Zool. Atl. ii, 1829, 6, t. 8, f. 3) provided for it a new genus, which he named *Loxocrepis*. Brullé (Audouin and Brullé's Hist. Nat. Ins. iv, 1834, 325, t. 12, f. 2) adopted Eschscholtz's name, but applied it to a different species, viz. *Dicranoncus amabilis* Chaud. (Ann. Soc. Ent. Fr. 1859, 350 (note) and 359). Bates quite misconceived Macleay's species, and followed Brullé: the various references to *Colpodes ruficeps* Macl. in Bates' works (Trans. Ent. Soc. 1883, 263; Ann. and Mag. of Nat. Hist. 5, xvii, 1886, 147; Ann. Mus. Civ. Gen. 1892, 376) must all be read as *Dicranoncus amabilis* Chaud. Bates commented on the species freely, and blamed Chaudoir—quite rightly—for confusing with it Schmidt-Goebel's *Euplynes cyanipennis* (Faun. Col. Birm. 1846, 52). Chaudoir, however, knew Macleay's species, and refers to it correctly both in his " Monographie du genre Colpodes " (Ann. Soc. Ent. Fr. 1859, 348), and in his subsequent " Révision des Colpodes " (Ann. Soc. Ent. Fr. 1878, 376), but he did not know the genus *Euplynes*, and even went so far as to propose the new name of *schmidti* for Schmidt-Goebel's species (Mon. 360). Chaudoir gives a full description in his Monograph (p. 348), and I need not therefore give a fresh one. Eschscholtz's example was taken at Manilla. Apart from the type, all the examples I have seen came from India and Ceylon, and Macleay himself remarks that the species appears to be less common in Java than in India.

35. **Callida (Lebia) splendidula.** This species is not intro-

duced by Macleay as being identical with *Carabus splendidulus* F., but they are in fact the same, and it seems to be only a coincidence that Macleay gave his specimen the name already employed by Fabricius. Macleay supposed that his species was closely allied to Wiedemann's *Lebia marginalis* (Zool. Mag. ii, 1, 1823, 60), for which a new genus *Promecoptera* was proposed by Dejean (Spec. Gen. v, 1831, 443). I have not at present been able to identify Wiedemann's species, but it cannot be very closely connected with Macleay's, which has pectinate claws and a cleft fourth tarsal joint—characters which are not presented by *Promecoptera marginalis.*

The following references seem worth noting down : Fab., Syst. Eleuth. i, 1801, 184; Dej., Spec. Gen. v, 1831, 341; Schm.-Goeb., Faun. Col. Birm. 1846, 32; Motch., Et. Ent. 1855, 51; Chaud., "Monographie des Callidides." Ann. Soc. Ent. Belg. xv, 1872, 113; Bates, Ann. Soc. Ent. Fr. 1889, 283; *id.* Ann. Soc. Ent. Belg. 1892, 233; Lesne, Miss. Pavie 1904, Col. 81; Maindron, Ann. Soc. Ent. Fr. 1905, 334.

The species has a wide distribution throughout the Indo-Malay region, including South China, Indo-China, and the Philippine Is.

36. **Orthogonius picilabris.** This genus, named by Dejean, was first described in the "Annulosa Javanica," and must accordingly be attributed to Macleay. *O. picilabris* = *O. femoratus* Dej. (Spec. Gen. i, 1825, 281), but Macleay's name has priority. Chaudoir in his "Essai monographique sur les Orthogoniens" (Ann. Soc. Ent. Belg. xiv, 1871, 122) gives priority to Dejean, but he recognised that the two descriptions referred to the same species. In addition to Java, it is recorded by Chaudoir from Penang and Malacca.

37. **Orthogonius brunnilabris = O. (Carabus) acrogonus** Wied. (Zool. Mag. i, 3, 1819, 167). The species was also described by Dejean (Spec. Gen. v, 1831, 398) under Wiedemann's name, and its identity with Macleay's species is referred to by Chaudoir in his Monograph (l.c. 104). It appears to be peculiar to Java.

38. **Orthogonius alternans.** Macleay believed that his species was identical with *O.* (*Plochionus*) *alternans* Wied. (Zool. Mag. ii, 1, 1823, 52). Chaudoir mentions Macleay's citation (l.c. 102), but expresses no opinion. The species of *Orthogonius* allied to *O. alternans* Wied., with elytral intervals alternately wider and narrower, seem to me

variable, but after comparing Macleay's type with Wiedemann's description, and examining a number of specimens from different localities, I think the species are distinct, and for Macleay's I propose the new name of *O. macleayi*. To settle the matter beyond doubt, it will be necessary to wait till Wiedemann's type is available for examination. Macleay's species seems to be confined to Java. Wiedemann's is recorded also from Burma, Indo-China, and the Philippine Is.

Orthogonius macleayi. Length 18 mill. Width: head 3·25, prothorax 4·5, elytra 6·25 mill.

Dark brown, ventral surface and mouth-parts a little lighter.

Head wide, intricately wrinkled, more lightly behind and more deeply in front, a small smooth space in the middle of front, just behind which are two short impressed longitudinal lines (possibly individual), frontal impressions rather concealed by the strigose surface, clypeus truncate in front, its surface raised in the middle behind, suture deep; labrum porrect, 6-setose, a little raised at side margins; eyes projecting, two supra-orbital setae; antennae short, stout, just reaching base of prothorax; ligula bisetose at apex.

Prothorax slightly convex, much wider than long, truncate in front, a little bisinuate behind, bordered in front and at base, explanate at sides, more widely behind, sides rounded, more so in front than behind, so that the front angles have disappeared, but the hind angles are merely obtuse and rounded; front transverse impression weakly, hind one strongly marked, median line faint, basal foveae deep; surface rather finely transversely wrinkled, more coarsely along base, longitudinally strigose along the front transverse impression, explanate side margin uneven.

Elytra parallel, square at shoulder, a deep impression on each side in front of base of stria 4, margin rounded at apex, punctate-striate, a scutellary striole between 1 and 2, joining 1 behind; odd intervals much wider than even ones, 2 with a single row of punctures reaching middle, 4 irregularly but thinly punctured up to two-thirds from base, 6 more closely punctured (roughly in two rows) up to three-quarters, 8 with an irregular row stopping at two-thirds, 3 with two large setiferous punctures near apex adjoining stria 2, 5 with two or three large setiferous punctures near base, 7—which is very narrow—with a row of about twelve setiferous punctures extending along its entire length (the setae on these are very conspicuous), 9 with an uninterrupted row of large punctures, some of which certainly have small setae.

Underside smooth, prosternal process bordered, metepisterna smooth, elongate, ventral surface with a small callosity on each side of last segment near side margins, two setiferous foveae on each side of anus. Front tibiae dilated at apex into a strong external tooth, joint 4 of tarsi bilobed in all feet, spines on hind tibiae short and strong but not spathulate, claws pectinate (but hind ones wanting).

Compared with Macleay's type, the examples of *O. alternans* Wied. which I have seen are darker and more elongate, the hind angles of the prothorax more rounded, the even intervals of the elytra—especially 6—more finely and much more closely punctured, 7 with only half a dozen setiferous punctures.

39. **Drypta lineola.** Named by Dejean, this species is here described for the first time by Macleay. Dejean described it subsequently (Spec. Gen. i, 1825, 184) and the name has hitherto been ascribed erroneously to him. It is a common species and often referred to in entomological literature; it varies a good deal and several local forms have been described, among which I may mention *D. virgata* Chaud. (Bull. Mosc. 1850, i, 34), which extends over Burma, S. China, and Indo-China, and *D. philippinensis* Chaud. (Bull. Mosc. 1877, ii, 262) from the Philippine Is. Bates' *D. japonica* (Trans. Ent. Soc. 1873, 303) is closely allied, but seems a fairly distinct species. Following Macleay's description is an " Observation," in the course of which he indicates an Australian species under the name of *D. australis*; this may, perhaps, also rank as distinct. In its various forms the species is spread all over S.E. Asia and the Malay region.

40. **Desera (Drypta) unidentata.** Described later on by Klug (Jahrb. 1834, 53) under the name of *D. coelestina.* Both descriptions are so inadequate that I give a more detailed one. The species is apparently confined to Java.

Desera unidentata. Length 11·5 mill. Width: head 1·6, prothorax 1·4, elytra 3·5 mill.

Dark blue, elytra blue-black; femora (except apex) and trochanters, palpi, antennae (joint 1 at base only, joint 3 at base and apex) red; mandibles and tarsi brown; apex of femora, tibiae, joint 1 of antennae (except base) and a ring round joint 3 black. Covered throughout with short grey pubescence.

Head elongate, rather flat, closely, coarsely, and confluently punctate, with a very small, smooth area in middle of front, neck smooth, clypeal suture fine, labrum with front margin arcuate, two large pores with long setae at each end, a smaller one on each side in the middle, mandibles strong and elongate, palpi very long and slender, last joint securiform and obliquely truncate, much larger in the maxillaries than in the labials, joint 1 of antennae very long = 2 to 6 (about) taken together, eyes prominent, distant beneath from buccal fissure.

Prothorax nearly twice as long as wide, more or less cylindrical, widest at middle, densely and coarsely punctate, more coarsely than head, punctures strongly confluent at sides; sides nearly parallel, moderately constricted at a third from base, side margin well marked in middle only.

Elytra elongate, shoulders strongly rounded, a little widened towards apex, where truncate, outer angle with a short strong tooth, sutural angle fairly sharp but not toothed; punctate-striate with a long scutellary striole between 1 and suture; intervals closely punctate, the punctures much finer than on head and prothorax.

Underside shiny, more finely punctured, and with finer pubescence than upper side; last ventral segment apparently with one large setiferous puncture on each side, but owing to the puncturation and pubescence this is not easy to see. Joint 4 of all the tarsi strongly bilobed; claws finely pectinate.

Colour bluer and darker than in *D. geniculata* Klug (Jahrb. 1834, 52), without any brassy tint, and with black tibiae. Head, prothorax, and elytra all longer, surface rougher and more strongly punctate throughout, outer angle of truncature dentate—not merely sharply angled, joint 1 of antennae relatively longer.

In an " Observation " Macleay incidentally describes *Desera longicollis*, another species hitherto attributed to Dejean (Spec. Gen. i, 1825, 185). The description, it is true, is a slender one, but it must stand. He also adds quite truly that Wiedemann's *Drypta flavipes* (Zool. Mag. ii, 1, 1823, 60) is a distinct species; its locality, however, is N. India, not Brazil.

41. **Pheropsophus (Aptinus) occipitalis** = **P. fuscicollis** Dej. (Spec. Gen. i, 1825, 306). Although Macleay's description was the earlier, the species has always been known by Dejean's name, probably because Chaudoir, in his " Monographie des Brachynides " (Ann. Soc. Ent. Belg. xix, 1876, 42) wrongly identifies *P. occipitalis* with Dejean's *P. javanus* (l c. 305). Mr. G. J. Arrow (Trans. Ent. Soc. 1901, 204) first pointed out the identity of *P. occipitalis* and

P. fuscicollis, though he was not then able to determine the question of priority.

Very common in India, Ceylon, and Burma, this species extends through the Malay Peninsula to Java and Borneo, but I have seen no examples from Siam or Indo-China.

Macleay discusses the genera *Aptinus* and *Brachynus*, but *Pheropsophus*, to which his species belongs, was not described till eight years later by Solier (Ann. Soc. Ent. Fr. 1833, 461).

42. **Planetes bimaculatus.** Macleay placed his genus between *Tarus* Clairv. (= *Cymindis* Latr.) and *Helluo* Bon., but it is not very closely related to either genus, and Bates I think is right (Trans. Ent. Soc. 1873, 304) in putting it near *Galerita*. Nietner redescribed it (Journ. As. Soc. Beng. 1857, ii, 141) under the name of *Heteroglossa*, but his *H. bimaculata* (l.c. 144) is another species, identical with *P. ruficeps* Schaum (Berl. Ent. Zeit. 1863, 81). I have seen specimens from Java, Sumatra, Burma, Siam, and Indo-China.

Bates (l.c.) identifies Japanese specimens with this species, and it is one of the few cases in which he tells us he has consulted Macleay's types. I am unable to agree with his identification, or with Putzeys' (Compt. rend. Soc. Ent. Belg. 1875, 52) or Heyden's (Deutsch. Ent. Zeit. 1879, 329), and have recently described the Japanese and Chinese species, of which I have seen a good many examples, under the name of *P. puncticeps* (Ann. and Mag. of Nat. Hist. 9, iii, 1919, 480).

In an "Observation" Macleay refers to several other species, which he supposes to be allied to his. *Carabus stigma* Fab. (Syst. Eleuth, i, 1801, 192) is a *Strigia*, and *Helluo distactus* Wied. is probably a *Creagris*; neither of these comes very near *Planetes*.

Hope.

The types of Oriental Carabidae described by Hope and preserved in the British Museum may be divided into three groups, of which the first is the most important.

(1) In the Zoological Miscellany 1831, p. 21, Hope published a "Synopsis of the new species of Nepaul Insects in the collection of Major-General Hardwicke." This synopsis was never amplified, and the descriptions are extremely meagre, seldom exceeding a couple of lines.

As a result the species are little known, and have seldom been referred to by subsequent writers, except occasionally with a mark of interrogation. General Hardwicke's Collection was fortunately bequeathed to the nation, and all the types of the Carabidae in question (with one exception) are at South Kensington.

I propose to go through the various species comprised in this paper in the order in which Hope mentions them, and add such comments and descriptions as appear necessary.

1. **Desera nepalensis.** The genus was indicated rather than described by Hope (Col. Man. ii, 1838, 105). The name never came into general use, and was supplanted by Schmidt-Goebel's genus *Dendrocellus* (Faun. Col. Birm. 1846, 24), which held the field until during the last few years Hope's name was reintroduced by Commandant Dupuis, and as the older name should stand.

Hope's species was identified by Chaudoir (Rev. et. Mag. Zool. 1872, 102) with his *D. rugicollis* (Bull. Mosc. 1861, ii, 546), a name designed to replace *D. flavipes* Schm.-Goeb. (not Wied.) (l.c. 24). With this view I do not agree, and I think Dohrn (Stett. Ent. Zeit. 1879, 457) was probably right in identifying *D. nepalensis* with *D. discolor* Schm.-Goeb. (l.c. 24). Bates later on (Compt. rend. Soc. Ent. Belg. 1891, 336) identified as *D. discolor* some specimens taken in Bengal and Assam, but without attributing them to Hope's species. There are examples in the British Museum from Manipur as well as Nepal, and Mr. R. Vitalis de Salvaza has recently taken specimens at Chapa in Tonkin. I have also in my collection specimens from Madura in S. India. As Schmidt-Goebel's description is good, I need not add any description of my own.

2. **Scarites geryon = S. sulcatus** Oliv. (Ent. iii, 36, 1795, 7, t. 1, f. 11). A well-known insect, the habitat of which extends from Central India, through Assam, N. Burma, Indo-China, Formosa, and E. China to Korea. Chaudoir in his "Monographie des Scaritides" (Ann. Soc. Ent. Belg. 1880, 81) gives a note to this species, recording a small local race from Java; of this I have seen no examples.

3. **Broscus (Percus) nepalensis = B. (Cephalotes) punctatus** Dej. (Spec. Gen. iii, 1828, 431). Dohrn (Stett. Ent. Zeit. 1879, 458) seems to have suspected the identity of these two species, and I have no doubt about it. Originally described from the Sinai Peninsula, the species ranges from Egypt, through Arabia and Mesopotamia, to N. India.

Bates (Scient. Results of Sec. Yark. Miss. 1891, Col. 4) also records ? Yarkand and China. In all probability *B. limbatus* Ball (Bull. Mosc. 1870, iv, 327), and *B. batesi* Sem. (Hor. Soc. Ent. Ross. xxv, 1891, 276 (note)) belong to this species. *B. davidianus* Fairm. (Ann. Soc. Ent. Belg. 1888, 7) is a well-marked local race found in Yunnan and at Hong-Kong.

4. **Calosoma indicum.** The type of this species cannot be traced, but I have little hesitation in identifying it with *C. orientale* Chaud. (Ann. Soc. Ent. Fr. 1869, 368).* Chaudoir's specimen came from Bengal, and Bates (Scient. Results of Sec. Yark. Miss. 1891, Col. 3) identifies examples from the Sind Valley and Kashmir with Chaudoir's species. My own records are all from N. India.

The species only differs from *C. chinense* Kirby (Trans. Linn. Soc. xii, 1818, 379) in its rather darker colour, and shorter elytra; both of them—along with various other described species—are little more than local forms of *C. maderae* F. (Syst. Ent. 1775, 237), of which the type is in the Banks Collection.

5. **Carabus wallichi.** The type agrees with Fairmaire's description of his *C. indicus* (Bull. Soc. Ent. Fr. 1889, 15), and I feel little doubt as to the identity of these two species. Bates (Compt. rend. Soc. Ent. Belg. 1891, 324) records a single specimen taken by Père Cardon at Konbir (Bengal). There are examples in the British Museum from Mungphu (British Sikkim), and Fairmaire's specimen came from Darjiling.

6. **Chlaenius nepalensis = C. (Diaphoropsophus) mellyi** Chaud. (Bull. Mosc. 1850, ii, 407). Dohrn (Stett. Ent. Zeit. 1879, 458) seems first to have recognised that Chaudoir's species was the same as Hope's, but with only a two-line description before him he naturally hesitated to substitute *nepalensis* for *mellyi*. Laferté described the species twice over under the names of *Barymorphus concinnus* and *B. planicornis* (Ann. Soc. Ent. Fr. 1851, 236), and Bates described it yet again from Formosa as *C. swinhoei* (Proc. Zool. Soc. 1866, 342). It is found all over India, in Ceylon, Burma, Siam, Cambodia, S.E. China, and Formosa.

There is a specimen at Oxford also indicated as the

* This was written some time ago. I now think Chaudoir's species different from Hope's. I accept the named specimen of *C. indicum* Hope in the British Museum as typical of that species.

type; I give the preference to the British Museum example only on the ground that the other Hardwicke types are at South Kensington.

7. **Colpodes hardwicki.** Chaudoir, in his Monograph of the genus (Ann. Soc. Ent. Fr. 1859, 359), mentions this species among others unknown to him, but in the "Révision" (Ann. Soc. Ent. Fr. 1878) he ignores it altogether. I have seen no examples of it other than the type, another specimen labelled "India" in the British Museum, and a third taken quite recently at Gopaldhara, British Sikkim, by Mr. H. Stevens. The following is a description:—

Colpodes hardwicki, ♂. Length 16 mill. Width 5·5 mill.

Metepisterna twice as long as wide. Tibiae without external grooves. Tarsi without grooves.

Dark red, underside (including epipleurae of elytra) a little lighter; disk of thorax darker; head (except labrum, front of clypeus, and appendages) dark brown; elytra very dark brown with bright green reflections in the type, blue-green in the second example. Head smooth, a little contracted behind, with faint frontal foveae and a furrow along the upper margin of the eye, extending forwards to the base of the antennae; joints of antennae relatively long, 1 three times as long as 2 and a little longer than 3; eyes rather flat.

Prothorax one-third as wide again as head, widest before middle, strongly emarginate in front, truncate behind; front angles porrect but rounded, sides strongly rounded in front, then straight to hind angle, which is also rounded and obtuse; disk rather convex, explanate at sides, margins widely reflexed; a fairly deep fovea at each side of base near the angles, transverse impressions slight, median furrow faint, hardly reaching margins.

Elytra long, rather more than half as wide again as prothorax, nearly parallel, shoulders prominent, margin slightly sinuate behind, apex narrowly truncate, but without any spine at either angle of truncature; striae shallow, impunctate, intervals flat, the whole surface very smooth and shiny; interval 3 with three punctures, 1 at fifth from base, 2 just behind middle, 3 at a sixth from apex. Underside smooth, with some shallow depressions at sides of ventral surface. Legs slender; joint 4 of tarsi bilobed in all pairs of legs, the external lobe rather longer than the internal one in the intermediate and hind tarsi; joint 5 without setae beneath; front tarsi ♂ with three joints narrowly dilated, biseriately squamose beneath.

The species is not unlike *C. buchanani* Hope, but it is considerably larger, and rather narrower. Prothorax relatively wider and more rounded, front margin more strongly emarginate, angles more rounded, and sides more widely reflexed. The second puncture on the third elytral interval is placed a little further towards apex, and the suture is not mucronate at the apex. Both tibiae and tarsi are without grooves.

8. **Colpodes buchanani** = **C. amoenus** Chaud. (Ann. Soc. Ent. Fr. 1859, 326). Mentioned by Chaudoir in his Monograph (l.c. 359) among the species unknown to him, and also referred to vaguely in the "Révision" (Ann. Soc. Ent. Fr. 1878, 367). Morawitz (Bull. Ac. St. Pet. v, 1863, 324) described the species again from Japan under the name of *C. splendens*.

It has a wide range from India and Ceylon to Japan. Bates also records it from Java, and this is quite probable, as I have an example taken by Dr. M. Cameron in the Malay Peninsula.

9. **Pterostichus (Omaseus) indicus**, ♂. } Length 14 mill.
10. **Pterostichus (Omaseus) aëratus**, ♀. } Width 5·5 mill.

I take these together because I think they are probably the same species, but the type of *P. aëratus* is in such poor condition that I cannot state this with certainty. There are only the two types in the British Museum Collection, nor have I seen any other examples elsewhere. In structure the two specimens agree, but in *aëratus* the head, margins of prothorax and elytra, and first joint of the antennae are brassy, whereas in *indicus* the whole insect is black, and, as it is a male, the surface is rather more shiny than in the female *aëratus*. I have not found any references in later writers, so I give a description :—

Head smooth, with shallow frontal foveae, neck wide and rather tumid. Antennae reaching a little beyond the base of prothorax; palpi a little narrowed at apex and truncate. Prothorax one-third as wide again as head, transverse, width to length about 4 to 3 (in *aëratus* the prothorax appears rather wider than in *indicus*, but it is damaged and the wider appearance may be due to this cause); slightly emarginate in front and also (over the median portion of the base) behind; sides rounded in front, sinuate behind, reflexed margin well marked, a pore and seta at one-third from apex, and another at base near hind angle (this latter is only visible in *aëratus*); front angles rounded, hind angles about right, very slightly projecting; surface smooth, both transverse impressions well marked, a deep basal furrow on each side, between which and the side margin the surface is convex, median furrow fairly strong, reaching base but not apex.

Elytra moderately wide, one-third as wide again as prothorax, margin sinuate towards apex; striae deep, intervals smooth, convex, one puncture on third interval a little before middle (the condition of the surface does not allow me to see more, if they are present). Under surface smooth, shiny; prosternal process widened and rounded behind, furrowed in middle, not bordered; metepisterna hardly longer than wide; a setiferous puncture on each side of the last four ventral segments (♂), similar punctures (♀) but two on each side of last segment. Joint 5 of tarsi with setae beneath.

In size and general appearance rather like *P. cristatus* Duf. (*parumpunctatus* Germ.). Head wider; prothorax wider, more strongly rounded and more sinuate at sides, with sharper angles, side border thicker, surface more convex; elytra more rounded at shoulders, margin less reflexed, only one puncture (apparently) on third interval; last ventral segment (♂) without carina; dilated joints of tarsi (♂) not so wide.

11. **Pterostichus (Platisma) gagates**, ♂. Length 12·5 mill. Width 4·25 mill. Another solitary specimen.

Black; tarsi and apex of joints of palpi reddish. Head wide, smooth, with rather strong frontal impressions, faint wrinkles covering the anterior surface; neck tumid; antennae reaching just beyond base of thorax, joint 1 = 3.

Prothorax a little transverse (about 8 × 7), not quite half as wide again as head, emarginate in front and behind, widest a trifle before middle, sides regularly rounded without sinuation from front to hind angles; front angles rounded, hind angles obtuse, margins narrowly raised, with a setiferous pore at one-fourth from apex, and another near hind angle; surface smooth, moderately and uniformly convex, declivous towards front angles, transverse impressions obsolete, median line fine, reaching very nearly to base and apex, a short strong furrow on each side of base rather nearer margin than median line.

Elytra a little more than a third as wide again as prothorax, widened behind, the reflexed margin narrow with a faint sinuation near apex; striae deep, finely crenulate, intervals a little convex, third (apparently) with two punctures, one at about middle, the other about two-thirds from base. Underside smooth, ventral segments with a setiferous puncture on each side; prosternal process not bordered; metepisterna a little longer than wide; joint 5 of tarsi with setae beneath. (Both hind legs are wanting.)

I know of no other species with which I can usefully compare this one. The hind angles of the prothorax are only obtuse and not rounded, or I should have put it into the *Steropus* group.

12. **Pristonychus (Sphodrus) brunneus,** ♀. Length 15 mill. Width 5·5 mill.

The simple claws and immarginate base of the prothorax put this species into the *Antisphodrus* group, which in Europe seems to be confined to caves and grottoes. The type is the only example I have seen.

Dull red, head (except labrum) dark brown, hind margins of ventral segments light red. Head and thorax moderately shiny, elytra opaque.

Head nearly smooth, frontal foveae shallow; only two supra-orbital setae on each side; eyes small and flat; antennae (up to joint 5—remainder wanting) stout, joint 3 hardly longer than 1.

Prothorax a third as wide again as head, as broad as long, a little emarginate in front, truncate behind; sides fairly widely reflexed—especially at hind angles, there is a puncture at the hind angle and several along the marginal channel but no setae are visible; front angles rounded but fairly sharp, hind angles right; disk a little convex, front transverse impression more marked than hind one, median line fine extending from the front impression to the base, a large shallow fovea on each side of the base, which is very faintly punctured.

Elytra a little more than half as wide again as prothorax, finely shagreened, oval, basal margin bisinuate forming at shoulder a sharp angle with side margin, which is reflexed, sinuate behind shoulder but not near apex; surface rather flat and a little explanate at sides; striae fairly deep, closely and minutely punctured; intervals flat, smooth. Underside smooth and shiny; metepisterna a little longer than wide; prosternal process bordered.

Broader than *A. schreibersi* Küst., head relatively shorter and wider, eyes larger, prothorax wider, both front and hind angles less prominent, surface less smooth and shiny.

(2) In the Coleopterist's Manual, Part II, published in 1838, a few new species of Oriental Carabidae are described. The types of two of these species are at Oxford,

and will be referred to later on; only one type is in the British Museum Collection.

Macrochilus bensoni (l.c. 166, t. 1, f. 5). There is a specimen at Oxford, also indicated as the type, but Hope at the end of his description says: "The above insect was originally described from Mr. Kirby's Cabinet; in his MSS. he has given it the name of *Macrocheilus bensoni*, which I retain." The British Museum example came from Kirby's collection, and bears the name in his handwriting; it is therefore no doubt the actual specimen referred to by Hope. I think it may fairly be regarded as the type, though the ambiguity of Hope's observations leaves room for doubt.

The species was redescribed by Guérin (Rev. Zool. 1840, 38) under the name of *Helluo quadrimaculatus*, and it was generally known by that name until recent years, when Hope's name was revived. Both names must now give place to *Macrochilus trimaculatus* Oliv. (See under Olivier.)

It is a common species, taken almost always at light in the evening, and has a wide range from India and Ceylon, through Burma, the Malay Peninsula, and Tonkin to Hong-Kong.

(3) In 1845 Hope wrote some "Descriptions of New Coleoptera from Canton sent to England by Dr. Cantor" (Trans. Ent. Soc. iv, 13–17). Twenty-two species were described, and I give some notes on the six species of Carabidae in the order in which they appear in Hope's paper.

1. **Harpalus sinicus.** Redescribed by Motchulsky (Et. Ent. 1860, 5) as *Harpalus rugicollis*, and by Morawitz (Bull. Ac. St. Pet. v, 1863, 327) as *Harpalus japonicus*; the species has been referred to by numerous authors in dealing with Chinese and Japanese Carabidae. Tchitcherin (Hor. Soc. Ent. Ross. xxxvii, 1906, 253) is—as far as I know—the only author who has correctly identified Hope's species, and he did so with hesitation. It belongs to the group formed by Des Gozis (Mitt. Schweiz. Ent. Ges. vi, 1882, 289) under the name of *Pardileus*.

The species is commonly and widely distributed over China, Japan, Korea, and Formosa; Mr. Vitalis de Salvaza has lately taken it in Tonkin. Bates (Scient. Results of Sec. Yark. Miss. 1891, Col. 7) records the species from

Murree in N. India, but I accept this for the present with reserve.

2. **Iridessus (Amara) orientalis** = **Iridessus (Harpalus) relucens** Bates (Trans. Ent. Soc. 1873, 264; *ibid.* 1883, 240). Tchitcherin deals with this genus several times (Abeille, xxix, 1897, 60; Hor. Soc. Ent. Ross. xxxiv, 1900, 363; *ibid.* xxxv, 1901, 245; *ibid.* xxxvii, 1906, 284). In his diagnosis Bates said that the penultimate joint of the labial palpi was bisetose, but Tchitcherin (Hor. Soc. Ent. Ross. xxxvii, 1906, 285, note (9)) says that, although at first he could distinguish only three setae, on dissection he discovered that there were actually four, two very short and fine, the other two longer and much more conspicuous. In Hope's specimen, which is very poor and defective, the labial palpi are present, but their condition does not allow of more than a superficial examination. Tchitcherin in a further note (l.c. N.B.) points out that Bates, in his description of the genus, contradicts himself regarding the form of the thorax; the Latin and not the English diagnosis should be treated as correct. In Hope's type the neck is covered with short irregular longitudinal wrinkles, but I look upon this as an individual variation.

The species is only known from China and Japan.

3. **Anoplogenius (Harpalus) cyanescens** = **A. (Megrammus) circumcinctus** Motch. (Et. Ent. 1857, 27). The genus *Anoplogenius* was published by Chaudoir (Bull. Mosc. 1852, i, 88) five years before Motchulsky (l.c. 26) published his genus *Megrammus*; Nietner's genus *Lepithrix* (Journ. As. Soc. Beng. 1857, ii, 151) seems to be identical. Schmidt-Goebel (Faun. Col. Birm. 1846, t. iii, f. 9) figures a species which he names *Loxoncus elevatus*, but there is no corresponding text; there is little doubt, however, that *Loxoncus* is identical with the other genera named, and, had Schmidt-Goebel published a description, his genus would have ranked in priority to Chaudoir's. For the species Hope's name must stand.

It is common in China, Japan, and Korea.

4. **Stenolophus (Harpalus) difficilis** = **S. chalceus** Bates (Trans. Ent. Soc. 1873, 270). The solitary example was unnamed, and I attached little importance to it. Fortunately Mr. Arrow recognised the locality-label, and, with this as a guide, I was able to identify the specimen as being almost certainly Hope's type of *Harpalus difficilis*, for which I had long sought in vain. Tchitcherin (Hor. Soc. Ent.

Ross. xxxv, 1901, 246 note (77)) considered Bates' *S. chalceus* identical with Redtenbacher's *S. iridicolor* (Reis. Novar. Zool. ii, Col. 1867, 16). The species, which must bear the name of *S. difficilis*, occurs in China and Japan. Mr. Lesne (Miss. Pavie 1904, Col. 76) records it from Siam.

5. **Stenolophus (Harpalus) trechoides.** An immature example, which I think is to be identified with the very common and very variable *S. smaragdulus* Fab. (Suppl. Ent. Syst. 1798, 60). I consider *S. quinquepustulatus* Wied. (Zool. Mag. ii, 1, 1823, 58) and *S. cyanellus*, Bates (Ann. Mus, Civ. Gen. 1889, 103) to be respectively 5-spotted and spotless forms of this species, which is extremely common throughout the whole of S.E. Asia, including the Malay Islands and New Guinea, and extends southwards into Queensland.

6. **Somotrichus (Coptodera) bicinctus.** This species has had a curious history. Fabricius (Mant. Ins. i, 1787, 198) described a *Carabus elevatus*, the type of which is now in the Hunterian Collection at Glasgow. This is an American insect, now placed in the genus *Scaphinotus*. A little later (Ent. Syst, i, 1792, 162) he described quite another species under the same name of *Carabus elevatus*, and it is this description which was reproduced subsequently (Syst. Eleuth. i, 1801, 204). The locality of this second species is indicated as Paris, and Hope's *Coptodera bicincta* from Canton is identical with it. Dejean (Spec. Gen. v, 1831, 389) next described if from Mauritius under the name of *Lebia unifasciata*, and two years later Brullé (Silb. Rev. ii, 1834, 108) identified this with Fabricius' species. In 1845 came Hope's *Coptodera bicincta* from Canton, and a year later the species is recorded by Schmidt-Goebel (Faun. Col. Birm. 1846, 43) from Calcutta. Three years later Fairmaire (Ann. Soc. Ent. Fr. 1849, 419) redescribed it from Marseilles as *Coptodera massiliensis*. Mr. Bedel (Faune Seine, i, 1879, 114 note (1)) recorded it from Rouen and referred it to the genus *Somoplatus*; later (Cat. rais. Col. N. Afr. 1905, 243 note (3), and 244) he tells us it has also been taken at Algiers.

The genus *Somotrichus* was formed for the species by Seidlitz (Faun. Balt. Ed. ii, 1888, 7), and, in view of Fabricius' double use of *Carabus elevatus*, the species should be known as *Somotrichus unifasciatus* Dej. As will have been inferred from the above remarks, it is more or less a Cosmopolitan species, being carried from port to port by vessels trading in ground-nuts, etc. My records, in addition to the localities already mentioned, include Ceylon, Hong-Kong, Batchian, and Celebes. Mr. Bedel also mentions, though not on his own authority, the French ports of Caen, Le Hâvre, and Bordeaux, Tarsus (in Asia Minor), and Guadeloupe.

But this does not complete the tale. Chaudoir had in his collection a specimen of a *Coptodera* received from Dohrn and taken by Bowring at Hong-Kong. Undeterred by the fact that his specimen was twice as long as Hope's, he seems to have persuaded himself that the two were identical, which was far from being the case. The dimensions given by Hope are " Long. lin. 2, lat. lin. $\frac{1}{2}$," and by Chaudoir " Long. 8 m.; larg. $8\frac{3}{4}$ m." (Mémoire sur les Coptodérides, Ann. Soc. Ent. Belg. xii, 1869, 187). For Chaudoir's species I propose the name of *Coptodera chaudoiri*. I may add that its alleged width is exaggerated.

Westwood.

Westwood does not seem to have been in the habit of writing the word " type " on the labels of the specimens he described as new. Of the three examples of Oriental Carabidae so described, the types of two should be in the British Museum, but I have been able to identify only one of them.

1. **Clivina castanea** (Proc. Zool. Soc. 1837, 128). A small and immature specimen, as I think, of the species described by Putzeys in his " Postscriptum ad Cliv. Mon." (Mém. Liège xviii, 1863, 60) under the name of *C. parryi*. When writing his " Révision générale des Clivinides " (Ann. Soc. Ent. Belg. x, 1867), Putzeys tells us (p. 131 note (1)) that he sent a " type " of *C. parryi* to Westwood, who compared it with his own species, and reported some slight differences, which seem to have been sufficient in Putzeys' eyes to justify him in keeping the species distinct. No one seems to have examined Westwood's type since, and Putzeys' name has been the one in common use. It may be mentioned that the species was figured in Schmidt-Goebel's work (Faun. Col. Birm. 1846, t. 3, f. 4) under the name of *Eupalamus clivinoides*, but no description appeared. Bates thought that Putzeys' *C. lata* and *C. agona* (both " Révision," p. 131) were either identical with or only slight varieties of *C. parryi* (*vide* Trans. Ent. Soc. 1876, 3, and Ann. Soc. Ent. Fr. 1889, 262). In regard to the former I have no doubt he was right, but *C. agona*, to which I shall refer later on, I consider a distinct species. The

type of *C. castanea* came from Manilla. The species ranges over the whole of S.E. Asia, including Japan in the North, and the Malay Archipelago, with New Guinea, in the South.

2. **Oxylobus (Scarites) sculptilis** (Arc. Ent. i, 1843, 88, t. 23, f. 1). This Indian type had no head when described, it was said to come from Van Diemen's Land, and it is now lost. It ought to be either in the Linnaean Society's collection, or in that of the British Museum, but I have searched both in vain; nor has it turned up at Oxford. It is evidently an Indian species of the genus *Oxylobus*, but I doubt whether it will ever be possible, unless the type is found, to identify it with certainty. See also remarks under *O. designans* Walk.

3. **Helluodes taprobanae** (Trans. Ent. Soc. iv, 1847, 279, t. xxi, fig. B). I mention this well-known species here, as I am not likely to have any better opportunity. It is figured by Lacordaire (Gen. Col. 1854, Atl. t. 7, f. 1), but under the erroneous name of *Physocrotaphus ceylonicus* Parry. The species is confined to Ceylon. Westwood says that the specimen from which his description was drawn up was in Melly's Collection, now in the Geneva Museum. I am informed by Dr. J. Carl that there is such a specimen now at Geneva, and, although it is not so marked, I have little doubt that it is the type of the genus and species.

Adam White.

Macrochilus (Acanthogenius) astericus (Ann. and Mag. of Nat. Hist. xiv, 1844, 422). A well-known Eastern species, which was redescribed by Redtenbacher (Reis. Novar. Zool. ii, Col. 1867, 4, t. 2, f. 3) under the name of *Planetes crucifer*. See also Chaudoir (Rev. et Mag. Zool. 1872, 172) and Bates (Ann. Mus. Civ. Gen. 1892, 389). All the specimens I have seen were, like the type, from Hong-Kong. Bates gives Bhamo and Assam also as localities. There is an example in the British Museum labelled "Malabar," but this is almost certainly an error.

Tatum

Two types of Eastern Carabidae described by this author are in the British Museum, both belonging to the genus *Carabus*, and both belonging also to the group named

Imaïbius by Bates (Proc. Zool. Soc. 1889, 211), and subsequently *Tropidocarabus* by Kraatz (Deutsch. Ent. Zeit. 1895, 366).

1. **Carabus lithariophorus** (Ann. and Mag. of Nat. Hist. xx, 1847, 14) = **Carabus caschmirensis** Koll. and Redt. (Hügel's Kaschmir, iv, 2, 1844, 499, t. 23, f. 4). Bates (Scient. Results of Sec. Yark. Miss. Col. 1891, 3) records a specimen taken at Murree. Dr. Roeschke (Deutsch. Ent. Zeit. 1907, 541) gives a very full account of the various species in the *Imaïbius* group, and deals with *C. caschmirensis* on pp. 544 and 549.

The species is spread over the N.W. Himalayas at from 5000–7500 ft., and is not uncommon.

2. **Carabus boysi** (Ann. and Mag. of Nat. Hist. 2, viii, 1851, 51). Recorded by Bates (Entom. xxiv, 1891, Suppl. 8) from Kulu. Kraatz (Deutsch. Ent. Zeit. 1895, 366) misidentified the species with *C. wallichi* Hope (referred to elsewhere). Dr. Roeschke has written fully on it (l.c. 546 and 553).

Like the previous species, this one is fairly common in the N.W. Himalayas, and at rather higher altitudes. Dr. Roeschke gives 6000–10,000 ft., and I have records from 7000 ft. and 9000 ft.

Wollaston.

Among the numerous types of Carabidae from Madeira, Cape Verde Is., etc., there is one which extends its habitat to the Oriental region, and I therefore include it here.

Perigona (Trechicus) fimicola = **Perigona (Bembidium) nigriceps** Dej. This species in one or other of its manifold forms has an almost world-wide distribution. The synonymy seems to be as under :—

Bembidium nigriceps Dej. (Spec. Gen. v, 1831, 44). N. America.

Trechicus umbripennis Lec. (Trans. Am. Phil. Soc. x, 1853, 386). United States.

Trechicus fimicola Woll. (Ins. Mad. 1854, 63). Cape Verde Is.

Trechus jansonianus Woll. (Ann. and Mag. of Nat. Hist. 3, i, 1858, 19). Madeira.

Nestra atriceps Fairm. (Ann. Soc. Ent. Fr. 1869, 184). Madagascar.

Trechicus japonicus Bates (Trans. Ent. Soc. 1873, 281). Japan.

Perigona beccarii Putz. (Ann. Mus. Civ. Gen. 1875, 732). Sarawak.

Perigona discalis Chaud. (Rev. et Mag. Zool. 1876, 553). E. Africa.

Perigona suffusa Bates (Ann. and Mag. of Nat. Hist. 5, xvii, 1886, 151). Ceylon.

Extromus pusillus Pér. (Descr. Cat. S. Afr. Ins. ii, 1896, 587). S. Africa.

Perigona australica Sloane (Proc. Linn. Soc. N.S.W. 1903, 635). Australia.

James Thomson.

Three types of *Catascopus* are at South Kensington.

1. **Catascopus (Pericalus) presidens** (Arch. Ent. i, 1857, 281). Chaudoir (Berl. Ent. Zeit. 1861, 122) expressed the tentative opinion that this species might be a variety of the same author's *C. cupripennis*: I can find no further references. It is actually identical with Chaudoir's *C. costulatus* (Rev. et Mag. Zool. 1862, 489), and Thomson's name must replace Chaudoir's. In the following year Saunders (Trans. Ent. Soc. 1863, 459, t. 17, f. 1) described it again under the name of *C. splendidus*. The species has been found in the Malay Peninsula, Borneo (Sarawak), and Celebes.

2. **Catascopus (Pericalus) cupripennis** (l.c. 282). A well-known species, about which no doubt exists, so that I need not refer to it further. The type came from the Malay Peninsula (Singapore), and I have records also from Penang, Malacca, Perak, Borneo (Sarawak, Labuan, and Pontianak), and Celebes.

3. **Catascopus (Pericalus) celebensis** (l.c. 282). Identified by Chaudoir (Berl. Ent. Zeit. 1861, 120), I think quite rightly, as a form of *C.* (*Carabus*) *elegans* Fab. (Syst. Eleuth. i, 1801, 184), described a few months earlier by Weber (Obs. Ent. 1801, 45) as *C.* (*Elaphrus*) *elegans*. It differs from the type form in the colour of the elytra, which are a bright reddish-purple. The type form extends all over the Malay Archipelago as far as Northern Australia. On the mainland of Asia it ranges from Indo-China on the East to Bengal on the West, but I have not seen specimens from any other part of India, or from China.

F. Walker.

All Walker's Ceylonese types of Oriental Carabidae are in the British Museum Collection, and the descriptions will be found in the Annals and Magazine of Nat. Hist. 3rd Series, vol. ii, 1858, pp. 202–204, and vol. iii, 1859, pp. 51–52. It would serve no useful purpose to pretend that Walker's descriptions have any scientific value, and the genera to which he attributes his species are almost invariably wide of the mark. When Bates—also in the Annals and Magazine (5, xvii, 1886)—reviewed the Carabidae taken by Mr. Geo. Lewis in Ceylon, he had to recognise Walker's work; this evidently went against the grain, and the observations which he lets fall about it here and there cannot be described as flattering. However, the types are there, and it only remains to identify or redescribe them. Bates has already done this to a great extent; but he frequently introduces his own names to take the place of Walker's; this, of course, is inadmissible, and I shall indicate wherever changes have to be made. As I shall have to quote rather frequently from Bates' paper in the Annals and Magazine, I need not do more than give the page; any other quotation from his works will have a fuller reference. I shall take Walker's species in the order in which he mentions them, dealing as briefly as possible with those already elucidated by Bates.

1. **Miscelus (Cymindis) rufiventris** = **M. ceylonicus** Chaud. (Berl. Ent. Zeit. 1861, 125). Chaudoir's description is no better than Walker's, and is later. Bates merely records the synonymy (p. 202). I am inclined to think that *M. javanus* Klug (Jahrb. 1834, 82, t. 1, f. 9) is a red-spotted form of the same species, and I should not be surprised to find that *M. unicolor* Putz. (Mém. Liège, ii, 1845, 375) was the same thing. I hope I may later on be able to see the types, and settle the question.

I have seen numerous examples from Ceylon (Colombo), Madras (Nilgiri Hills), and Bombay (Kanara); also solitary specimens labelled Kashmir, and Hong-Kong. Bates (Ann. Soc. Ent. Fr. 1889, 283) records it from Indo-China.

The existing descriptions are so very slender that I give a more detailed one.

Miscelus rufiventris. Length 8·5 mill. Width 3 mill.

Pitch black, labrum, palpi, joint 1 of antennae, legs, sterna, and ventral surface reddish (in the type), or more generally pitch-brown. The marginal and other setae are nearly all extraordinarily long.

Head small, convex, shiny, smooth—except for a few minute punctures here and there, frontal foveae faint, clypeal suture finely marked and ending in a large shallow pore on each side, from which a very fine line runs towards the base of the antenna, a short, fine, longitudinal impressed line in middle of front, clypeus smooth, strongly emarginate, a seta near each front angle, labrum porrect, as long as wide, rounded in front and 6-setose; eyes rather flat, with one supraorbital seta, neck slightly constricted, antennae reaching a little beyond base of prothorax, joints equal, except 2 which is about two-thirds as long as the others, pubescent from middle of joint 3.

Prothorax cordiform, a little wider than head, strongly emarginate in front, base truncate, widest at a third from apex, sides rounded in front, margin reflexed, widely so behind, a seta at a third from apex, another at hind angle, front angles porrect, a little rounded, hind angles rather obtuse; front transverse impression weak, hind one deep, median line well marked, deeper behind, reaching base but not front margin, basal foveae deep; surface less shining than that of head, smooth but with very fine transverse wrinkles, and a faint rounded impression on each side of disk, midway between median line and margin.

Elytra elongate, rather flat, a third as wide again as prothorax, shoulders well marked, apex truncate with outer angle rounded, margin narrow, a little wider in middle, slightly sinuate at a third from base; striae finely crenulate, a scutellary striole between 1 and suture, 3 joining 4 and 5 joining 6 a little before apex, 7 carried round nearly to apex; intervals slightly convex, 5 and 7 narrower and more convex towards base, 3 with a setiferous pore close to apex, 9 with a series of large setiferous pores, viz. half a dozen at shoulder, one or two at a fourth from apex, three or four at the external angle of the truncature, and one or two near apex.

Underside smooth and shiny, head with half a dozen long erect setae, prosternal process not bordered, covered with minute erect setae, metepisterna long and narrow, last ventral segment minutely and sparsely punctate, with two setae on each side. Front tarsal joints short, hind ones longer, joint 1 rather shorter than 5, which very nearly equals $2 + 3 + 4$, 5 with a few setae at sides, claws simple. In the ♂ joint 1 of front tarsi $= 2 + 3$, the first three joints a little dilated, and biseriately clothed beneath with white filamentous scales.

2. **Dolichoctis (Dromius) marginifer.** A unique specimen.

which Bates described very briefly (p. 210), differentiating it from *D. quadriplagiatus* Motch. (Bull. Mosc. 1861, i, 106, t. 9, f. 4). After examining a number of specimens, and noticing considerable differences in the form of the thorax and the size of the shoulder spots, I consider that *D. marginifer* is only a small dark example of Motchulsky's species. Walker's name is the earlier one. As will be seen later on, the species was again described by Walker as *Colpodes marginicollis.*

3. **Colpodes (Lebia) bipars.** Redescribed by Bates (p. 147) under the name of *Colpodes lampriodes.* I think Bates must have recognised the identity of the two species, but he did not like Walker's description. In this case Walker's name must stand. This is apparently the species which Chaudoir (Révision des Colpodes, Ann. Soc. Ent. Fr. 1878, 375) mistook for Nietner's *Euplynes dohrni.* It seems to be confined to Ceylon.

4. **Catascopus reductus.** Another unique specimen. Bates gives a short description (p. 210), and points out that the species is quite different from that which Chaudoir mistook for *C. reductus* (Berl. Ent. Zeit. 1861, 117). I think the latter will prove to be identical with Bates' *C. cingalensis* (p. 203). Walker's species requires some further description.

Catascopus reductus. Length 10 mill. Width 3·75 mill.

Black, with a brassy tinge on the elytra, head and thorax dark brassy green; antennae, mouth-parts, and legs brown-black.

Head shiny, faintly punctate, a large shallow depression on middle of front, two ocular ridges on each side, the inner one carried forward beyond the base of the clypeus and ending in a large pore; clypeus finely and closely punctate, a depression in the middle near base, a seta at each anterior angle, suture fine, front a little emarginate; eyes moderately prominent, mandibles short, strong, hooked at tip, antennae slender, reaching a little beyond base of prothorax.

Prothorax as wide as head, widest at a third from apex, a little emarginate in front, bisinuate at base, sides, base, and sides of front margin bordered; sides very gently rounded in front, with a long sinuation to hind angles, which are reflexed, right, and a little projecting, front angles not much rounded, a seta on the border just before middle and another on hind angle; front transverse impression shallow, hind one deep, median line well marked, deeper at extremities—especially behind, basal foveae deep; surface shiny, very finely punctate, with a little faint cross-striation.

Elytra rather short, half as wide again as prothorax, moderately convex, square at shoulder, dentate at outer angle of apical truncature, and close to apex, with a small re-entrant angle at suture, sides depressed before middle, with a corresponding sinuation of the margin; punctate-striate, a scutellary striole between 1 and suture, intervals smooth, slightly convex, 7 carinate at base, 3 with three punctures, one near base, one about middle, and one at a fourth from apex.

Underside smooth, ventral surface finely and sparsely punctate; metepisterna elongate smooth; two setae on each side of last ventral segment.

In form *C. reductus* resembles *C. fuscoaeneus* Chaud., but the general colour is darker and there is no coppery hue. The head is less strongly punctate, the ocular ridges less marked and the eyes less prominent, thorax wider, elytral intervals flatter—especially 5, and apex of each elytron bidentate.

5. **Coptolobus (Scarites) obliterans.** } Both = *C. glabriculus*
6. **Coptolobus (Scarites) subsignans.** } Chaud. (Bull. Mosc. 1857, iii, 60), an older name. Bates refers to the synonymy (p. 72).

7. **Oxylobus (Scarites) designans.** Chaudoir, in his "Monographie des Scaritides" (Ann. Soc. Ent. Belg. xxii, 1879, 133) identifies the species with *O.* (*Scarites*) *sculptilis* West., for further remarks on which see under Westwood. Bates (p. 210) did not agree with Chaudoir's opinion, nor did he consider Walker's species the same as Dejean's *O.* (*Scarites*) *lateralis* (Spec. Gen. i, 1825, 400), in which I agree. In these circumstances I give a description of the type.

Oxylobus designans. Length 18·5 mill. Width 5·75 mill.

Black, shiny, palpi reddish.

Head (excl. mandibles) transverse, flat, vertex smooth, two small depressed areas on each side of middle of front, frontal impressions in the forms of elongate narrow furrows extending backwards to neck and forwards to clypeal suture, several short ridges with one or two punctures about level with hind margin of eyes; clypeus longitudinally striate at extremities, almost straight in front, labrum trilobed, the median lobe longest, neck not narrowed behind, eyes small, fairly prominent, mandibles as long as head, sharp but not hooked, finely striate, internal ridge a little sinuate in middle, each with three strong teeth, antennae short, moniliform, paragenae without tooth or emargination.

Prothorax convex, a third as wide again as head, a little wider than long, widest at a third from base, gradually and very slightly narrowing to front angles, a little emarginate in front, side margin strongly bordered, the border turning the front angle and meeting the end of the transverse impression without forming any fovea; two setae, close together, inside the side border at about a fifth from apex, another on the border at hind angle, which is completely rounded and without tooth; front transverse impression and median line both fine, hind transverse impression and basal foveae wanting; surface smooth, except for a few transverse wrinkles along side margins and median line.

Elytra very slightly wider than prothorax, oval, convex, base aciculate; 7 striae (including marginal one), not reaching base, impunctate on disk, widening out and strongly punctured near apex, 6 ending long before apex, no scutellary striole; intervals smooth, flat, 6 narrower and more convex, joining sutural interval, 7 very narrow, carinate, all intervals subcarinate near apex, marginal interval with an uninterrupted series of small umbilicate punctures.

Underside shiny, prosternum a little aciculate, ventral segments with an irregular transverse row of very large punctures, which are more numerous and very irregular on the last one; this has a large (presumably setiferous) pore at each side on the margin; epipleurae very wide at base, smooth; outer margin of abdominal tergites finely tranversely strigose. Front tibiae with three digitations (including apical one).

Rather larger than *O. lateralis* Dej., which has a much smoother head, with frontal furrows not carried so far back, ending on a level with hind margin of eye, prothorax quite smooth, with one seta and pore at a fourth from apex, actually on border (showing a distinct nick in the marginal outline), striae punctured throughout, though very finely on disk, intervals 4 and 5 a good deal narrower than 1–3, and becoming carinate further from apex; epipleurae of elytra punctured on middle, but not at base or apex, ventral surface less punctured, last segment with only 6 or 8 irregular punctures.

There is a second example of *O. designans*, also from Ceylon, in the British Museum Collection.

8. **Clivina recta** = **C. indica** Putz. (Mon. des Clivina et genres voisins, Mém. Liège, ii, 1846, 585 (67)). Bates expresses no opinion. Putzeys' type is at Oxford and will be referred to later on.

9. **Morio trogositoides.**
10. **Morio cucujoides.** Bates (p. 211) gives his views regarding these two species, which he evidently considered different, and which he did not identify with any other described species. He was also uncertain whether the example, referred doubtfully by Chaudoir in his "Essai monographique sur les Morionides" (Bull. Mosc. 1880, ii, 342) to Walker's *M. cucujoides*, was in fact that species. Earlier in his paper (p. 143) Bates identified some specimens taken by Mr. Lewis as *M. cordicollis* Chaud. (Mon. 343). I am unable to express any opinion regarding Chaudoir's *M. cucujoides*, but I consider that *M. trogositoides* Walk. = *M. cucujoides* Walk. = *M. cordicollis* Chaud. The name *trogositoides* is preoccupied, and *cordicollis* was only described in 1880. I think the species should bear the name *M. cucujoides* Walk.

It is widely spread through India, and I have seen examples from Siam (Renong), Andaman Is., Philippine Is., Java, Gilolo, and Morty I. Mr. Vitalis de Salvaza has lately taken many specimens in Tonkin and Laos.

11. **Celaenephes (? Leïstus) linearis = C. parallelus** Schm.-Goeb. (Faun. Col. Birm. 1846, 78, t. 2, f. 5). Bates (p. 211) considered the reference of this species to the genus *Leïstus* as "one of Walker's greatest feats of random identification."

Bates tells us that this is a widely distributed Indian and Australasian species, but I have not myself seen examples from or found any record of examples taken in either India or Australia. I have seen specimens from Ceylon, Burma, and the Malay Peninsula; also many examples from the Malay Archipelago, including the Moluccas and New Guinea. There are records also from Siam, Indo-China, and New Caledonia.

12. **Dioryche (Cardiaderus) scita = D. (Selenophorus) colombensis** Nietn. Bates (p. 76) gives some details and identifies Walker's species with Nietner's. It is a common one in India and Ceylon, but does not seem to extend further. I have, however, seen examples from the Maldive Is.

13. **Anchomenus illocatus.** Bates adopted Walker's name here (p. 146) and redescribed the species. Walker described it again on the next page under the name of *Argutor degener*. It appears to be confined to Ceylon.

14. **Abacetus (Agonum) placidulus.** Bates does not mention either this species or *Selenophorus infixus* described

on the succeeding page. These are identical, and the species was redescribed by Bates (p. 144) as *Abacetus carinifrons*. It should be known as *Abacetus placidulus* Walk.

I have records from Ceylon only, except for a solitary specimen in the British Museum Collection labelled "Pondichery."

15. **Mochtherus (Panagaeus) retractus** = **M. tetraspilotus** Macl.

I have already given some notes on this under MACLEAY.

16. **Orthogonius (Maraga) planigerus.** Walker's description of his genus is quite inaccurate. Bates does not deal with either the genus or species. Chaudoir in his "Essai monographique sur les Orthogoniens" (Ann. Soc. Ent. Belg. xiv, 1871, 121) discusses both, but naturally could make little of them. C. O. Waterhouse (Ent. Month. Mag. x, 1873, 17) pointed out some of Walker's errors, and also redescribed the species from the type. It is evidently very near *O. parvus* Chaud. (Mon. 112) from the Nilgiri Hills, but I do not consider the two species identical. I have not seen any other example.

17. **Anchomenus (Argutor) degener** = **A. illocatus** Walk. and Bates, as already mentioned.

18. **Abacetus (Argutor) relinquens** = **A. (Argutor) antiquus** Dej. (Spec. Gen. iii, 1828, 246). Chaudoir in his "Essai monographique sur le genre Abacetus" (Bull. Mosc. 1869, ii, 400) merely mentions the species, but Bates (p. 144) identifies it not only with *A. antiquus*, but also with *A.* (*Distrigus*) *submetallicus* Nietn. (Ann. and Mag. of Nat. Hist. 3, ii, 1858, 177). Chaudoir (Mon. 391) had already identified Dejean's and Nietner's species.

It is not uncommon in Central and Southern India, as well as in Ceylon, but I have seen no specimens from N. India. Chaudoir gives Burma also as a locality.

19. **Stenolophus (Harpalus) stolidus** = **S. (Carabus) smaragdulus** Fab. (Suppl. Ent. Syst. 1798, 60). Bates (p. 80) could only suggest a "bluer colour and somewhat more robust form" to differentiate this species from *S. 5-pustulatus* Wied. (Zool. Mag. ii, 1, 1823, 58). See also remarks under *S. trechoides* Hope.

20. **Siopelus (Curtonotus) compositus** = **S. ferreus** Bates (p. 76). Bates evidently suspected the identity of the two species (p. 211), and I feel no doubt about it. The species should therefore be known as *Siopelus compositus* Walk.

In addition to the type, I have seen only the examples taken by Mr. Lewis in Ceylon.

21. **Abacetus (Selenophorus) infixus** = **A. (Agonum) placidulus** Walk. = **A. carinifrons** Bates. See above under *A. placidulus*.

22. **Acupalpus derogatus.** Bates (p. 80) accepts Walker's name, but he gives such a short description that I propose to amplify it. The species is apparently confined to Ceylon. Walker's type is a very poor specimen.

Acupalpus derogatus. Length 3·5 mill. Width 1·25 mill.

Black, slightly iridescent; mouth-parts, antennae, legs, margin of prothorax, and margin and suture of elytra reddish.

Head smooth, wide, convex, frontal foveae short, deep, curved towards eye behind, eyes flat, neck not narrowed.

Prothorax rather wider than head, widest at a third from apex, a little emarginate in front, truncate behind, sides rounded in front, then straight to hind angles, which are obtuse; transverse impressions and median line all rather faint, basal foveae deep, joining marginal channel at sides, surface smooth, shiny.

Elytra shiny, parallel, shoulders well marked, obliquely truncate at apex, striae fairly deep, impunctate, a short striole between 1 and 2, intervals a little convex, 3 with a pore rather behind middle, marginal series interrupted.

The black colour differentiates this species from its Eastern allies. It is rather similar in form to *A. meridianus* Dej., but smaller, thorax more narrowed behind, angles more rounded, basal area without punctures, elytra a little shorter and more strongly striate, the pore on interval 3 further forward, and distinguished at once by the absence of the basal yellow fascia.

23. **Tachyta (Acupalpus) extrema** = **T. (Tachys) umbrosa** Motch. (Bull. Mosc. 1851, iv, 507). As Bates points out (p. 151) "only a fragment of Walker's type in the British Museum remains for comparison," but he considered the two species as being probably identical, and I quite agree with him. Schaum described it again (Berl. Ent. Zeit. 1863, 88) under the name of *T. nietneri*.

It occurs all over S.E. Asia and extends to the Malay Archipelago and New Guinea, but is replaced in Australia by *T.* (*Bembidium*) *brunnipennis* Macl., jun. (Trans. Ent. Soc. N.S.W. 1871, ii, 118), and in Japan by the palaearctic *T.* (*Bembidium*) *nana* Gylh. (Ins. Suec, ii, 1810, 30).

24. **Tachys (Bembidium) finitimus.** A single specimen, and also a very poor one. Bates gives some account of it, but his description is so short that I give some further particulars.

Tachys finitimus. Length (approx.) 2·5 mill. Width (approx.) 1·5 mill.

Dark brown, elytra reddish, but darker along suture and at margins, labrum, joint 1 and base of joint 2 of antennae (rest darker), and legs testaceous. (The elytra are partially dissociated from the body, and, being translucent, probably appear lighter in colour than they really are).

Head smooth, not contracted behind, eyes moderately prominent, labrum slightly emarginate, frontal grooves short but fairly deep, bounded by an external ridge, as in *T. haemorrhoidalis* Dej.

Prothorax transverse, widest rather before middle, wider than head, front emarginate, base slightly arcuate; sides rounded, sinuate just before hind angles, narrowly bordered, a seta at two-fifths from apex and another at hind angle, front angles quite rounded, hind angles right; front transverse stria obsolete, hind one well marked, punctured, median stria very faint, not ending in a puncture behind, basal foveae bounded outwardly by a fine carina.

Elytra half as wide again as prothorax, with two sutural impressed striae, the front discal pore and seta at a third from base, hind one at a little more than a third from apex, the inner stria extends in each direction rather beyond the pores, eighth stria entire, with three or four setiferous pores along its course.

Very close to Bates' *T. peryphinus* (p. 153), but distinguishable by the (apparently) reddish elytra, only $1\frac{1}{2}$ (instead of $3\frac{1}{2}$) basal joints of the antennae testaceous, and the fact that the median line does not terminate in a fovea at the base.

25. **Tetragonica (Dromius) repandens.** Another unique specimen. Bates says only a few words about it (p. 210), so I give below a rather longer description.

Tetragonica repandens. Length 3·75 mill. Width 1·25 mill.

Brown, disk of elytra (except suture) light brown; palpi and labrum testaceous; border of prothorax and head pitch black, latter a little lighter on vertex; upper surface finely shagreened.

Head smooth, shiny, convex, frontal foveae shallow, bounded externally by a short ridge running from middle of eye to base of antennae, clypeus with a seta on each side, labrum slightly emarginate, eyes moderately prominent, antennae reaching rather beyond middle of body.

Prothorax a shade narrower than head (with eyes), as long as wide, widest at a third from apex, a little convex, truncate at extremities, but sides of base turn forward to meet hind angles; sides narrowly bordered, gently rounded in front, widely but only slightly sinuate before hind angles, which are obtuse, with a pore and seta just before the angle, a second pore visible at each side on the border at a fifth from apex, but the setae have disappeared; front angles rounded, transverse impressions, median line, and basal foveae all moderately deep, the last named joining marginal channel; surface smooth, shiny, with faint transverse wrinkles.

Elytra nearly three times as long, and a little more than twice as wide as prothorax, flat on disk, but rather convex at margins, which are explanate behind, shoulders strongly, sides gently rounded, apex obliquely truncate, outer angle of truncature rounded, sutural angle rather sharp; striae fairly deep, with large very faint shallow punctures, no scutellary striole, intervals gently convex, 3 with two large punctures occupying the whole width of the interval, one at a third from base, the other at a sixth from apex, a third very small puncture at extreme apex of interval adjoining stria 2, some large setiferous punctures along margin. Fourth joint of tarsi strongly bilobed; claws pectinate.

I put this species in the genus *Tetragonica* with some hesitation. Walker's specimen is unique, and more material is required for dissection. The prothorax is more convex and much more narrowed behind than in the other described species of the genus, the elytra are shorter, with more rounded shoulders, and more squarely truncate apex.

26. **Dolichoctis (Colpodes) marginicollis** = **D. (Cyrtopterus) quadriplagiatus** Motch. (Bull. Mosc. 1861, i, 106, t. 9, f. 4). As already mentioned, both species are identical with Walker's *D. marginifer*, and this is the name which should be used.

The species is apparently confined to Ceylon, though Bates (Compt. rend. Soc. Ent. Belg. 1891, 339) mentions a solitary specimen from Tetara, differing, however, in some respects from the typical form.

27. **Diplochila (Platysma) retinens.** The genus was identified by Bates (p. 212) with Chaudoir's *Eccoptogenius* (Bull. Mosc. 1852, i, 72), and he considered the species closely allied to, if not identical with *E. moestus* Chaud.

(l.c. 74). I do not share this opinion, and identify Walker's species with *D.* (*Rhembus*) *distinguenda* Laf. (Ann. Soc. Ent. Fr. 1851, 278). Bates himself later on not only described the species, but did so twice over—though each time under the same name of *Rhembus rectificatus* (Compt. rend. Soc. Ent. Belg. 1891, 329, and Ann. Mus. Civ. Gen. 1892, 325).

The species is common throughout India and Burma, but its habitat does not seem to extend further.

28. **Gnathaphanus (Harpalus) dispellens** = **G. (Harpalus) punctilabris** Macl., referred to elsewhere.

29. **Lamprophonus** (? **Drimostoma**) **marginalis.** Bates says (p. 212): "A Harpalid, with upper surface finely punctured and frontal furrows as in *Bradycellus* and allies. The type being female, its generic position cannot be ascertained." The species actually belongs to Bates' own genus *Lamprophonus*, described three years later (Ann. Mus. Civ. Gen. 1889, 101), and I consider the type to be a male. There is a further example from Ceylon in the British Museum Collection, and one in my own collection, but like the type they are old. I have also a specimen, only partly developed, from the Nilgiri Hills.

Lamprophonus marginalis, ♂. Length 7 mill. Width 3 mill.

Piceous, upper surface aeneous, side margins of labrum and clypeus, base of mandibles, palpi, mentum, antennae, legs, margin of prothorax (widely), side and apical margins of elytra (the latter more widely), epipleurae of prothorax and elytra, and sides of abdomen reddish-testaceous, undersides of middle and hind femora each with two dark longitudinal streaks, apex of hind trochanters infuscate.

Head wide, convex, moderately shiny, closely and finely punctate, frontal foveae rounded, rather shallow, clypeus truncate with a seta on each side, suture well marked, mandibles strong, blunt, eyes prominent, nearly reaching buccal fissure, antennae reaching a little beyond base of prothorax, first two joints glabrous.

Prothorax transverse, hardly wider than head, widest at a third from apex, rather flat, but declivous towards front angles, a little emarginate in front, base slightly emarginate in middle, the sides coming forward to meet hind angles; side margins finely bordered, very slightly explanate in front, sides gently rounded, faintly and widely sinuate behind, a seta at two-fifths from apex, none at hind angles, front angles touching neck, hind angles sharp, very little more than right; transverse impressions vague, median line reaching apex but not base, well marked only in middle, basal foveae shallow; surface moderately shiny, closely and finely punctate, more closely and confluently at base and sides.

Elytra short, moderately shiny, narrowly bordered, shoulders not much rounded, margin sinuate near apex; striae rather fine, impunctate, a scutellary striole between 1 and 2, intervals flat, closely and finely punctate, rather more coarsely near margins, a large pore on 3, adjoining stria 2, at a third from apex, punctures of marginal series wider apart in middle; testaceous border covering intervals 8 and 9 up to two-thirds from base, then widening out over the apical area, the edge of the aeneous discal area being irregular, with projections towards the apex on intervals 6 and 4.

Underside smooth, but with some fine puncturation along the median line of the body, especially on the prosternal process, metasternum, and basal segment of abdomen, metepisterna elongate, prosternal process not bordered, a few small hairs at apex, two widely distant setae on each side of margin of last ventral segment; testaceous margin not uniform, but formed by a series of small triangular patches, each segment with a small rounded depression on each side. Hind femora compressed and strongly curved (? if natural); tarsi smooth on upper surface, in the hind tarsi $1 = 2 + 3 + 4$; in the type one front leg is wanting, but the first four joints of the other one appear to be slightly dilated, and squamose beneath.

The species is smaller and less elongate than *L. lucens* Bates, with wide testaceous margins to both thorax and apex of elytra, the shallow basal furrows present in *L. lucens* are wanting. Otherwise the species are remarkably alike.

Bates says nothing in his diagnosis of the genus about the ligula and paraglossae; the former is narrow and bisetose at apex, the paraglossae are glabrous and membranous, wider and longer than the ligula, rounded at the sides, with an angle at the apex, not meeting in front. The penultimate joint of the labial palpi is plurisetose. Of the front tarsi in the ♂ Bates says, "quatuor subtus pilis griseis erectis dense vestitis," which is entirely erroneous. The tarsi are, in fact, biseriately squamose, as in *Harpalus*; I cannot, however, detect any squamae on joint 1.

30. **Selina (Pselaphanax) setosa** = **S. westermanni** Motch. (Et. Ent. 1857, 110, t. f. 6). Walker did not recognise the family to which this insect belongs, but put it among the *Pselaphidae*. Schaum redescribed and figured the species

(Berl. Ent. Zeit. 1860, 172, t. 3, f. 11), and three years later (l.c. 1863, 74) created for it—quite unnecessarily—the new genus *Steleodera*. Further observations have been made by Bates (Ent. Month. Mag. viii, 1871, 31, and Ann. and Mag. of Nat. Hist. 5, xvii, 1886, 199), Chaudoir (Bull. Mosc. 1872, i, 396), Mr. R. Oberthür (Notes Leyd. Mus. v, 1883, 223), and Mr. Reitter (Wien. Ent. Zeit. ii, 1883, 96). C. O. Waterhouse figures the species in his "Aid to the Identification of Insects" (xv, 1882, t. 120, fig.).

The species occurs all over India, and in the British Museum Collection there is an example labelled "Hong-Kong." Mr. Vitalis de Salvaza has recently sent a specimen from Cambodia.

* * * * * *

Tachys rufulus. Putzeys (Ann. Mus. Civ. Gen. 1875, 737) refers to a *Tachys rufulus* Walk., and Bates also mentions it (p. 212), but I have been unable to find any description and should be grateful to any one who could tell me where it appeared. I fancy it will prove to be a MS. name. There is no trace of any specimen bearing this name in the British Museum Collection.

Pascoe.

Only one type is in the British Museum Collection.

Omophron brettinghamae (Journ. of Entom. i, 1, 1860, 38). Chaudoir gives a few notes on the species in his "Note monographique sur le genre Omophron" (Rev. et Mag. Zool. 1868, 56). See also Dr. Rousseau (Gen. Ins. Omophroninae, 1908, 3). Dr. Gestro (Ann. Mus. Civ. Gen. 1888, 172) described a species taken by Mr. Fea in Burma as *O. levigatus*, and Bates refers to this in his detailed work on Mr. Fea's Carabidae (Ann. Mus. Civ. Gen. 1892, 269). Dr. Gestro, who suspected that his insect might be the same as Pascoe's, tells us that he sent a specimen to Bates, who compared it with the type of *brettinghamae*, and decided that the two species were different. In my collection is a cotype of *O. levigatus*, which I have compared with Pascoe's type; I find the two specimens to be exactly alike. Possibly the species is a variable one. Pascoe's locality was Dacca, Dr. Gestro's Teinzo (Upper Burma). I know of no other.

Chaudoir.

Opisthius indicus (Ann. Soc. Ent. Fr. 1863, 449). Until

I read the description of this species I was not aware that there was a single type of Chaudoir in the British Museum. However, at the end of his description Chaudoir remarks: "Cette intéressante espèce, qui habite le nord de l'Inde, fait partie de la collection du Musée britannique, où elle n'est representée que par un individu unique." This individual, unique no longer, was placed in the collection alongside another example labelled in Mr. René Oberthür's handwriting, "Comparé au type." It would appear, therefore, that there is another "type" in his collection, but the description leaves no doubt as to the authenticity of the British Museum example. This is one of the very few Chaudoir types not in Mr. Oberthür's Collection.

This genus has been dealt with by Commandant Dupuis (Gen. Ins. Opisthiinae 1912, 2), and *O. indicus* appears on the plate, figs. 1 and 8–10. The species seems to be common where it occurs; Mr. H. Stevens has taken it in considerable numbers at Nagri Spur, near Darjiling (Sikkim), and once at 9000 ft. at Kalapokri in Eastern Nepal. The type came from "N. India," and other examples in the British Museum come from Mungphu and Khamba Jong, both in Sikkim (the latter at 15,000–16,000 ft.), and Guentok.

H. W. Bates.

When Bates was describing a new species he did not make a practice of designating a particular insect as the "type," so that, except in the case of unique specimens, there is only a typical series. In such cases it is I believe the practice, and I think rightly so, of indicating as the type the specimen labelled by the author in his own handwriting; if more than one specimen is so labelled, the one most nearly agreeing with the description will be chosen. I mention this matter because there are two important collections of Oriental Carabidae now in the British Museum, both made by Mr. George Lewis, one in Ceylon, the other in Japan, the new species in which were described by Bates, the Ceylon collection in Ann. and Mag. of Nat. Hist. 5, xvii, 1886, and the Japanese collection in Trans. Ent. Soc. Lond. 1873, 1876, and 1883. The new species are numerous, and specimens labelled by Bates are indicated as the types. I think it quite unnecessary to go through the long list.

The types of the "new genera and species of Geodephagous Coleoptera from China" described by Bates in Trans. Ent. Soc. Lond. 1873 are not in the British Museum.

In addition to the above, types of four species of Carabidae from N. Borneo (Mt. Kinibalu), from the collection of the late Alexander Fry, are now at South Kensington. These are as follows :—

1. **Simous borneensis** (Proc. Zool. Soc. 1889, 384). Found also in S.E. Borneo.

2. **Colpodes fryi** (l.c. 384).

3. **Euplynes aurocinctus** (l.c. 384). Taken also by Dr. Beccari in Sumatra, and by Mr. G. E. Bryant at Quop, W. Sarawak.

4. **Dinopelma plantigradum** (l.c. 385). A second specimen is in my collection.

C. O. Waterhouse.

Of these more modern types I need, I think, give a list only.

1. **Callida terminata** (Trans. Ent. Soc. 1876, 11). Borneo (Sarawak).

2. **Catascopus cupreicollis** (l.c. 1877, 1). Andaman Is.

Bates points out (Ann. Mus. Civ. Gen. 1892, 410) that, apart from colour, there is nothing to distinguish this species from *C. aeneus* Motch. (Bull. Mosc. 1864, iv, 303) = *C. fuscoaeneus* Chaud. (Rev. et Mag. Zool. 1872, 247) from Burma, Malay Peninsula, Siam, and Indo-China. There is, however, some little doubt about the identification of Motchulsky's species.

3. **Adelotopus collaris** (l.c. 1877, 2). Siam.

4. **Cryptocephalomorpha (Adelotopus) marginata** (l.c. 1877, 2). Java.

Ritsema points out (Tijds. v. Ent. xxii, 1879, Verslag. 87) that Waterhouse's species is identical with his previously described *Cryptocephalomorpha gaverei* (l.c. xviii, 1875, Verslag. 93).

5. **Paussotropus parallelus** (l.c. 1877, 3). Batchian.

6. **Callistomimus dicksoni** (Ann. and Mag. of Nat. Hist. 5, xiv, 1884, 429). Formosa.

G. Lewis.

Mouhotia convexa (Ent. Month. Mag. xix, 1883, 193). Laos.

G. J. Arrow.

1. **Pheropsophus nigricollis** (Trans. Ent. Soc. 1901, 203, t. 9, f. 2). S. India (Bangalore).

2. **Pheropsophus bimaculatus** L. var. **posticalis** (l.c. 203). S. India (Mt. Kodeicanel).

3. **Pheropsophus curtus** (l.c. 204, t. 9, f. 3). S. India (Malabar, Kanara).

4. **Pheropsophus heathi** (l.c. 205, t. 9, f. 1). Burma (Maulmein).

Motchulsky.

Motchulsky's collection, formerly in Moscow, is understood to have perished as a result of neglect—a matter of special regret in view of the numerous and very imperfect descriptions of this author. Some reputed "typical" specimens, however, are in existence in foreign Museums and private collections. A few such specimens, all from Ceylon, found their way into F. Walker's Collection, now incorporated in that of the British Museum; Motchulsky and Walker were describing Ceylonese insects at about the same time, and no doubt some exchanges were made between them. The specimens in question, according to the British Museum Register, were typical examples from Motchulsky's Collection, so that they may be regarded as cotypes, and have consequently considerable importance. Unfortunately they are few in number and poor in quality. They are all small species, mounted on shiny cardboard, generally much blackened on the upper surface. The species are as under :—

Amblystomus (Hispalis) fuscescens (Et. Ent. 1858, 23). 1 ex.

Tachys flaviculus (l.c. 1859, 39). 1 ex.

This example exactly resembles *T. infans* Bates (Ann. and Mag. of Nat. Hist. 5, xvii, 1886, 154), and no doubt they are the same species, though there are only three juxta-sutural striae on each elytron instead of four, as in Motchulsky's description. I have seen examples from Perak, Penang, Philippine Is., and Hong-Kong. Bates records it also from various parts of Burma (Ann. Mus. Civ. Gen. 1892, 294).

Tachys suturalis (Bull. Mosc. 1861, iv, 508). 2 ex.

Tachys (Lopha) ovatus (l.c. 509). 1 ex.

A widely-spread Eastern species, described also from Hong-Kong by Schaum as *T. albicornis* (Berl. Ent. Zeit. 1860, 199). I have seen specimens from Ceylon, various localities in India, Burma, Malay Peninsula, Hong-Kong, and Celebes.

There is an example in the British Museum labelled "N. China," but I think this probably refers to the neighbourhood of Hong-Kong.

Tachys politus (l.c. 509). 1 ex.

A very common species, which is probably identical both with Nietner's *T.* (*Bembidium*) *ebeninus* (Ann. and Mag. of Nat. Hist. 3, ii, 1858, 424) and Putzeys' *T. bioculatus* (Ann. Mus. Civ. Gen. 1875, 743).

Tachys sulcatus (l.c. 509). 1 ex.

There are a few examples from the Jekel Collection, some of them mounted on the same shiny blackened cardboard, which are probably also from the Motchulsky Collection, but satisfactory evidence is wanting.

II. *Types in the Hope Department of the Oxford University Museum.*

These are to be found either in the Hope Collection proper, or in the more recently acquired Chevrolat Collection. I will deal with these separately.

(1) *Hope Collection.*

Hope.

Although Hope put manuscript names on a large number of the specimens of Oriental Carabidae in his collection, he actually described very few of them. Most of the published descriptions appeared in the Coleopterist's Manual, vol. ii, regarding which I give some notes below. In the Transactions of the Zoological Society, i, 1833, pp. 91-3, Hope also published "Characters and Descriptions of Several New Genera and Species of Coleopterous Insects." Two of the three species of Carabidae were figured and the figures are well executed; the descriptions too are fuller and better than those referred to elsewhere. These insects formed part of the Sykes Collection, which seemed to have disappeared altogether until quite recently

I found one of the three types in question at Oxford. The other two cannot at present be found, but I give a few notes on all three.

1. **Anthia (Pachymorpha) orientalis** (Col. Man. ii, 1838, 163, t. 3, f. 4).

Hope proposed his genus (l.c. 51) for the Asiatic as distinguished from the African species of the genus *Anthia*, but the name is now used only as a group index. I consider *A. orientalis* a local race of *A. sexguttata* F. (Syst. Ent. 1775, 236), though Chaudoir (Bull. Mosc. 1861, ii, 563), Motchulsky (Bull. Mosc. 1864, iii, 216), and Bates (Scient. Results of Sec. Yark. Miss. 1891, Col. 19) all treated it as a distinct species. See also Obst's "Synopsis des Col. Gen. Anthia" (Arch. für Naturgesch. 1901, 286), and Dr. Rousseau (Gen. Ins. Anthiinae, 1905, 5).

The type of *A. orientalis* is much smaller than the ordinary *A. sexguttata*-form, and (including mandibles) is only 24 mill. in length. The proportions are about the same, but the head is less inflated. The puncturation of the elytra, especially towards the apex, is much finer and closer, and near the apex the surface is finely rugose. The coarse erect pubescence is black (or dark brown), as in the *sexguttata*-form, but the fine recumbent pubescence is brown (in other examples, however, this recumbent pubescence is grey-black). The fourth and fifth ventral segments, though with a few stray punctures, are very smooth along the median line.

Hope seems right in thinking that *A. orientalis* is confined to Western India. The type came from the neighbourhood of Poona, and other examples in the British Museum come from Bangalore. He mentions also a specimen from the Himalayas, but it is to be noted that N. Indian examples, though in other respects resembling *A. sexguttata*, are generally much smaller than those from S. India, viz. about 35 mill. against 45 mill.

2. **Catascopus whithilli** (l.c. 164, t. 3, f. 2). Hope says: "This magnificent insect is named in honour of Col. Whithill, who brought it with him from Darpouillie." I imagine that this locality is in N. India; I have not, however, so far been able to identify it, and shall be glad of information as to its whereabouts. The species does not seem a common one, but I have seen examples from all the three Indian Presidencies, and Commandant Dupuis records it from Laos (Ann. Soc. Ent. Belg. 1914, 119). I cannot find that

anything more than Hope's brief diagnosis has ever appeared, so I give a description.

Catascopus whithilli. Length 20 mill. Width: head and prothorax 4 mill, elytra 6 mill.

Blue-violet; middle of sterna, ventral surface (hind margins of segments lighter), epipleurae of elytra (more or less), coxae, trochanters, underside of femora, and joints 5–11 of antennae reddish-brown; clypeus, labrum, palpi and joints 1–4 of antennae (apex of joints lighter), tibiae and tarsi piceous.

Head large, shiny, gradually narrowed behind eyes, moderately punctate on vertex and at sides, frontal foveae short but moderately deep, a single short ridge on each side close to eye, clypeus with a seta near each front angle, eyes prominent, mandibles strong, hooked at tip, antennae reaching a little beyond base of prothorax, pubescent from middle of joint 4.

Prothorax cordate, convex, shiny, moderately transverse, widest at a fourth from apex, emarginate in front, faintly bisinuate behind, sides gently rounded in front, sinuate long before base, side margin narrowly bordered and reflexed, a seta at a third from apex and another at hind angle; front angles well marked but rounded, hind angles right, base with a narrow border; transverse impressions, median line, and basal foveae all strongly marked, a vague shallow impressed line running parallel with side margin and at a little distance from it; surface smooth, with very fine transverse wrinkles.

Elytra relatively short, parallel, very square at shoulders, sides rather compressed and margin sinuate at a third from base, apical truncature emarginate, outer angle toothed, inner angle narrowly truncate; punctate-striate, the punctures much stronger at sides, a rather deep scutellary striole between 1 and suture, intervals rather flat on disk, faintly depressed at about first third, 3 slightly raised over a short distance near base, 5 and 7 carinate up to two-fifths from apex, a pore close to base between 1 and scutellary striole, 3 with five pores nearly evenly distributed along its length, marginal pores rather far apart, closer near shoulder, with very long setae.

Underside smooth, shiny, middle of sterna and base of first ventral segment more or less punctate and pilose, prosternal process not bordered, punctate and pilose, metepisterna long, narrow, smooth, and deeply channelled, last ventral segment bordered on outer margin, a seta on each side in ♂, 2 setae in ♀.

Tarsi hairy on upper surface, ♂ with three first joints of front tarsi moderately dilated, and clothed beneath with white filamentous scales.

Much larger than *C. facialis* Wied. (Zool. Mag. i, 3, 1819, 165). The blue colour has more violet in it, and no green reflections; head smoother, but punctures larger, without longitudinal striation at sides of front; front angles of prothorax more rounded and basal transverse depression deeper; the carinae on intervals 5 and 7 of elytra sharper, though not extending quite so far towards apex, interval 3 with five (instead of three) pores, tooth at outer angle of truncature not so sharp.

3. **Macrochilus bensoni** (l.c. 166, t. 1, f. 5). An example marked "type"; for reasons already given, I consider the "type" to be in the British Museum.

4. **Chlaenius nepalensis** (Zool. Misc. 1831, 21). There is also an example of this species marked "type," to which I have already referred in my remarks (under Hope) on the Hardwicke Collection, now in the British Museum.

5. **Gnathaphanus licinoides** (Ann. and Mag. of Nat. Hist. ix, 1842, 427). This is a well-known Australian species, but I mention it here because its habitat extends to New Guinea. It was described again by Montrouzier (Ann. Soc. Ent. Fr. 1860, 240) as *Catadromus? impressus*, and by Castlenau (Notes on Australian Coleoptera 1867, 99) as *Harpalus alternans*. Mr. T. G. Sloane has published a table (Deutsch. Ent. Zeit. 1907, 468) differentiating this and allied species. In addition to Australia and New Guinea, the species is found in New Caledonia.

6. **Brachynus (Aploa) pictus** (Trans. Zool. Soc. i, 1833, 92, t. 13, f. 1). Sykes Collection: type lost. Subsequently described by Chaudoir (Bull. Mosc. 1852, i, 41) as *B. figuratus*. The species is omitted from the Munich Catalogue. When Chaudoir came to write his "Monographie des Brachynides" (Ann. Soc. Ent. Belg. 1876), he had discovered Hope's description, and the species appears correctly under the name of *pictus* (p. 54). It is a well-known species, closely allied to *B. nobilis* Dej. (Spec. Gen. v, 1831, 415) from N. E. Africa, but differing widely in appearance from most other species of the genus. Hope's type, like the other two described from the Sykes Collection, came from Poona, and I have records also from Bengal, Delhi, Nagpur, Belgaum (Bombay), S. India, and Ceylon. At Oxford there is a specimen labelled "Siam"—the only extra-Indian locality I have come across—and this is possibly inaccurate.

7. **Calosoma orientale** (l.c. 92). Sykes Collection: type

lost. I think this species is identical with Chaudoir's *C. squamigerum* (Ann. Soc. Ent. Fr. 1869, 368). Hope's description here is a little thin, but as far as it goes it agrees fairly with Chaudoir's, and no other species of *Calosoma* is known as yet from Central and Southern India. Hope's type came from Poona, and Chaudoir's two specimens came from Bengal and Coimbatore (Madras). I have records also from Khandwa (Central Provinces), Nasik (Bombay), and Manaparai (Madras).

8. **Chlaenius sykesi** (l.c. 93, t. 13, f. 2). Until quite recently I believed that this, like the other Sykes types, was lost, but it has turned up in the Hope Collection, though in a very battered condition. The species belongs to the group designated *Homalolachnus* by Laferté (Ann. Soc. Ent. Fr. 1851, 233 and 293); and retained by Chaudoir in his Monograph. Chaudoir did not possess it, and omits all reference to it, as does the Munich Catalogue (see Bates, Notes Leyd. Mus. xi, 1889, 207). It is closely allied to *C. sexpunctatus* Dej. (Spec. Gen. v, 1831, 616) from Abyssinia, but even more closely to *C. panagaeoides* Laf. (l.c. 235) from Malabar. The type came from Poona, and I took another example (♀) also at Poona in the year 1887; a third example (♀) in the British Museum is labelled "India" only. I give below a detailed description, but as the type is too fragmentary for this purpose, I have described my own specimen, after comparing it, as far as circumstances permit, with the type.

Chlaenius sykesi, ♀. Length 19 mill. Width: head 3·5, prothorax 5·5, elytra 8 mill.

Black, underside iridescent. Head aeneous-green, prothorax with faint greenish reflections, elytra sericeous, three spots on each elytron and labrum yellow, first three joints of antennae and tips of palpi red.. Upper surface covered, but not at all densely, with a pubescence of short black and yellow hairs.

Head convex, moderately shiny, not contracted behind, coarsely but not closely punctate, with a few finer punctures, frontal foveae very faint, slightly furrowed near eyes, a large pore and seta on each side of clypeus, midway between base and apex; last joint of maxillary palpi moderately, of labial palpi more strongly dilated, eyes rather flat, antennae reaching beyond base of thorax, joint 3 two and a half times as long as 1, half as long again as 4.

Prothorax convex, moderately transverse, widest rather behind middle, narrower at apex than base, truncate at extremities, sides gently rounded, narrowly bordered, with a long seta at about a fifth from (apparent) base, front angles hardly, hind angles almost completely rounded; transverse impressions obsolete, median line faint, basal foveae small, round, shallow; surface coarsely, densely, and confluently punctate.

Elytra convex, rather elongate, not wider at base than prothorax, dilated behind, widest at three-fifths from base, very finely bordered, margin faintly sinuate behind shoulders and again near apex; punctate-striate, a rather long scutellary striole between stria 1 and suture, marginal series interrupted in middle, intervals nearly flat, each with two more or less regular rows of setiferous umbilicate punctures, 2 and 3 (but only on disk) with a few similar punctures on middle of intervals; front yellow spot roughly rounded, covering the shoulder and extending inwards to stria 3, middle spot rather larger and a little transverse, reaching stria 2, on interval 9 the colour running forward a little way towards the front spot, hind spot near apex, equal to front one and also rounded, extending inwards to stria 3, all spots reaching margin, but leaving the narrow border black, tapering a little towards suture.

Underside shiny, all sterna and episterna coarsely but rather sparsely punctate, meso-episterna only on anterior half, ventral surface fairly strongly punctate at sides, very finely and sparsely in middle, prosternal process unbordered, pilose, metepisterna as long as wide, last ventral segment with half a dozen pores along margin on each side.

Closely allied to *C. panagaeoides* Laf., but considerably larger and distinguished at once by the presence of six yellow spots on the elytra instead of 4. Head more strongly punctured, eyes not quite so flat, prothorax much less contracted behind, elytral intervals flatter, colour of spots darker.

Gray.

Orthogonius hopei (Griffith's Animal Kingdom, Col. i, 1832, 273, t. 13, f. 4). Described again in the following year by Gory (Ann. Soc. Ent. Fr. 1833, 196) under the name of *O. malabariensis*. Gray's species was said to come from India; the type bears a label, which I am unable to read. Gory's species was said to come from Malabar. Provisionally I disbelieve both these statements. Chaudoir, in his "Essai monographique sur les Orthogoniens" (Ann. Soc. Ent. Belg. xiv, 1871, 103), describes the species and tells us that he possesses two specimens, one of which (Gory's type) " était indiqué comme venant des Indes orientales," the other coming from Malacca.

In the British Museum there are examples from Malacca, Singapore, Penang, Tringanu, Pulo Aor (wherever that may be), and the N.E. coast of Sumatra. If Gray had no better indication of origin than the label on the type specimen, I do not know how he squeezed " India " out of it. Gory possibly misread " Malacca " for " Malabar." At all events I have seen no examples from India, and I regard the species as a Malay one.

W. W. Saunders.

Catascopus wallacei (Trans. Ent. Soc. 1863, 462, t. 17, f. 4). There is in the Hope Collection a damaged specimen of this species, without a head, claiming to be the type. It seems unlikely that one solitary type should have been detached from all the others described by Saunders in his paper. Mr. O. E. Janson tells me that the Saunders Collection of Carabidae was sold to Mr. Edwin Brown, and that on his death it was resold and probably went abroad. The species comes from Waigiou.

Putzeys.

There are four types of *Clivina*, all described by Putzeys in his " Monographie des Clivina et genres voisins " (Mém. Liège, ii, 1846). The original descriptions are long and detailed, and no redescription appears necessary, though I give a few notes.

1. **Clivina assamensis** (Mon. 584 (66)). I cannot find any mention of this species since the description was published. Putzeys' account of the head does not seem to me quite accurate, and the mentum—a very curious organ—is hardly mentioned.

The sides of the mentum are nearly parallel, lobes obliquely truncate in front, epilobes projecting very slightly in front, general surface shagreened, surface of lobes slightly striate, middle of basal area raised and longitudinally furrowed, tooth in the form of a cup, the concave area directed forwards, the upper margin projecting beyond the lower and a little emarginate, the lower margin forming a small rounded knob projecting downwards.

Head with a curved ridge in front, convex part directed forwards, as in *C. indica*, a little behind and parallel with this a slight curved furrow, and behind this another slight furrow curved so that the convex part faces backwards, on each side of middle of front a deep pit, with a short transverse furrow behind it; neck strongly punctured, two or three ridges between front and frontal plates. Hind angles of prothorax rounded, lateral grooves shallow, crenulate, extending to front margin. Elytra with striae 1–4 free at base, interval 3 without pores, 8 joining 7 before base, 6 at base, all a little carinate at base, 8 carinate at apex. Prosternal channel narrow; underside finely punctured, except along median line, last three ventral segments bordered, two setae—rather distant from each other—on each side of last one.

2. **Clivina indica** (Mon. 585 (67)). One of the best-known and most widely distributed Eastern Clivinas. It was redescribed by Nietner (Journ. As. Soc. Beng. 1856, v, 390) as *C. rugosifrons*, and two years later by Walker (Ann. and Mag. of Nat. Hist. 3, ii, 1858, 203) as *C. recta*. I have seen examples from numerous localities in India, Ceylon, Burma, and Indo-China. In India the average length is 8 mill., but in Indo-China it is only 6·5 mill.

3. **Clivina melanaria** (Mon. 586 (68)) = **C. (Scarites) attenuata** Herbst (Nat. Ins. Käf. x, 1806, 264, t. 176, f. 7). Also described by Bonelli (Obs. Ent. ii, 1813, 481) as *C. picipes*. A common species in N. India, but I have not seen examples from any places further South than Nagpur (Cent. Prov.), and Bandra and Kalyan (Bombay). A local race was described by Bates from Bhamo (Ann. Mus. Civ. Gen. 1892, 275) as var. *bhamoensis*. The species reappears in Indo-China, where the dimensions, as in the case of *C. indica*, are 6·5 mill., compared with 8 mill. in India.

4. **Clivina striata** (Mon. 592 (74)). Very closely allied to *C. attenuata* Herbst, the points in which it differs being well brought out by Putzeys. I have found no references to this species in entomological literature. It is fairly common in Southern India, and extends about as far towards the North as *C. attenuata* does towards the South.

(2) *Chevrolat Collection.*

Chevrolat.

Among the types of Oriental Carabidae in this collection there are two described by Chevrolat himself.

1. **Pericallus guttatus** (Mag. Zool. 1832, cl. ix, t. 46).

The description does not go into great detail, but it has been expanded by Chaudoir (Berl. Ent. Zeit. 1861, 123) and Commandant Dupuis (Ann. Soc. Ent. Belg. 1913, 82). The type came from Java, and so did nearly all the examples I have seen. There are, however, two specimens in the British Museum labelled respectively "India," and Mungphu (Sikkim): I think these indications should be accepted with reserve.

2. **Gnathaphanus (Amblygnathus) philippensis** (Rev. Zool. 1841, 221). Two examples (♂ ♀), without any indication as to which is the type. Chevrolat probably had both examples before him, and I think they may fairly be treated as the ♂ and ♀ types. These came from Manilla, but the range of the species is from S. India to tropical Australia. W. Macleay, jun., described it from Port Denison (Trans. Ent. Soc. N.S.W. 1864, i, 117) under the name of *Pachauchenius laeviceps*, and Chaudoir added some further notes (Ann. Mus. Civ. Gen. xii, 1878, 511). Bates records the species from Rangoon, Chaudoir from Queensland, and Mr. Sloane adds Celebes and New Guinea. I have seen Indian specimens from Belgaum and Kanara (Bombay), and Virsee (Central Provinces). I believe the species to be fairly common in Australia, but it seems to be uncommon in the Indian region.

Castlenau.

Chlaenius flavofemoratus (Et. Ent. 1834, 81, t. 1, f. 3). Chaudoir did not apparently know this species, for in his "Monographie des Chléniens" (Ann. Mus. Civ. Gen. 1876, 93) he treats it as a synonym of *C. femoratus* Dej. (Spec. Gen. ii, 1826, 328). This is quite a mistake. It is actually identical with *C. nigricoxis* Motch. (Bull. Mosc. 1864, iv, 339), by which name it has hitherto been known; this name must, however, give place to Castlenau's much earlier one. Chaudoir (Mon. 94) gives a further description of Motchulsky's species, and Bates (Ann. Mus. Civ. Gen. 1892, 312) also has a reference to it. The type came from Java, Motchulsky's species from Hong-Kong. Bates mentions Bhamo, Palon, and Karin Cheba (Burma); also Laos in Indo-China.

Putzeys.

There are in the Chevrolat Collection some *Clivina* types and cotypes. Putzeys' types seem to be scattered, and without an examination of foreign collections, it is impossible to decide whether certain specimens are types or not.

1. **Clivina agona** (Rév. gén. des Clivinides, Ann. Soc. Ent. Belg. x, 1867, 131). After the description we read, "Rapporté de Siam par M. de Castelnau 1 ind." The label is marked "Siam Castelnau type," and there seems no reason to doubt that this specimen is actually the type of the species, though I find nothing in Putzeys' writings to indicate that it was in the Chevrolat Collection. The species, of which I have seen no other example, is very much like *C. castanea* (see under WESTWOOD), and the only material difference I can detect between them is in the sculpture of the thorax. In *C. castanea* the surface is smooth or only slightly wrinkled; in *C. agona* the transverse wrinkling is very marked. The longitudinal wrinkles are not so apparent; they are situated on each side of the median furrow, and though irregular run parallel with it; they may sometimes be seen indicated in *C. castanea.* The finely punctured spaces on the disk I have never seen on any of the numerous specimens of *C. castanea* I have examined. It is possible that this surface structure may be individual, and one would like to see more Siamese specimens. Bates thought *C. agona* a variety only of *C. parryi* Putz. (= *C. castanea* West.), but for the present I treat it as distinct.

2. **Clivina transversa** (Rév. gén. 125). This is also a specimen taken by Castelnau in Siam, but it does not claim to be the type. Putzeys says, "Siam 1 ind. communiqué par M. Signoret." I have not been able to learn what became of the Signoret Collection.

I know of only one other reference to the species, viz. by Bates (Ann. Soc. Ent. Fr. 1889, 262), who gives Mytho (Indo-China) as a locality.

3. **Clivina siamica** (Rév. gén. 124). Six examples, all taken by Castelnau in Siam. These are possibly all cotypes, and the labelled specimen may be the type, though this is not indicated. Putzeys had before him 7 examples taken by Castelnau in Siam. Bates (Ann. Soc. Ent. Fr. 1889, 261) identified some examples from Saigon as belonging to this species.

I think *C. siamica* may prove to be identical with *C. lobata* Bon. (Obs. Ent. ii, 1813, 481), but I have not the means at present of deciding this point.

4. **Clivina javanica** (Mon. des Clivina et genres voisins, Mém. Liège, ii, 1846, 592 (74)). The description is followed by the note "Java 1 ind. Coll. Chevrolat." In going through the collection I was unable to find any specimen labelled *C. javanica.* I found, however, an example labelled "*Clivina indica* (D. Bardel)," which has nothing to do with *C. indica*, and (except that the lateral groove on the thorax does not quite reach the anterior margin) agrees with the description of *C. javanica.* This specimen does not claim to be a type, but it is possible that some accidental confusion of labels has occurred, and in default of other competitors with better claims, I think it may be regarded as the probable type of the species. In the "Révision générale" (p. 124) Putzeys mentions another specimen in his own collection from the same locality, and Bouchard (Ann. Soc. Ent. Fr. 1903, 169) also records the species from Java.

5. **Clivina ephippiata** (Mon. 602 (84)). Putzeys says, "Java 1 ind. Coll. Chevrolat," but I actually find two specimens designated "type," one labelled "Java" twice over, the other labelled "Java" on one ticket and "Macassar" on another. In his "Postscriptum ad Cliv. Mon." (Mém. Liège, xviii, 1863, 29) Putzeys remarks, "J'en ai vu un individu de Macassar. J'en possède deux que j'ai reçus de M. Stevens comme venant des Iles Célèbes." In the "Révision générale" (p. 185), the other localities have disappeared, and we are confronted with "Iles Célèbes" only. It appears certain that one of the two Oxford specimens is the type, but there seems no longer any means of ascertaining which of the two enjoys that distinction.

There is one specimen from Java in the British Museum, and I have one in my own collection, received from Mr. Sloane, labelled "Sukabumi" (E. Java).

6. **Clivina lobata** (Bonelli, Obs. Ent. ii, 1813, 481; Dejean, Spec. Gen. i, 1825, 414). Though this species was not described by Putzeys, I mention it here because he makes it the type of a considerable group. He did not know Bonelli's type, but, for reasons given in the "Révision" (p. 120), he considered that Dejean's was identical with it. These reasons seem to me inadequate, but until Bonelli's type (if it still exists) is available for examination, the question must remain open. In the Chevrolat Collection there are two examples, one from Bengal, the other

labelled "Ind. Or." and claiming to be a type of Dejean's *C. lobata*. I think this unlikely, but it was probably compared with Dejean's type. Putzeys says (Mon. 599 (81)), "Indes Orientales (Bengale). 2 ind. coll. Dejean. 1 ind. coll. Chevrolat sous le nom de *Cliv. fodiens* Illig." I have seen nothing with any such label attached. Redtenbacher (Reis. Novar. Zool. ii, Col. 1867, 8) records what he takes for this species from Shanghai.

7. **Ancus excavaticeps** (Rév. gén. 199). The locality is Siam, and Putzeys adds to his description, "J'en ai examiné des individus dans les Collections de M. de Chaudoir, Signoret, et Chevrolat." At Oxford there are 5 examples taken by Castelnau in Siam. The labelled specimen might be regarded as the type, but in any case I think they may all be considered as "cotypes."

Mr. Sloane kindly sent me two examples, also from Siam, and there are six specimens in the British Museum, three labelled "Siam" (ex coll. Bowring) and three labelled "Malay-Castelnau" (ex coll. Fry).

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INDEX OF GENERA AND SPECIES.

References to descriptions are given in heavy type.

VII. *The British Species of* Andrena *and* Nomada. By R. C. L. Perkins, M.A., D.Sc.

[Read May 7th, 1919.]

Plates XI—XV

The species of the genus *Andrena* and its parasites of the genus *Nomada* have perhaps been more sought after and collected than any other of our Aculeate Hymenoptera. This is probably due to the fact that in our limited fauna they present a good appearance in a collection, few being of small size and many of considerable beauty, while at the same time hardly any places are so poor as not to possess some local and interesting species. *Andrena* is a genus of enormous extent, our sixty-one species being a small fraction of those that exist, or, indeed, of those that have been already collected. Unfortunately, no one has yet been found to classify the species as a whole, and no satisfactory grouping even of the European forms has yet been achieved.

The various arrangements that have been proposed for our British species all leave something to be desired. Those adopted by F. Smith and Shuckard are quite impossible and unnatural, being based on superficial appearances. The classification used in the works of Edward Saunders was a vast improvement on these, especially that in his last book. Schmiedeknecht's arrangement in the "Apidae Europaeae" is often unsatisfactory. But before considering in detail the arrangement in groups of our British species, some notes on the habits of the species and their parasites may be given. Smith, Saunders and Shuckard have all described these to some extent. All these collectors had constant access to some of the finest collecting grounds that are to be found in the South of England, and consequently there is a tendency, I think, in their writings to consider species that are really quite local to be of more general distribution than they actually are. As a beginner it was my lot to collect in a district where a sandy soil—so attractive to most Aculeata—was wanting, and in consequence it was years before I met with living specimens of many species, which in a more favourable district would be considered very commonplace.

The habit of forming "colonies," that is for great numbers of individuals of a species to form their burrows side by side, often so close together as almost to touch one another, is very marked in some species of *Andrena*, while others rarely or never do so. Thus one may sometimes see hundreds of burrows of such species as *A. humilis* * or *A. sericea* (*albicrus*) in a square yard or two of surface, while species like *A. trimmerana*, *nitida*, *albicans* and others rarely or never form these compact colonies. Some species, e.g., *A. cineraria*, sometimes form dense colonies, but at other times their burrows are scattered singly or two or three together over a large acreage of land. In such cases it is probable that in the one instance the soil and other conditions are pretty much the same over the whole area occupied, and in the other that a limited spot affords conditions pre-eminently favourable, as compared with the surrounding country. I suspect the colonising is due sometimes to a natural sociability of the species or a reluctance to depart from their immediate birthplace, for we have seen a colony with few individuals—probably it had originally been started by a single female—increase in size and become permanently a large one, subject only to increase or decrease as the seasons were favourable or otherwise. Some of these colonies persist for many years. V. R. Perkins, in his list of the bees of Wotton-under-Edge, Gloucestershire, records the discovery of a colony of *A. humilis* in 1876, from which he collected the species again in 1882, 1887 and 1891. I myself collected from this colony in 1886, 1887 and 1890, and observed it to be still present in 1907 and 1914. As no other colony of this bee has ever been observed in the district, we may assume that this one has maintained its hold for nearly forty years at least, and might conceivably have existed for centuries. Some colonies are of such vast extent as to produce almost incredible numbers of individuals. Thus those of such species as *A. humilis* and *A. sericea* sometimes extend in favourable situations, with breaks perhaps at intervals, for hundreds of yards. Smith remarks of the first named that in a pathway at Hawley Green,

* The changes in nomenclature adopted in this paper will be found on p. 269, the names used in recent British works and catalogues being added in brackets.

Hants, there was a colony "so numerous that their flight as they skim over the surface of the ground, produces a loud humming noise." I have noticed similar colonies of this species myself, and have recorded the same of *A. wilkella*. Other species that do not form those huge dense colonies are sometimes equally successful in the production of individuals, and I suppose every one must have noted the incalculable numbers of *A. albicans* that may be seen flying along a single hedgerow, or of mixed common species flying round some attractive flowering tree or bush. At times local or even rare species may be observed in numbers not at all inferior to those of the commonest. Indeed, many of the most local species, where they do occur, are amongst the most plentiful. In Devonshire we have seen at times the males of *A. synadelpha* (*ambigua*), *fucata*, *fulvago*, *bimaculata* and others so numerous on the wing that a number could be taken at a single stroke of the net. One most noticeable feature about the species of *Andrena* is the frequent apparent disparity of the sexes in the number of individuals observed, when both ♂ and ♀ are fully out. Thus in the case of *A. synadelpha* above mentioned, if one stands for an hour or two by a hedgerow that I have in mind, up and down which the males are coursing in great numbers, it is most probable that not more than one or two females will be seen. These burrow in a scattered fashion over the adjoining heath, and do not flock, like the males, to the hedge that borders it, so that, unless one happens to be found sunning itself on a leaf or entering a burrow, it is quite possible that not even a single example of this sex will be met with. Nor have I ever found them on flowers in the immediate vicinity, and they must go elsewhere to find these. Mr. Morice once lent me a long series of beautifully fresh females of this species which he found all together (and many males in their company) on the flowers of *Erysimum alliaria*, but this plant does not grow in the locality where I find the males so plentifully. If, when a species first appears, the weather continues fine and hot, the males generally last for a very short time. This is especially the case with many of the less common species, and it is very annoying to find a plentiful supply of females of a desirable species, either on flowers or at their burrows, and not to be able to secure a single specimen, or only a few old and worn specimens, of the other sex. The males invariably appear before the females, either by a day or two or still more in advance, and, as has been said, last for a much shorter period. Isolated cases of a female captured before a male has been seen are not to be considered as anything but abnormal exceptions, the aggregate of the latter sex always preceding the other. Sandy, gravelly or light soils are absolute requirements of some species, and they need not be looked for where these do not occur. Rich meadowland is greatly inferior as a collecting ground to sandy heaths, waste places and coast land. Certain species, however, such as *A. albicans, nigroaenea* and *wilkella* seem to flourish equally in almost all situations in the South of England.

The welfare of our wild bees and wasps is probably more dependent on weather conditions than is that of any other group of insects. Most of their species never venture from their burrows unless the sun is bright, though some will do so on sultry days, even though the sky is overcast. In early spring some species of *Andrena* are active enough, even though the temperature is low, provided that the sun is bright. A thoroughly wet and cold season is very disastrous. Of those that I have spent in England since I began to collect our Aculeates, the year 1888 was the most remarkable. The preceding season was a favourable one in North Wiltshire, and during the autumn the species of such genera as *Halictus* and *Sphecodes* had in all probability reached their maximum abundance. The hibernated females of these, of course, appeared in the following spring, but the new generation was almost wanting. Only a few males of the most abundant species began to appear in August, about a month late—and four of the commonest *Sphecodes* could not be found at all. *Andrena nigroaenea* was still endeavouring to collect pollen at the end of August, and *A. wilkella* far into September. The first males of *Halictus nitidiusculus* and *H. xanthopus* appeared on Sept. 20th, while on Oct. 5th nearly every garden flower was cut down by the severe frosts. A colony of the last named, thousands strong, was entirely destroyed and never reappeared. Sudden storms, especially hail-storms, that occur when the season is well advanced are very disastrous. Being aware of a spot where *A. proxima* occurred, I started one day at the beginning of June in bright sunshine to the locality. On reaching the place males were at once noticed flying about the bushes, and females gathering pollen from the flowers of a white Umbellifer. Just then it clouded over and hail began to fall. A few of the bees were picked up in a torpid condition from the herbage, but the bad weather continued, and further visits on the fine days following failed to yield a single specimen. In the early spring bees seem to be aware of these coming changes of weather, and vanish as if by magic when the sun disappears. That rarer species manage to survive such disastrous climatic changes is very probably due to the fact that in some species, and perhaps in all, a percentage of individuals do not emerge in the normal period, but remain over as larvae, to become developed in the following season. This occurs not only in cold climates, but also in the tropics, and must be of great advantage for the continuance of a species. It has already been mentioned that some species of *Andrena* are not constant in their habits of forming compact colonies, nor are they so with regard to their choice of a situation for these colonies. For instance, I have found the fine *A. hattorfiana* forming a compact colony in a hard-trodden pathway, while hard by others were burrowing singly in places where the ground was well covered with vegetation. Again, when we consider the plants from which they collect the pollen and honey for their nests and procure the latter for their food, we find a great diversity of plants chosen by the individuals of some species. Also a flower that is much visited in one locality appears to be nearly or quite neglected in another. In Suffolk the summer brood of *A. bimaculata* was found on one occasion in great numbers on the flowers of *Senecio* on the breck-sands, whereas in Devonshire I have been through acres covered with these flowers where, although *bimaculata* was numerous, not one was observed to visit them. Smith says that *Nomada* * *roberjeotiana* is to be sought for on the flowers of *Senecio*, but in Devonshire this bee visits almost exclusively the *Potentilla*, even though ragwort abounds in the same locality, and Mr. Morice informs me that he has only taken it on this flower. Very few of our Andrenas are constant to a single or one or two species of plants, but there are many that have a marked predilection for one or two. *A. florea* is, as is well known, peculiarly attached to the bryony, *cingulata* to the speedwell (*Veronica*), *humilis* and *fulvago* to *Hieracium*, *cetii* and *hattorfiana* to the scabious. Some flowers are extremely attractive to a considerable number of species, chief amongst which are the catkins of *Salix*, together with the flowers

* = *tormentillae*, Alfk.

of dandelions and other yellow composites, blackthorn, the white-flowered Umbelliferae and the bramble. Other flowers will be mentioned in connection with the different species.

The pairing of the sexes of *Andrena* is often noticed, and the vast numbers of males that one sees coursing up and down hedgerows and round sunny bushes are in reality searching for the females. When one of these alights, a collection of males is generally quickly attracted to the particular spot. In many cases these males will fly around, often within a few inches of the female apparently without seeing her, and it would seem as if sight played but a small part in the matter. Sometimes, however, she is perceived and pounced upon almost immediately. With species that form compact colonies there are often large numbers of males hovering about the burrows ready to seize the female as she leaves or returns to the nest. The females of some species seem to put themselves in the brightest sunshine on some broad leaf and in the most conspicuous position with the object of pairing, but others I have observed to settle on a branch or dead leaf, where had they not been seen to alight, they would not have been noticed at all. Probably pairing sometimes takes place in the burrows, for one evening in March I dug out a number of males and females of *A. apicata*, and although it was almost dark, it was possible to see that in several cases pairing was effected at once, when the sexes were placed together in glass-topped boxes. Pairing of individuals of distinct but closely allied species must be very rare, as I have never seen a case, though I have spent much time in watching the pairings of *A. wilkella*, *afzeliella* and *similis*, where these all occurred in company, and similarly with the equally closely allied species of the *trimmerana* group and the small bees of the *minutula* group. Nor have I ever seen a specimen that I should consider likely to be a hybrid. Saunders has suggested that *A. praetexta* of Smith might be a cross between *carbonaria* and *bimaculata*, but it seems to me to be merely a variety of the former, comparable with the var. *consimilis* of *A. nitida*.

Variation in the colour of the pubescence of *Andrena* is considerable in some species, especially in the substitution of brown or yellow hairs for black or vice versa, while in a few cases white and black become interchanged. Of course, changes due to fading from exposure to weather are not to be reckoned as variation. Few of these variations have received names, excepting where the change of colour is due to seasonal dimorphism, and in these cases the names were given under the supposition that the two forms were distinct species. Such cases are *A. bimaculata* and *decorata*, *parvula* and *minutula* and others. The supposed species *A. mixta* Schenck is, I have satisfied myself, a variety of *A. varians* ♀, in which white hairs replace the black ones on the abdomen, face, and on other parts. More or less intermediate conditions are sometimes found, and a similar kind of variation, but less extreme, is found in the female of the allied species *A. synadelpha*. In neither case are there two forms of male known. All the few species of *Andrena* which have the integument ornamented with red are variable in a high degree, excepting only *A. cingulata*. All have melanic forms. Smith was of the opinion, that in the case of *A. hattorfiana* * the red forms were produced in hot summers, but I do not think that this will prove to be a complete explanation. In my observations of this species in Devonshire only once have I seen a red-bodied example, though I have observed the bee in at least two summers of extraordinary heat and dryness, but this specimen of the red variety did not occur in either of the dry years. It is remarkable that in South Devonshire no red-marked varieties of either brood of *A. bimaculata*, nor any conspicuously red-bodied ones of *A. marginata* have ever occurred to me, though in the more eastern counties such are common, and those of the latter species are plentiful even in the neighbouring county of Dorset.

The dimorphic forms of first and second broods of the double-brooded species are in some cases of very great interest, and those which are in any way remarkable, and some even of those which are not so, have varietal names. In most cases the difference in structure or appearance between the spring and summer broods is far more marked in the ♂ sex. Saunders suggested that this dimorphism was produced by the different food (pollen of quite distinct species of plants) supplied to the larvae of each brood; but there is little reason to suppose that this is the cause of the dimorphism, for we see no such variation in the individuals of a single-brooded species, which must often be produced from

* Mr. Morice informs me that in Mediterranean localities both sexes are almost invariably of the red variety. I have a long series from Germany with the males of the dark, the females of the red form.

larvae fed on food quite as different, as that supplied to each generation of the double-brooded species. *Andrena spinigera* is the most interesting of all these forms, since its second brood undergoes such marked changes in structure as to become very similar to the single-brooded *A. trimmerana* (Auct. *nec* K.), whereas the ♂ of its first brood (*i.e.* typical *spinigera*) is quite distinct structurally.

It is most interesting to notice the difference between closely allied species with regard to the production of a single or of two broods a year. Thus *A. tibialis*, one of the earliest spring bees, is always single-brooded, while its very close congener, *bimaculata*, is double-brooded. In this case the spring brood of the latter is contemporaneous with the one brood of the former. Of the very closely allied species *A. wilkella* and *ovatula* the former is single, the latter double brooded; but the first brood of the *ovatula* is, as a rule, decidedly earlier in appearance than the one brood of the other. Many of our earliest spring bees, which frequently appear in March, if the weather be at all warm, *e.g.*, *A. praecox*, *apicata*, *clarkella* and *albicans*, never produce a second brood, while others like *gwynana*, *bimaculata*, *spinigera*, *dorsata* and *parvula* do so regularly in the south, and when they are parasitised by *Nomada*, the parasite also is either regularly or occasionally double-brooded. In Northern Europe species which with us, even in the extreme south of England, are invariably single-brooded produce a second brood in summer, the first brood often appearing earlier than our one brood of the same species. Most notable of these are *A. sericea* and *argentata*, which appear in April, the former even in March, with a second brood in June, while it is also said to have even a third brood ! A few of our species, *e.g.*, the small bees *A. saundersella* (*nana* E. S.) and *subopaca*, under exceptional conditions produce a partial second brood in August.

Some species of *Andrena*, e.g., *carbonaria*, which have always an abundant second brood in the south, are generally single-brooded as one goes further north. Generally the specimens of first and second broods are easily distinguished in the majority of specimens, as is the case with *A. eximia*, *spinigera*, *gwynana*, *parvula* and others, but nearly always, in the ♀ sex at least, there will be found examples of either brood which cannot be distinguished at all or only with the greatest difficulty or uncertainty. We have at present no accurate information as to the actual life-history of any of these bees, and it is quite possible that not all the individuals that one sees in the summer of a double-brooded species are really the offspring of a spring parent; for it may be that some of the offspring of the summer brood do not emerge till the following summer, and likewise that some of the spring brood have also taken a complete year before they have emerged. The somewhat perplexing aberrations one finds in these dimorphic species may possibly be due to such variations in the time occupied in development. In any case these double-brooded species are of the greatest interest, and so far they have been at the best very superficially studied. Some thirty years ago Edward Saunders intended to study them specially and publish his observations, but unfortunately he did not (so far as I am aware) carry out his intention. One other point which must be considered in connection with the spring Andrenas, which produce only a single brood, is the fact that in many cases, though there is no second emergence, the fully developed bee has left the pupa the same year that the egg was laid by the parent, and possibly even before the end of the summer. Consequently, the difference in the actual period of development between some of the single-brooded species we capture in the spring and the examples of other species, which are the offspring of a second brood of the preceding year, is not nearly so great as may have been imagined, but the conditions of temperature, etc., may be different and of importance. We know from Smith's observations that in the case of some bees, such as *Anthophora*, some individuals pass the winter as larvae, and pupate and produce mature bees in the following year, while others are already fully mature on the approach of winter, and, in fact, are occasionally dug up in that condition during the winter months. In the case of *Anthophora* this does not appear to lead to any noticeable variation. When we find examples of either brood of such a species as *A. dorsata* exactly resembling one another, while others have quite differently coloured legs, at present we do not know whether these different varieties have really taken very different periods of time for their development, a few months in one case and many months in the other, or whether those which are alike may or may not have taken the same period to become mature.

Of other variations one may mention that in which either the scopae or the anal fimbria or one of these, instead of being dark or fuscous, becomes yellow or golden. Such are the var. *consimilis* Sm. of *A. nitida* and the var. *praetexta* of *A. carbonaria*, while among species that have a yellow scopa but normally a more or less fuscous fimbria there is a form of *A. tarsata*, in which the latter is a bright pale golden colour, and similar forms of *A. ovatula* also occur. In some species, e.g., *A. fucata*, the scopa may become quite pale without the fimbria being affected. The entire replacement of black hairs by white in *varians* var. *mixta* has already been mentioned, and the change from white hairs on the face to fuscous or blackish ones occurs in *A. nitida* var. *baltica*, common in Devonshire, and also in some specimens of *angustior* and others. Hermaphrodites of *A. flavipes* (*fulvicrus*), *bimaculata*, *dorsata* and *albicans* have been described by myself, and one of *A. nitida* by Smith.

Extraordinary variation in size is a remarkable feature of the males of many Andrenas, but in the females this is much less marked and of a different nature. In the latter sex there is usually a fairly average size in the largest specimens, while quite abnormally small, or starved ones, are found occasionally. In the males, on the contrary, whereas there is great general variability in the size, in many species gigantic examples are occasionally met with. This phenomenon is not at all uncommon, and there is nothing like it in the ♀ sex. Where the species are naturally large-headed, these giant specimens have a most striking and even formidable appearance. *A. bucephala*, *spinigera*, *trimmerana*, *fulva*, *synadelpha*, *fucata*, *denticulata* and others are conspicuous examples, but even in small species such as *chrysosceles* and minute ones like *minutula* one meets with individuals grossly oversized and sufficiently conspicuous amongst the normal.

Most, if not all, species of *Andrena* emit, when handled, a very distinct odour, and this is sometimes the case with both sexes. Kirby in his wonderful old book refers to this under several species. Thus of *Melitta pilipes*, he says: "*Allium spirat recens insectum.*" *A. gwynana* and *fulvicrus* are also said to smell of garlic. But *parvula* "*moscham spirat*" and *afzeliella* "*suavem spargit odorem.*" To myself the majority of species are mildly unpleasant, e. g., *A. albicans*, but some, if not actually pleasant, are certainly less unpleasant than others. *A. denticulata* emits an odour unlike that of such other Andrenas as I have examined in this respect. Mr. A. H. Hamm suggested that the odour resembled that of burnt sugar, and this is perhaps as near a comparison as can be made.

Some of the bees of this genus feign death when alarmed, and may be seen lying on their backs on the ground or at the bottom of the net after capture with their limbs closely appressed to the body. This condition is assumed much more readily by some species than others. Some of the small species of the *minutula* group when the net is placed over them will often fall at once to the ground, and remain motionless amongst the grass roots till one's patience is exhausted in waiting for them to fly up. Some are much more willing to feign death when the sun disappears than when it is shining hotly, and some are able, like insects of other Orders, to slip along on their backs without the use of their legs, which remain appressed to the body. Species of the *wilkella* group, *A. chrysosceles*, *A. albicans* notably, and probably many others feign death, and will remain quiescent for a considerable time at the roots of herbage, no doubt until they consider the danger is past.

Andrena has numerous natural enemies, the bees of the genus *Nomada* and the remarkable Strepsipterous *Stylops* being of special interest. A few species are also attacked by members of the genus *Sphecodes*—most of which are, however, parasites of *Halictus*—and by the conspicuous and beautiful flies of the genus *Bombylius*.* Some of the Conopidae also appear to be attached to *Andrena*, and they may be noticed flying at and striking against the bees as they fly around hedges or bushes, and even pursuing them for some distance. We have seen one species follow a laden ♀ of *A. nitida* right to its burrow and cling to it there. One may suppose that this proceeding is for the purpose of oviposition, so that the larva of the fly may be carried into the bees' burrow, but I have no information as to the actual deposition of an egg,

* Chapman observed the oviposition of *Bombylius major* at the burrows of *Andrena labialis*, and, as mentioned hereafter, I have seen the same fly at pure colonies of *A. flavipes*, but it is not at all confined to these two species. On April 3, 1919, a dense colony of *A. clarkella* was found with one or two empty pupa cases of *Bombylius minor* in the opening of nearly every burrow, and some of the flies, recently emerged, were sunning themselves on the bare earth in which the colony was placed. No doubt the formidable armature of curved spines on the head of the pupa beneath serves to enable it to reach the mouth of the bees' burrow, before the fly emerges.

when the insects come into contact. The burrows of colonies of *Andrena* are ravaged by *Forficula*, which frequently raise their young in them, and various Carabid beetles and the Myriapod *Lithobius* are numerous in the same situation.

In the case of *Nomada*, the different species are all mentioned hereafter in connection with those of *Andrena*, which they parasitise. It is possible that some have a rather wider range of hosts than I have allowed. Of one only, *N. flavopicta* K. (*jacobaeae* Auct. plur.), the host appears a little doubtful. Smith records it as having once been seen to enter the burrow of the second brood of *A. flavipes* (*fulvicrus*), and this may be its host. It has, however, occurred in some localities, where this *Andrena* either does not occur at all or, at any rate, has been overlooked, and should there have been some mistake on Smith's part, I suggest that it is attached to members of the group of *A. nigriceps*, one or other of which I have always found present in its localities. Two of our species are quite peculiar in their habits, *N. sexfasciata* breeding in colonies of *Eucera longicornis* and *N. furva* in those of *Halictus nitidiusculus*. The latter has been said also to be attached to *H. morio*, but I myself have never found this to be the case, though I have carefully investigated the matter in such distant localities as Oxford, Monmouth and Devon. *H. morio* is abundant in all these places, but the *Nomada* in my own experience either attacked pure colonies of *nitidiusculus*, or, if *morio* occurred in the same bank, was only obtained from the burrows of the former. In Devon it is sometimes found in mixed colonies of *H. nitidiusculus* and *minutus*,* and in this case, owing to the great similarity of these two species, I could not be sure whether one or both were attacked. Smith says that this minute species was obtained from the cells of *Colletes daviesana*, but this, of course, does not necessarily mean that it is parasitic on that bee. Halicti, like other bees, sometimes enter burrows made by other species and form their nests therein, just as Andrenas enter rabbit, rat, and mice burrows. Similarly, Smith records finding *N. marshamella* in the cell of *Eucera*, this no doubt having

* Since the remarks above were written this little *Nomada* has been obtained before the time of emergence from burrows of *H. minutus*, and, of course, it may well be parasitic on *H. morio*, but positive evidence of this is required.

been utilised previously by *Andrena*. The same author records several of our species of *Nomada* as parasites on various larger *Halictus*, and one, *N. fabriciana*, as being the peculiar parasite of *Panurgus banksianus*. Shuckard corroborates this, but Smith is certainly wrong in the case of *Halictus*, and in general, when assigning hosts to the various Nomadas, appears to have formed his opinion from such bees as he saw on the same flowers as the parasites or flying about in the same vicinity.

Of *N. fabriciana* in his first edition he says that it is met with on Hampstead Heath "about the end of April and during May, and it has also been taken in Yorkshire in the month of July." April and May is the normal time for this *Nomada*, and *Panurgus* is not to be found then. In Yorkshire it was probably a late season, when Smith found specimens in July, and these belonged to the first brood, since he took fresh males of early spring bees at the same time (e. g., ♂ *trimmerana* and *cineraria*). For these reasons one cannot place much faith on Smith's observations as a whole, though, of course, in a number of cases he is correct. Some records of parasitism given by Saunders are also, I believe, incorrect, but it may be suspected that these were chiefly taken from Smith's works and not due to his own observation.

There are a few well-known Continental species of *Nomada* which attack species of *Andrena* common in this country, but are themselves unknown here. Such are *N. obscura* on *A. ruficrus*, *N. cinnabarina* on *A. labialis*, and *alboguttata*, a large race of *baccata*, on *A. sericea*. *N. rhenana* is said to be parasitic on *A. afzeliella*.

It is, I think, very rare for a species of *Nomada*, or even for a group of closely allied species of this genus, to attack Andrenas that are widely separated in structure, and consequently the study of their parasitism will help in fixing the affinities of species and of groups in *Andrena*. Of course this rule is not without exceptions. The *ruficornis* group of *Nomada* is attached to the *varians* group of *Andrena*, but *N. flava* and *N. bucephalae* attack that of *N. trimmerana*, a distinct group, but still clearly allied to that of *varians*. I know no case in our British Nomadas where the same species of parasite attacks Andrenas belonging to two distinct groups, though, if we accept some of Smith's conclusions, such cases would be not uncommon and of a most surprising character.

The most remarkable divergence found in our British species is in the case of *N. flavipes* (*solidaginis*). Obviously this parasite belongs to a most distinct group, including *N. tormentillae* (*roberjeotiana*) and *obtusifrons*, which attack *A. tarsata* and *coitana*, but itself is especially attached to *A. fuscipes*, belonging to quite a different group of *Andrena*.

In the present state of our knowledge I think it a mistake to accept numerous and diverse species of *Andrena* as the host of a single *Nomada* on casual observations. It is quite certain that parasitic bees, either for shelter or in search of their proper host, do at times enter burrows of species on which they are not parasitic, and certainly non-parasitic bees that burrow in the ground do sometimes make use of a burrow not formed by themselves, but by some other non-parasitic species, just as we know that wood-boring bees constantly make use of burrows formed by other Hymenoptera or by Coleoptera.

When Saunders tells us that *N. marshamella* parasitises *A. nigroaenea* and *atriceps* and Alfken supposes or conjectures that *nitida* is its host, one may not be able to prove that such is not the case; but when after very close attention to the habits of this *Nomada* in widely different localities one has found it peculiarly attached either to *A. trimmerana* Auct., or more rarely to its close ally *A. spinigera*, neither of which are mentioned, one would like to know on exactly what evidence it is assigned to species representing two quite different groups from that of its normal host. Both English and Continental writings are full of these abnormal associations of host and parasite, and since, as I have shown, we can be certain that many of these were mere guesses, we shall do well to look with suspicion on all such, until they have been thoroughly investigated.

In spite of their parasitic habits the Nomadas are freely attracted by flowers, but, as might be expected, in general the males visit these more frequently than the females. It is noteworthy that some species are particularly attracted by the same flower that is most attractive to their hosts. Thus, as is well known, *N. armata* and *atrata* frequent the flowers of scabious with *A. hattorfiana* and *marginata*, *N. tormentillae* those of *Potentilla* with *A. tarsata*, and so with others. This seems particularly the case, where the *Andrena* affects a very limited number of plants—a fact in itself of considerable interest.

The females of *Nomada* naturally spend most of their time either searching for the burrows of their hosts or in the neighbourhood of these. When a large number are seen hovering over the mouths of the burrows of some compact colony, investigating these on the wing before entering, they present a most striking appearance—not only large species like *armata*, *lineola*, or 6-*fasciata*, but even moderate-sized ones like *hillana*, *ruficornis* or *germanica* become conspicuous and appear to exhibit their bright colours to the best advantage. We may presume that these colours have some protective value against such predaceous animals as might attack them, since they are thus by the nature of their habits very much exposed to any such enemies as may be at hand. Certainly the Andrenas are not exposed to the same extent, for when once the work of provisioning their cells has begun, they as a rule quickly enter the burrows with their load of pollen, whereas the parasite is often very conspicuous while hovering over a bare soil for a long time together and investigating the burrows, to find one which is in a fit condition for its entry. Such a view of the coloration of *Nomada* is far preferable to that which supposes the wasp-like or conspicuous colours to be for the purpose of intimidating the host! For a time after their emergence the parasites appear to resort to the burrows, where they were born, for shelter at night and in unfavourable weather, but when the hosts become fully occupied with their labours, the Nomadas habitually remain out at nights. Some of them sleep clinging by the mandibles alone to the heads of flowering grasses, the legs all drawn close to the body and the antennae porrect, so as to resemble a little stalk. The bright colours of the body being much toned down by the closed and superincumbent wings, the bees closely resemble the seeds or flowers of grasses, and are often difficult to detect. Some may be found clinging to dead twigs or leaves, with which their colours also harmonise very well. On grasses I have taken large numbers of *N. hillana* and *germanica*, and also of the very minute *N. furva*; while attached to dead hedgerow branches I once found a number of ♀ *N. bifida*, and on heather many *N. rufipes*.

Probably all the species of *Nomada* possess a strong odour, more or less disagreeable to me in the case of *N. marshamella*, but rather pleasant in the case of

N. goodeniana. Kirby noticed it specially of the latter, "odore *melissae* flagrantissima," while *N. lineola* (*cornigera* K.) "moscham redolet." Some at times feign death when alarmed. The sting even of the larger species is not at all severe, and when the bee is taken between the finger and thumb the cuticle is rarely penetrated, though vigorous attempts are made to do so. If the thin skin beneath the nail is pierced, the sting is sometimes sufficiently sharp, as I have myself experienced, to cause one to involuntarily relax one's hold of the bee, but the pain is short-lived. It is impossible to help noticing, that though the sting is feeble, the quite remarkable mobility of the abdomen admits of the weapon being used with a far greater range of movement than in most bees.

All the species of *Nomada* have a hard and thick chitinous cuticle, forming a stronger protection from injury than that of their hosts. Indeed, it may be accepted as an almost universal law that in parasitic Aculeata the integument is less easily pierced than that of the species they parasitise. Thus *Coelioxys* is harder than *Megachile*, *Crocisa* or *Melecta* than *Anthophora*, *Epeolus* than *Colletes*, *Psithyrus* than *Bombus*, *Chrysis* and *Sapyga* than their usual hosts, *Nysson* than *Gorytes* and *Harpactus*, and so on. Only perhaps in the case of a few species, which have lately taken to parasitism, as we judge, and not yet become greatly modified thereby, does this fact seem hardly apparent. This hardness of covering (accompanied as it often is by spines, prominences or projections) may be of use to the parasites as a protection from some predaceous enemies, or even conceivably to some extent from the unfavourable weather, to which their mode of life exposes them, but one cannot help suspecting that it is primarily as a protection against attacks of their hosts that their thicker armour is so regularly developed.

There is considerable difference of opinion as to the frequency of conflict between host and parasite. Shuckard particularly notices the fierce fights between *Anthophora* and *Melecta*, and I have described an attack on *Halictus* by *Sphecodes*. On the Continent Marchal saw *S. subquadratus* kill the ♀ of *H. malachurus* and take possession of its burrow. *Hedychrum* has been recorded in an often-quoted passage as being surprised and attacked by its host, and as protecting itself by its well-known habit of rolling itself up into a ball. It is probable that fights between host and parasite are not infrequent, but that they occur in the burrow itself and are rarely observed in consequence. The fight between *Halictus* and *Sphecodes* observed by me was begun there, and Shuckard says of *Anthophora*: "if they catch the intruder" (*Melecta*) "in her invasion, they will draw her forth and deliver battle with great fury." The *Hedychrum* alluded to above was caught in the burrow by its host. It must often happen that the rightful owner of the burrow comes home and surprises the parasite within, but what takes place beneath the surface, in which the burrow is formed, is, except in special instances, as cited above, quite uncertain. The main object of the parasite must be a safe escape, and one may suppose that the hardness of the cuticle helps to ensure this. It is said that in the case of *Nomada sexfasciata* and its host *Eucera* the latter gives way to the parasite, but accurate and detailed information on such points is much wanted. It seems improbable that any host would tolerate an interference with the performance of its labour. It is certain that the parasites exhibit care or caution in entering the burrows, for one often notices many of our Nomadas hovering over the openings for some time before they determine to enter, or pass on to investigate another burrow. It would appear that either they wish to ascertain the presence or absence of the maker, or else perhaps, by some unknown means, to learn the condition of the contents of the burrow, as to its fitness or readiness for the reception of an egg. Whether the odours of the *Nomadae* and other parasites play any part in the event of collision between them and their hosts, or whether they are otherwise protective, *e.g.*, against predaceous creatures, or, again, are only of sexual significance we have no evidence.

In the case of the conflict between *Halictus* and *Sphecodes* observed by me, it would appear that the latter was the aggressor, but this may only have been apparent and not really the case. When the female *Psithyrus* insinuates itself into the nest of *Bombus*, it is probable that the beginning of the actual combat may be due to either one of them according to circumstances, but the harder *Psithyrus* is assumed to be generally victorious.

It is a notorious fact that in many cases the number of individuals of a parasite compared with that of the host varies extremely in different seasons. Thus one year in a given locality an *Andrena* and its parasite may be both numerous, and the next year, though the former may be again plentiful, the latter may be very scarce or even not found at all. The cause of this is, I think, entirely due to the difference of habits, for the host in the shelter of its burrow is less affected by unfavourable weather conditions than the exposed parasite. A day or two with continued cold rains no doubt decimates the latter. On wet days we have often found *Melecta*, *Epeolus* and *Nomada* hanging on to herbage or shrubs in the manner described, soaked with the rain and torpid with cold. On the other hand, with favourable conditions *Nomada* is capable of very rapid increase, remarkably so in the case of some species that attack those species of *Andrena* that form large colonies. In such cases the parasite can enter and oviposit in a number of different cells in the time that it takes to store a single one. Consequently, in rare instances we have known a *Nomada* even to outnumber its host considerably, though such a success is not often likely to last more than one or two seasons. This phenomenon is not at all confined to *Nomada*, for under exceptional circumstances a careful examination of large colonies of *Anthophora pilipes* and *Colletes succincta* has shown an enormous preponderance of their parasites, *Melecta armata* and *Epeolus cruciger* (*rufipes*), in some seasons.

From these general remarks on *Nomada* and other parasitic bees it will be seen that a wide field is here presented for accurate observations, our knowledge on many points being of the most slender kind. The most we can say is that one certain host at least is now known for every species of *Nomada* that we have in this country, excepting only *N. flavopicta*, which requires further investigation. How many of the associations recorded, whether by British or Continental authors, are correct, when they do not agree with those which are given here under the various species of *Andrena*, is quite uncertain, but it may be said with certainty that some are absolutely incorrect and impossible. Having found myself more than once deceived in assigning a parasite to host, even after having, as I thought, taken particular pains to be correct, I feel sure that it often needs great care and repeated observations to arrive at correct conclusions.

Not many of our British *Nomada* are regularly double-brooded even in the south, while some which are so on the Continent have but one brood with us. This may be the case, even though the host be regularly double-brooded.

Several of our species are irregularly double-brooded, e. g., *N. flavoguttata* and *fabriciana*, both of which sometimes yield an abundant second generation. So too does *N. lineola* in some seasons, and perhaps generally in the extreme south. *N. marshamella*, when parasitic on *A. spinigera* frequently, and when on *A. trimmerana* (Auct.) occasionally, yields a summer brood; in the latter case generally partial and represented by only a few individuals, but in the former sometimes a copious one, females of which I have taken in plenty entering the burrows of the second brood of its host—the form named *A. anglica* by Alfken.

In August 1886, on the south coast I met with a second brood of *A. goodeniana* in almost incredible numbers, but strangely enough have never since met with a single example of such, though Hallett has observed a copious summer generation. I have seen an example of a second brood of *N. ruficornis* from Ireland, but not from elsewhere.

These examples of a second brood are in the case of *A. fabriciana* and *flavoguttata* much darker than the first, as may be seen when a series of examples is placed side by side; indeed, that of the latter has, I believe, been given a special name—var. *hoeppneri*—by Alfken.

The genus *Sphecodes* is essentially a parasite on *Halictus*, but three species appear to be strictly attached to *Andrena*, though the evidence is not so absolutely conclusive as one could wish. Of these species *S. rubicundus* is said to be a parasite on *A. labialis* both here and on the Continent, and certainly has been taken in closest company with that *Andrena* in Suffolk, Hampshire, Cambridge, etc., so that there would appear to be no reason to doubt this association.

S. reticulatus is said on the Continent to be attached to *A. argentata*, and certainly in localities where it occurs in this country, when extensive search has been made, this *Andrena* has always, I think, been met with. *Halictus prasinus* has also been suggested as a host for the *Sphecodes*, and, as it happens, this *Halictus* frequently abounds in the very same localities as the *Andrena*. On the other hand, *H. prasinus* occurs over a wide area of distribution in Britain, from which the *Sphecodes* has never been obtained, so that the evidence that exists is clearly in favour of the *Andrena* as host, especially as on the Continent its burrows have actually been seen to be entered by the parasite.

S. pellucidus (*pilifrons*) is a constant parasite of *A. sericea*, but is more local than the host. It is interesting to note that though this *Andrena*, like *labialis*, is generally found provisioning its cells in May and June, the *Sphecodes* parasitic on them differ in their habits from one another.

S. rubicundus appears in both sexes in May and June and has no later summer emergence, the females not hibernating, while only females of *S. pellucidus* are found at the time when *A. sericea* is at work, these being hibernated individuals of that sex which have survived from the brood of both sexes that appeared in the later summer months of the preceding year. This indeed accords with the normal life-history of the genus, but the case of *S. spinulosus* alone as regards the time of emergence is similar to that of *rubicundus*, and is the more remarkable because it is a parasite on *Halictus*, the species of which genus agree in the time of their emergence and in the hibernation of their females with normal *Sphecodes*. Consequently, *S. spinulosus* differs greatly from the normal habits of its genus in its life-cycle and also in like manner from its host; *S. pellucidus* resembles its congeners in this respect but differs greatly from its host; while *S. rubicundus* differs from the normal of its congeners but resembles its host. All other of our *Sphecodes*, so far as has been ascertained, are parasitic on *Halictus* and have the same habits as the latter, in so far as males and females emerge together after midsummer, the males dying before winter and the females hibernating.

The parasitic Strepsiptera of the genus *Stylops* attack many more of our species of *Andrena* than do the *Sphecodes*. In the Entomologist's Monthly Magazine 1918 (pp. 67, 115 and 129) I have given a list of such species as have been found stylopised in this country and a synopsis of such species of *Stylops* as are known to me, together with an account of the effects of the parasite on the host. The Strepsiptera that attack *Halictus* are a different genus from those parasitic on *Andrena*, and belong not to the genus *Halictophagus* (which is parasitic on Homopterous bugs, and was given its generic name under a mistaken idea that *Halictus* was the host), but to *Halictostylops* or *Halictoxenus* of Pierce.

The changes produced by *Stylops* are sometimes so considerable that stylopised examples will not agree with the characters given for the separation of the species, but I have never yet come across any so changed that the species could not be determined with certainty.

Habits and Distribution of British Species.

We may now consider the species in order from the point of view of their habits, and the parasites that affect them.

A. albicans is perhaps the most generally common of the whole genus, and is said by Smith to occur also in N. America. It frequents many flowers, and in the earliest warm spring days may be seen in numbers collecting its store or feeding on the sallow catkins and dandelion blossoms. It abounds in gardens on the flowers of larger fruit-trees, on gooseberry, *Cotoneaster*; also on *Crataegus*, *Viburnum*, *Euphorbia* and many other plants. In most southern localities it is parasitised by *Nomada bifida*, which also occurs with it in the north, and has been taken, entering its burrows, in all parts of the country, showing a distribution as wide as that of its host.

A. carbonaria (*pilipes*) is a local species very partial to the coast, but also found far inland, as at Oxford. It sometimes forms large and very compact colonies in cliffs, and I have noticed them so near the foot of these as to be constantly damped by the sea spray at high tide. In the south it regularly has a full second brood, but at Oxford apparently only one as a rule. The first brood visits catkins of *Salix* and is very partial to blackthorn, and is also found more or less commonly on dandelions, cabbage and mustard, on hawthorn, *Euphorbia*, and other plants. The second brood is extremely partial to pink thistle and blackberry flowers. I have rarely, only twice or three times, found it stylopised, and as often have taken *Nomada lineola* entering its burrows.

A. tibialis is a local species, its abundance in many localities around London having, no doubt, led to its being considered more generally common than is really the case. Over a large extent of country in Gloucestershire, Wiltshire and Devonshire, for instance, it is entirely absent, as is probably the case in many other counties even in the south, even though it may occur locally in them. Unless actual colonies be found, the females in my experience form an extremely small proportion of the total number of specimens that are seen. It is an early spring bee, and visits the sallow catkins and is extremely partial to the dandelion, but also occurs on *Brassica*, *Tussilago*, and various other plants. In N.W. Germany it has a second brood, which differs somewhat from the first, but there it appears to be only exceptionally double-brooded, and I have seen no such specimens from England.

In some localities this species is very frequently stylopised, but not by any means wherever it occurs. It is parasitised by *N. lineola*, but only locally, and I have found it very abundant in some places without a trace of this *Nomada*.

A. bimaculata, unlike the preceding, is regularly double-brooded in the southern counties, at least. It is very partial to coast localities, but is also found on the commons near London, and is widely distributed in such places in Surrey. It abounds locally in Norfolk and Suffolk and in Berks, and is particularly common in Devonshire, where it ranges inland to a height of nearly 1000 ft. above the sea on Dartmoor. But it is always quite local. I have never myself found an extensive compact colony of this species, but have seen the burrows scattered, at most two or three together, over acres of sandy soil. In the spring these bees visit chiefly *Salix* and *Prunus*, and in some localities the flowers of *Ulex* and even *Bellis*; in the summer they are most partial to *Rubus*, but in some places have abounded on *Senecio*.

Near London and in the eastern counties red-marked varieties are frequently common, but in the far west they must be very rare indeed, as I have never met with one.

This species is occasionally stylopised. On the 12th of August, 1914, I took two females on bramble flowers containing the parasite, one of these, as is usual, being free from pollen, except such as might have accidentally adhered, but the other had gathered a full load, not only the hind tibiae, the floccus and hind femoral receptacle, but even the propodeal basket being filled. The first brood is also subject to the attack of *Stylops*.

Nomada lineola is an abundant parasite of this *Andrena* in Devonshire, and like its host is double-brooded there.

A. flavipes (*fulvicrus*) is a regularly double-brooded species in the south, and though decidedly local, where it is found, it generally occurs in great numbers, frequently forming compact colonies of enormous size. It visits many plants, *Salix*, *Taraxacum* and *Ulex* being favourites with the first brood, but *Brassica*, *Sinapis*, *Veronica*, *Trifolium*, etc., are also resorted to; while the second brood is found on *Senecio* and other yellow Composites, thistles, yarrow, tansy, etc. In some places I have noticed specimens of the first brood numerously on daisies, *Tussilago* and blackthorn.

I have never myself found this species stylopised, but it is recorded to have been taken in this condition by Claude Morley.

It is parasitised by *Nomada fucata*, which in England is much more local than the host and apparently only infests its second brood. In N.W. Germany, as well as in Southern localities, it is found with both broods, and is very common; in the Bremen district, according to Alfken, almost more numerous than the host! According to Smith, *N. jacobaeae* is also parasitic on this *Andrena*, as he records that he took it entering a burrow (of the second brood); but it is curious that there should be so little definite knowledge as to the habits of this not uncommon parasite. I have found it sparingly in some localities, where the *Andrena* is still scarcer, and in others where I have not found the latter at all.

On the 22nd of April, 1914, I went to Sidmouth to examine a large compact colony of this *Andrena*, since it does not occur in my own neighbourhood. This colony I had found in August 1886, and I wished to see if any parasites were entering the burrows. So far as Hymenoptera were concerned, none occurred, but extraordinary numbers of the fly *Bombylius major* were hovering over the colony and every now and then touching the earth with the tips of their bodies, presumably in the act of oviposition. No change in the position nor in the extent of this great colony had taken place in the interval of twenty-seven years between my visits, and I have no doubt it was one of the great colonies recorded by Smith, as observed by him in 1871.

A. gravida (*fasciata*) is in England a local species, of apparently very restricted range in the south, having been found in Kent, Sussex and Essex, but as it has been recorded from Perth, it should occur in more numerous localities than have been noted. It is an early spring bee, and frequents sallows and al o visits the flowers of dandelions. It is, I believe, only single-brooded, but in Smith's collection there is a curious stylopised ♀ (which he wrongly considered to represent Kirby's *Mouffetella*) taken in Hampshire in the month of July 1840. I know of no other summer emergence nor of any other case of stylopisation.

A. nitida is a very widely distributed species, which generally is more abundant in meadowland and cultivated country than in wilder districts, but I have not myself collected in any part of the south of England, where it does not occur. It visits many different flowers, but is perhaps particularly attached to the dandelion. It visits *Salix* and *Prunus*, as do most spring Andrenas, also *Bellis*, *Brassica*, holly, *Cotoneaster*, *Ranunculus*, *Veronica*, various fruit-trees, *e.g.*, cherry and raspberry, and Cruciferous plants. On all these I have seen it commonly, and sometimes it may be seen on the white dead-nettle. I have never known of a specimen of a second brood, although the species often reaches maturity in its burrow before winter.

It does not appear to be very subject to parasites, though I believe *Nomada goodeniana* (*succincta*) is supposed to attack it. I have not been able to satisfy myself as to this, and one field of large acreage, throughout which the burrows of *nitida* were dispersed, never yielded a parasite during several years' search, although the abovenamed *Nomada* was very common in the district, infesting *A. nigroaenea*. Still *nitida* is a very probable host of this *Nomada*. Stylopised specimens are quite rare or at least excessively local. This species is very widely distributed and occurs in the north of England and in Ireland.

A. thoracica is more local than the preceding and in the south is regularly double-brooded. The first brood is found freely on *Salix* and *Prunus*, and is also partial to dandelions and to cabbage and mustard flowers. The second brood is generally found on *Rubus* and pink thistles. Unlike *nitida*, it frequently forms large compact colonies. One colony found by my children in a hard-trodden sheep-track on the edge of Dartmoor appeared to consist of only this species, and fine large specimens of *Nomada goodeniana* were taken entering the burrows. Otherwise the pure colonies of this species that I have examined seemed to be free from these parasites, and it is, of course, possible that in the case mentioned there may have been burrows of the ubiquitous *nigroaenea* mixed with the others. I suspect that the copious second brood of this *Nomada* previously referred to was bred in the burrows of *thoracica*.

The addition of *A. vaga* to our lists was made by myself on the discovery of a very ancient specimen of the ♂ in Walcott's British Collection, where it was named *A. polita*. I have little doubt that this specimen was taken in England. It is in some N. European localities the common host of *Nomada lathburiana*.

The beautiful bee, *A. cineraria*, is a local species, but of very wide distribution both in the north and south. It is mostly found in cultivated districts or meadowland, and is particularly attached to the dandelion, though it is sometimes found on heaths. At times it forms large compact colonies in trodden paths, but often its large burrows may be found singly or two or three together scattered over pasture-fields of large acreage, mixed with those of *A. nitida* and *nigroaenea* and such species as habitually frequent meadows, where there is an abundance of dandelion flowers in early spring. Not that it is in any way restricted to these flowers, for it is sometimes seen in numbers in gardens on *Brassica*, and the flowers of fruit-trees, and elsewhere on hedgerow plants such as the blackthorn, wild cherry, *Salix*, and even on the daisy.

Nomada lathburiana is the special parasite of this *Andrena*, but it is much scarcer than its host, and is entirely absent from many localities where the latter is abundant. I have never seen nor heard of a stylopised example of *cineraria*. On the Continent it sometimes produces a second brood, but in Devonshire, where in some seasons it occurs commonly in March, no specimen of a second generation has ever been observed.

A. nigroaenea is a most abundant bee, ubiquitous in the south and common in the northern counties. Like its allies it is very partial to dandelions, but affects the most varied plants. Sallow, blackthorn, flowering fruit-trees and holly often attract it in swarms, not to mention *Brassica*, *Sisymbrium* and a host of other lesser plants. It appears very early in the spring and continues on the wing for a long time, especially in cold summers, when it may be seen even well into August, but it is never double-brooded so far as we know. *Nomada goodeniana* is its constant and often extremely abundant parasite, and very large examples of *N. fabriciana* have been taken at its burrows, but it is doubtful whether it has other enemies in that genus, and unconfirmed records of others are probably erroneous. Stylopised individuals are numerous, and of wide distribution, but are somewhat local in their distribution.

The small species, *A. gwynana*, is an interesting bee (though common and generally distributed) on account of its variation and in other respects. It is constantly double-brooded in the south. In the first brood both sexes normally have the face and the greater part at least of the sides of the thorax clothed with black hairs, with sometimes a few pale hairs about the scape of the antennae, while some of the second-brood examples quite resemble these. But in extreme forms of this brood nearly the whole face of the ♂ is clothed with pale brown or ochreous hairs, and in the ♀ sometimes a large part of it, while the whole sides of the thorax may bear similar hairs. In the ♂ especially, such variations are not easily recognised as belonging to the species at all, without critical examination, while those of the ♀ greatly resemble *A. angustior*.

The bees of the first brood obtain honey and pollen from the most varied plants, the dandelion being a great favourite, as also are the sallow catkins. But blackthorn, fruit-trees, daisies, speedwell, celandine, cabbage, starwort, etc., are freely visited.

The second brood shows some peculiarity in its habits. In some localities one rarely sees the ♀ collect its pollen from any plants other than *Campanula* and *Malva*, the two plants which at the same period are resorted to by *Cilissa haemorrhoidalis*, so that the two species are often in company. But in other localities the bees of this second brood are found abundantly on yellow Compositae and on the flowers of *Rubus*. Nor does this always appear to be due to the absence of the plants first named, for in one case a large bed of mallow in full flower, which was visited freely by *A. coitana*, was unnoticed by *gwynana*, although it was common on the yellow Composites and blackberry that grew around.

The extremely distinct species of *Nomada*, *N. fabriciana*, is an abundant parasite of *gwynana*, and in some localities and seasons produces a partial,* more rarely a full second

* By a "partial" second brood I mean that only a small part of the progeny of the spring bees emerge in the summer, the rest hibernating in the burrows.

brood like its host. In N. Wiltshire one or two individuals of a second brood were found only in certain seasons. This *Nomada* probably parasitises also both *A. nigroaenea* and *angustior*, so that, where all the hosts occur, one may find an abundance of the parasite in the freshest condition in April, and then in May and the first part of June there appears another abundant supply of fresh specimens of both sexes, mixed with old ones, mostly ♀♀, of the early issue. In July the true second brood appears, this generation appearing conspicuously darker in colour than the spring form, when a series of each is placed side by side.

In some localities stylopised *gwynana* are not very infrequent, and those that I have noticed have mostly been examples of the second brood. Westwood, however, found the spring brood stylopised commonly at Oxford.

A. ruficrus is a northern species and was first made known as British from some males captured in Perthshire in 1899. Just at the time it was brought forward, I discovered two or three females amongst some old Hymenoptera and miscellaneous insects collected in Yorkshire and mixed with *A. fucata* and other common northern species. In the north-west of Europe it occurs in early spring on *Salix*, dandelions and coltsfoot. In most places where it is found the small parasite *Nomada obscura* Zett. is taken with it, but as a rule only in small numbers. It should certainly be looked for in the northern localities where the *Andrena* occurs with us.

A. angustior, though a rather local and inconspicuous species, is very widely distributed in the southern counties, and in many places is abundant. It is found in the north of England also. It visits dandelions and other yellow Compositae, and in some localities collects much pollen from *Veronica*. At Oxford I found it numerously on *Ranunculus*, and wherever it occurs the ♂♂ will be seen flying round the blue hyacinth flowers, if these are present, though rarely settling on them. *Allium*, *Bellis*, *Euphorbia* and *Crataegus* are all attractive in one locality or another, and it is occasionally taken on white Umbelliferae. Normally it appears in May and continues in good condition into June, but in some years it appears in April, and fresh examples of *A. gwynana* may be taken on the same day. On the other hand, in some seasons it, or at least the ♀, may be taken in good condition in company with the second brood of *gwynana*!

Nomada fabriciana, I believe, parasitises this species; at any rate, it has been taken entering its burrows. These appear usually to be scattered, but I have seen a compact colony established in the face of a vertical cutting in a roadside bank. It is partial to woodlands and to hedgerows in cultivated districts or meadowland, and seems to prefer these to open heaths, though not absent from the latter. Normally the ♀ has the face beneath the antennae clothed with pale or whitish hairs, but varieties occur in which the pubescence is sooty or dark fuscous. These may easily be mistaken for the second brood of *gwynana*.

Andrena trimmerana * Auct. is certainly one of the commonest and most widely distributed of the genus, being plentiful in England, Scotland and Ireland. It visits the most various plants, holly, sallows, blackthorn, whitethorn, and fruit-trees, as well as the dandelion and daisy, besides many garden shrubs of foreign origin. It seems to be nearly always single-brooded. Generally its burrows are scattered over fields or grassy slopes and along hedgebanks, and it has a liking for forming these in some existing cavity, and may sometimes be seen exploring a rabbit or rat hole for this purpose. Everywhere *Nomada marshamella* appears to be its special parasite, except that it also sometimes attacks the closely allied *A. spinigera* and possibly *A. bucephala.* It has a second parasite, *N. flava* (considered by some to be a variety of *ruficornis*), which so far as I have been able to discover, seems to be peculiar to it, but is a good deal more local than *marshamella*, and is absent from many localities where the host abounds. In some localities this *Andrena* is very commonly found stylopised, in others it is very rarely thus affected.

A. spinigera, closely allied to the preceding, is much more local and has not been recorded from very many localities, nor have I seen any northern examples. It is always double-brooded, and occurs in the London district, in Surrey, Kent, Suffolk, Essex, Sussex, Hants, Somerset, Dorset, Devon and Cornwall, and no doubt other localities. Owing to confusion with the next species the records of these are not always trustworthy. The bees of the first brood are mostly found on sallow and blackthorn, but they are fond of fruit-trees in gardens and of various foreign shrubs. The second brood (*anglica*) seems to be chiefly

* The type of *trimmerana* in Kirby's collection is not the species commonly so-called, but a ♀ of the second brood of *spinigera*.

found on *Rubus*, but it has been taken on white Umbelliferae. Occasionally *Nomada alternata* parasitises this species, and like it produces a second brood. Stylopised examples occur, but much less often than in *trimmerana*.

A. rosae (*eximia* = first brood) has been much confused with the preceding, the two not infrequently being found in company on the same flowers. But in some localities the one is found quite apart from the other, as appears to be the case in Monmouthshire and parts of S. Wales, where only *rosae* has occurred. True *rosae* is also found in Surrey, Kent, Sussex, Hants and Devon, and no doubt in a number of other counties, but is local and often rare. The first brood visits sallow and *Prunus*, and where these have been growing in fine flower side by side, it seems to prefer the latter; the second brood seems to be particularly attached to white Umbelliferae, though like most summer forms it is also found on *Rubus*. In this respect, therefore, its habits would seem rather different from those of *spinigera*. As I have elsewhere stated, when it was possible to study the three allied species where they occurred in company in the spring, no evidence of cross-pairing between them was obtained; nor has any individual been found which would suggest that such pairing ever occurs, all the specimens being clearly either one or other of the species, without intermediates. I have no knowledge whether this bee is attacked by *N. marshamella* like its allies, nor have I found any stylopised examples, but as they are thus affected in N.W. Europe, it is possible that such specimens have been taken by others. On the Continent *A. rosae* appears to be a more northern species than *spinigera*, and one would expect it to range into Scotland. The entirely black variety of the ♂ of the first brood is rare in Devonshire, where the species is generally highly coloured, and this variety has a remarkable appearance, quite unlike any other of its genus.

A. ferox is a species of wide distribution in the south, but very local, and seems never to have been obtained plentifully since the old Bristol collectors used to find it in considerable numbers in that district. Yet, since it occurs in Kent, Berkshire, Hampshire and Sussex, and no doubt will be rediscovered (although its former Bristol locality has been built over) somewhere near its old western haunt, and has been also found in Cornwall, it will probably turn up commonly enough in some of these counties, or be discovered in others. The few recent examples that I have seen have all been taken casually, so to speak, by those interested in Orders other than Hymenoptera, and all were single specimens. These were from Hants (on two occasions), Berks and Cornwall. It occurs in May and June, and may be expected to visit yellow Composites, as one examined by me contained this pollen on its legs. It is not known whether any *Nomada* is attached to this species, but it has been found stylopised.

A. bucephala is another extremely local species, also of wide distribution in the southern counties, and found by Hallett in Glamorganshire in Wales. It was once very abundant at Hampstead, and was found also at Bristol and in Hampshire. It has been taken in several localities in Surrey, in Kent, at Birmingham, and occurs also in Devonshire and Cornwall. This bee is partial to the flowers of blackthorn, and has also been taken on holly and *Viburnum.*

From the form of its pollinigerous apparatus one would expect it to visit such flowers as are favourites with the common *A. trimmerana.* *Nomada bucephalae* is its peculiar parasite, and has been erroneously considered a mere variety of *ruficornis* by some authors; while Smith and Shuckard considered it to be Panzer's *lateralis*, which is also an error. This parasite probably occurs in all localities where its host is properly established, for it formerly abounded on Hampstead Heath, and is found with it in Surrey, Devon and Glamorgan. Stylopised *bucephala* occur, as I have a ♂ and ♀ so affected.

All the colonies of this *Andrena* that I have seen have had only a single entrance. Into this one may see dozens of heavily laden females enter, when they are storing their pollen, and it is to be presumed that separate tubes will be found to be excavated from the common hole, by which all enter. Under special circumstances some other species show some approximation to the habits of *bucephala.* Twice *Nomada alternata* has been seen to enter or issue from the burrow of *bucephala*, and once a female *trimmerana* entered the same, so that it is not certain that this *Nomada* is parasitic on the former as it is on the latter.

We now come to the group of *Andrena varians.*

A. clarkella is a local bee, but of extremely wide distribution, and appears as early in the year as any of our bees. It is often common in Scotch localities and in the north of

England, as well as in the extreme south. The females gather their pollen nearly always from the catkins of sallows, but I have taken specimens on dandelion, and have some that were captured on *Tussilago* and *Ulex*. Though the males also visit sallow catkins, they are by no means always found on these even when the species is freshly out, and if they are present they usually appear to be mostly in search of the females, rather than visiting the flowers.

In March and sometimes even in February before any new leaves have appeared this sex may be seen flying wildly round *Ulex* or settling on the bare limbs and trunks of trees or on dead leaves on the ground, for the purpose of sunning themselves. In many and I think in most places where it occurs freely, this bee will be found accompanied by its parasite *Nomada leucophthalma* (*borealis*), which also visits the sallow catkins. This *Nomada* is not confined to *clarkella*, but is also attached to *A. apicata*, and probably this latter is its original host. According to Saunders *clarkella* is found stylopised, but only rarely.

A. fulva is in the female sex the most beautiful of all our Andrenas. It is a local bee entirely absent from many districts, but generally abundant, where it occurs at all. Owing to its partiality for the flowering fruit-trees it is a constant inhabitant of gardens in places where it is found, and is not easily overlooked for that reason, and because its burrows are often conspicuous on lawns. It may be taken on the catkins of *Salix*, and is very abundant away from gardens on the flowers of blackthorn, and occurs, too, on *Cotoneaster*, *Ulex* and various other plants. Its colonies are often large and compact, occupying trodden pathways on sandy commons for many yards together. A large form of *Nomada ruficornis* s.s. infests its burrows, and it also has as a special parasite *N. signata*, which some hymenopterists consider to be also a variety of *ruficornis*. In some localities, *e.g.*, at Oxford, only *ruficornis* appears to be found with it; in others, *e.g.*, at Raglan in Monmouthshire, only *signata*; but on some of the commons in the neighbourhood of London both these species are found at its burrows.

Stylopised specimens of *A. fulva* are rare, or, at least, very local, but are to be found on the commons near London. Males thus affected often have an extraordinary appearance, being very greatly changed by the parasite.

A. varians has much the habits of the preceding; indeed, the two species are often found in the same localities, and both may be entirely absent from large stretches of country that seem well adapted for them. Both visit the same flowers, and *varians* is also parasitised by *N. ruficornis*; by some writers its parasite is considered to be the typical form of this variable *Nomada*. Stylopisation occurs but rarely.

The variation exhibited by the ♀ of *varians* is of a remarkable character. One most extreme form was named *mixta* by Schenck, and considered to be a distinct species, and indeed its appearance is so very different from the typical form that, were no intermediates known, one would scarcely think it possible that he was in error. It is partly owing to this variation that such confusion has existed between the closely allied species of the *varians* group, for Smith referred the *mixta* form to *helvola*, and Saunders considered it to be *synadelpha*.

The following varieties of the ♀ may be distinguished :—

(i) Typical *varians* has black hair on the face, and the underparts of the thorax are clothed with blackish or sooty-grey pubescence, even the floccus being, at least in part, sordid in colour. The two basal abdominal segments bear bright fulvous hairs, all the others black ones. (ii) The fulvous hairs of the abdomen spread over the 3rd segment, the hairs of the underparts often become paler and the floccus whiter. (iii) Fulvous hairs, generally with more or less tendency to become white, cover the 4th as well as the 3rd segment, the facial hairs are greyish or whitish fuscous, the hairs beneath the thorax and the floccus either slightly discoloured, or else pure white. (iv) The hairs on the 1st and disc of the 2nd segments are fulvous, those on the rest of the 2nd and the two following white or hardly perceptibly yellowish, those on the face and whole underparts of the body mostly snow-white, or at most a little yellowish tinted in part. This is the true var. *mixta*, and in its finest condition it is a very beautiful insect.

A. helvola under normal conditions appears a little later than *A. varians*, and superficially is extremely like the var. *mixta* of that species. It is partial to dandelions, from which it often collects its pollen, but it visits many other plants for this purpose, e.g., *Crataegus*, *Rosa*, *Fragraria* in gardens, *Euphorbia*, etc. It is a decidedly local insect, and not always at all common even where it does occur, but will probably be found somewhere in most of the southern counties of England, and it also occurs in the north (Cumberland). It occurs also at Oxford, but, unless well authenticated, published records are of little value, owing to frequent misidentification. Smith's supposed Scotch specimens are a mixture of *A. praecox* and *synadelpha.*

It is, I think, certainly parasitised by *Nomada ruficornis*, but I have not seen a stylopised example, though these probably occur.

A. synadelpha is a very widely distributed species, but local. It occurs in many of the southern counties, and also in Scotland. The ♀ frequents the dandelion, hawthorn, wild rose and other flowers, and was taken in numbers together by Morice on *Sisymbrium alliaria.*

It is very much parasitised by *Nomada ruficornis* s.s., but is rarely stylopised. The variation in the ♀ is somewhat similar to that of *varians*, but less extreme.

A. fucata is one of the most widely distributed of all our bees, being common in the north of England and in Scotland, and also in many parts of the west of England and in Ireland. It also occurs, sometimes not rarely, in the more eastern counties, in Suffolk, Hampshire and Surrey, also in Oxfordshire and Warwickshire, and on a very unfavourable and stormy day I observed it in some numbers in Bricket Wood, Herts. Probably it is to be found in nearly every county, but in many localities it is only seen in small numbers. Where it frequents gardens, the females are sure to be found gathering their pollen from the raspberry flowers; on wild heaths or moorland it frequents the *Potentilla* in preference to any other plant, excepting perhaps *Vaccinium* in some localities. Sometimes it may be taken freely on *Crataegus* and the wild rose, and late examples on *Rubus*. It is normally on the wing in May in Devonshire, but in some counties not usually until June, or even July in the north. I have never come across a large colony of this species, but I once found a small one of about a dozen burrows placed close together.

I believe that this bee is parasitised by *Nomada ruficornis* s.s., since I have taken the latter in places where I could find no other member of the *varians* group. Occasionally, but quite rarely, stylopised individuals are met with.

A. lapponica is an extremely local species in the south, and can only be expected where there is a good growth of *Vaccinium*, since, so far as my limited experience goes, the ♀ collects its pollen only from this. The male is said to visit other plants, and in moorland localities is fond of flying round or settling on rocks. The burrows that I have seen have generally been single or at most a few near together, and entering these or flying round the heath in the vicinity, examples of a dark form of *ruficornis* s.s. seemed as numerous as the host, which was by no means abundant. No doubt on moors in the north of England, in Wales, and in Scotland this *Andrena* is often very abundant, and specimens of the *Nomada* taken with it in the Grampians and sent to me for examination were of exactly the same colour variety as those found with it in Devonshire. Amongst the whole number of specimens that have been examined none were stylopised.

Andrena apicata is one of the very earliest of spring bees, and it gathers its pollen almost entirely from sallow catkins, though occasionally it visits *Prunus* for this purpose. It is of extraordinarily wide distribution, but very local, at least in the south. I have myself seen specimens from Surrey, Sussex, Gloucestershire, Devon and Oxford as well as from Scotland. In the west of England the males pay little attention to flowers. They may be seen flying round the sallows in search of the females, but should there be old fences or gates in the vicinity of their breeding-place, they will generally be found sunning themselves on these, or will even settle on rocks. Occasionally a fresh female alights in a similar situation, evidently with the intention of pairing, and quickly attracts a number of the males, which are coursing along the fence.

Nomada leucophthalma, which has already been mentioned as a parasite of *A. clarkella* (q.v.), attacks this bee, and it would be interesting to compare together long series taken from each host, each series having been collected in a place where only one of these hosts occurs. At Hastings Theobald found this *Andrena* to be much infested by *Stylops*, as is the case in Germany, but in the west of England I have never come across a stylopised individual.

Alfken describes the ♂ of the German form of *apicata* as having a *small triangular* tooth at the base of the mandibles, and a specimen I have from the Continent agrees with this description; but in all British examples that I have examined the tooth cannot possibly be called small, and it would appear that the Continental form is racially distinct from ours. The tooth varies in shape in our examples, and it is quite possible by looking through long series of *praecox* and *apicata* to find individuals that do not differ much in the form of this.

A. praecox is closely allied to the preceding, and has the same habits, for both, at times, at any rate, form compact colonies of considerable extent, and both are pre-eminently attached to *Salix*. This species is local, but ranges from Scotland to the extreme south of England, and is, I think, commoner than *apicata*. It is found on the commons close to London, and is locally abundant in Surrey, Kent, Hants, Essex, Norfolk, Suffolk, Cambridge, Oxford and Monmouthshire. In Devon it is extremely local, and in places where I have myself observed it, it has steadily increased in numbers from 1914 to 1918, when it appeared in the first half of March. In Scotland it occurs, no doubt, commonly. Much scarcer than its host is its special parasite *Nomada xanthosticta*, which, however, is found just outside London, and in Norfolk, Suffolk and Cambridge. I have not been able to find any trace of this parasite in the west of England, even where the host abounds. From a large colony at Oxford I once took two stylopised examples of the latter, but have not seen any so affected elsewhere.

Passing now to the *nigriceps* group, that most distinct species *A. denticulata* is very widely distributed, but at the same time very local. It occurs in many of the southern counties, in the north of England and in Scotland, but only rarely is it really abundant. In some seasons and places it is found at the end of June, but more often in July, and the ♀ may even remain on the wing into September. It is found on yellow Composites, *Senecio*, *Crepis*, etc., abundantly sometimes on *Inula*, and is extremely partial in some localities to pink-flowered thistles; while Smith says it is attached to bryony. That plant has never been in flower or has been wanting in the localities where I myself have met with *denticulata*. It seems not to be attacked by *Stylops*, nor has it a special *Nomada*, but *N. rufipes* (*solidaginis*) is parasitic on it as well as on the more abundant *A. fuscipes*. Except as to the development of male characters in large examples, this species varies very little, but the characteristic black hairs are sometimes wanting on the thorax in the ♂.

A. tridentata is one of the most restricted in range of all our bees. I have seen authentic specimens from Norfolk (Cromer), Suffolk and Hants, but the ♂♂ supposed to be this species, collected by Bridgman at Norwich, so far as the material sent by him to F. Smith is concerned, are all *nigriceps*. This species visits *Senecio* and *Crepis*.

A. fuscipes is widely distributed and often very abundant on the flowers of *Calluna*, to which it is chiefly attached, but we have once taken females loaded with pollen from yellow Composites, when the ling blossom was mostly over. It will probably be found on most extensive heaths, and is common in Norfolk and Suffolk in the east, as also in Surrey and Hants; in Devonshire and in Wales in the west; it is found in Cumberland, and Smith had specimens (wrongly named as *simillima*) from Loch Rannoch, Scotland. Unless a colony is found, and these are sometimes large and compact, the males usually appear to be much more numerous than the females, flying wildly over the ling or heather, or round sunny bushes that happen to be growing near by.

Probably in all places where this *Andrena* is found its parasite *Nomada rufipes* (*solidaginis*) also occurs, and in some Devonshire localities it seems even to surpass its host in numbers. In some seasons it appears before any of the latter are abroad, though the *Andrena* in this case appears not many days later. I have some suspicion, however, that the earlier examples of the *Nomada* were parasites of *denticulata*.

A. simillima is a local and in general a rare species, and seems to be found chiefly on the coast of Kent, Hampshire and the Isle of Wight, but it also occurs on the coasts of Devon and Cornwall in the west. I have only met with it on the flowers of thistles and on *Rubus*. Smith's specimens from Scotland were wrongly determined by him, being merely *fuscipes*, as mentioned above.

Closely allied to the preceding, the local and generally uncommon species, *A. nigriceps*, seems to have somewhat different habits. It visits various plants, and I have taken it on ragwort and other yellow Composites, thistles, *Knautia*, *Potentilla*, etc. On the Continent it is said to be most partial to *Jasione*, but that flower does not seem to be very attractive to species in the west of England. In Norfolk, Suffolk, Essex and Hants this bee seems to be fairly common locally, and it is found in N. and S. Wales; while I have two much-worn females which were, I believe, taken in Yorkshire. It is found both near Oxford and Cambridge, and in Cheshire and Lancashire, so that its distribution is very wide.

A. sericea (*albicrus*) is common throughout the south of England, where conditions of soil are suitable, and also in

Scotland and Ireland. It is entirely absent from large areas, where the soil is of a heavy nature or of clay, and is very much at home on some coast sand-hills. It forms enormous compact colonies, often choosing hard, trodden footpaths or bare places on sandy commons to burrow in. It freely visits daisies and buttercups, but its favourite flowers are the yellow Compositae. Less often it collects pollen from bushes or trees of taller growth, such as the hawthorn. The males also freely visit flowers, but spend much time flying over the sand, in which the colonies are placed. This and the following species are probably representative of a fauna found in sandy wastes, the pale silvery hairing of the males being characteristic of many desert-loving bees, and adapted to their habits of flying over the sand.* I should think that a good many species allied to our two are likely to be found in such places in continental lands, ours being, as it were, highly successful forms, which have been able to occupy regions beyond the ordinary limits of their natural environment. Also in such places one may expect that many species of other groups will superficially resemble them.

With us *A. sericea* has no *Nomada* parasitic upon it, but on the Continent of common occurrence is *N. alboguttata*, this being either a race of the smaller *N. baccata*, which infests *A. argentata* both here and abroad, or else a very closely allied species.

On the other hand, *Sphecodes pilifrons* is the constant parasite of this *Andrena*, and I believe attacks no other species. I have seen examples named as *pilifrons* from localities where *sericea* is certainly wanting, the nature of the soil indeed rendering the possibility of its occurrence extremely small, but these were always wrongly determined, being giant examples of *S. similis*.

As to *A. argentata*, this bee is in this country of very restricted range, being abundant locally, however, on the commons in Surrey, Berkshire and Hampshire, and no doubt is to be found in one or two of the other southern counties. It visits the flowers of *Erica* and *Calluna* and probably some of the yellow Compositae, and apparently has no spring brood in this country. *N. baccata*, its parasite, seems to occur in all localities, where the host is common, and I think in most, if not all of these *Sphecodes*

* Mr. Morice has informed me that his captures in hot desert countries more resemble *A. fulvicrus*, etc.

reticulatus is to be found. There seems to be no doubt that the *Sphecodes* is peculiarly attached to this small *Andrena*. On the Continent it has been taken from the burrow of the latter.

A. fulvago is of very wide distribution; in some localities rare and dispersed, in others forming dense compact colonies, but so local that until one of these is chanced on its presence may remain undetected in the district. It likes a sandy soil, and is particularly attached to *Hieracium*. One would expect it to occur in most counties where conditions of soil are favourable, since it is found in Suffolk, Surrey, Sussex, the Isle of Wight and Hants; in Devon, Monmouth and South Wales in the west; in Warwickshire; in Yorkshire in the north, and in Scotland. It may appear in May, and is common in June, and continues into July or even August. Though I have closely examined colonies of this bee I have found no parasite at its burrows.

A. polita is now, perhaps, the rarest of all our Andrenas, and has very rarely been found since it was discovered by F. Smith. Being a large and conspicuous species it must be excessively local, since it could hardly be overlooked, and its range is probably very limited indeed. One would expect it to be found on yellow Composites, and it should be looked for in June and July in the south-eastern counties.

With *A. proxima* we pass to a group of very small and comparatively difficult bees, only the one just named being of medium size for the genus. It is a local species and often very scarce even where it does occur. In Norfolk, Suffolk, Kent, Dorset and Devon it is, I believe, to be obtained not uncommonly in its special localities; but it varies in numbers a good deal in different seasons. It is also recorded from Surrey, Hampshire, Gloucestershire and Cornwall, so that it is widely distributed in the south. It is peculiarly attached to the flowers of white Umbelliferae, on several species of which it may be found, both sexes alike visiting these plants. It is also partial to *Euphorbia*.

Probably in most localities, where it occurs at all freely, its special parasite *Nomada conjungens* will be found. Though so lately added to our lists, it is interesting to note that this species was taken one hundred years ago, there being a very good specimen in the Kirby Collection. It was first brought forward as British by Morice, who captured a single specimen in Dorset, and soon afterwards a number of examples were found in the Chitty Collection at Oxford, after I had already found it amongst some unmounted and unexamined Devonshire bees. Although on the Continent this *Andrena* is very subject to the attacks of *Stylops* (those thus affected appearing earlier than healthy individuals, and being found often on dandelion flowers), I have seen no stylopised English specimens.

A. nana K. (*schenckella* Pérez) is known as British only by Kirby's type, but will probably be rediscovered in the south-eastern counties, when more attention is paid to this group of small bees. It occurs in Germany, Switzerland and France.

A. moricella and *alfkenella* are probably first and second broods of a single species. The first I have taken on *Brassica*, *Veronica*, *Bellis* and *Potentilla*, etc., the latter on white Umbelliferae. The first brood appears a little later than *A. parvula*, and I have seen stylopised examples of each brood.

A. falsifica is a local species, and its first appearance is rather later than that of *A. moricella*. It visits many lowly plants—daisy, wild-strawberry, *Veronica*, etc.—while the females gather much pollen from *Potentilla*. It is not rarely stylopised, and has as a parasite *Nomada flavoguttata*. It is single-brooded.

A. saundersella (*nana* Auct. plur.) is a widely distributed species, probably occurring in all our counties, and abundant in some parts of the north of England. Its favourite flowers are *Veronica* and white Umbelliferae, from both which it gathers pollen, but it also visits daisies, *Myosotis*, *Potentilla*, *Fragraria*, etc., and late specimens may be found on *Rubus*. Very rarely a stray example of a second generation is met with. It is very subject to the attacks of *Stylops*, and also is parasitised by *Nomada flavoguttata*.

A. nanula is known to me as British only by a single ♀ sent to Smith by Bridgman of Norwich, and the continental examples that I have seen were taken in July.

A. subopaca is a very widely distributed species, found, I expect, in nearly all counties and common in the north. Such Scotch specimens as I have examined, passing under the names of *parvula* and *minutula*, really belonged to this species. It is mostly found on *Veronica*, *Bellis*, *Fragraria*, etc., and is normally single-brooded, appearing later than *parvula*. Once on the south coast I took a single ♂ of a second brood. It was the confusing of this species with *minutula* and *parvula* that caused Smith to err in describing the ♂ of the latter under the name of *nigrifrons* in the first edition of his Catalogue.

This species is very subject to the attack of *Stylops*, and also of *Nomada flavoguttata.*

A. spreta is much more local than the preceding, and is chiefly found on the coast and on or about sandy heaths, but rather curiously it occurs also in the fen country in Cambridgeshire. It is single-brooded and flies with *saundersella.* So far as I have been able to ascertain from a careful investigation of its breeding-grounds, it is not attacked by *Nomada flavoguttata*, but it is very freely stylopised. These little bees are very partial to different species of *Brassica*, and freely visit daisies and sometimes *Veronica.* There is no second brood.

A. parvula and *minutula* are certainly first and second broods of a single species. The first frequents the sallow catkins in the earliest days of spring, and gathers abundant pollen from blackthorn also, and later from *Crataegus* and *Veronica.* It is also often found on daisies, dandelion, cabbage, mustard, strawberry, flowers of fruit-trees and many other plants. The second brood is extremely partial to *Rubus* and various white-flowered Umbelliferae. Though sometimes stylopised, this bee is much less subject to attack than some of its allies. I have after careful observations been able to satisfy myself that it is also less freely parasitised by *Nomada flavoguttata* in this country. The species seems to be ubiquitous, occurring somewhere, even in the poorest localities.

A. parvuloides and *minutuloides* may also prove to be first and second generations of a single species. They are much more local than the preceding, and generally found either on the coast, or on or near sandy commons, hardly occurring in meadowlands and well-cultivated districts, when these are remote from their normal haunts.

If they really are one species, I find the second brood far more commonly than the first. This latter is found on various flowers, *Veronica*, *Brassica*, *Bellis*, etc., but the second brood almost entirely restricts its visits to white Umbelliferae, and I cannot remember taking it on *Rubus*, which is so attractive to *minutula*, so that the habits of these two very closely allied forms are somewhat different.

I have seen no stylopised example. The males are often much more difficult to find than the females, and appear on this account to be much less numerous, and the species is rather later in appearance in the spring than *A. parvula*. The variability to which—apart from that due to seasonal dimorphism—both species are subject, sometimes makes them difficult to separate, but *minutuloides* occurs in Surrey, Kent, Suffolk and Devonshire, and, doubtless, in many other counties, but I have seen none from the north.

A. dorsata in the *wilkella* group is a local bee, which one would expect to occur in Scotland, unless it were there replaced by the very similar *A. propinqua* of N.W. Europe, a species (or ? race) with similar habits; but I have seen no Scotch examples. It is regularly double-brooded, the first generation frequenting *Salix* and blackthorn, but also many other plants. I have taken it in abundance on daisies and *Brassica*, gathering pollen from these; also on *Veronica*, *Rubus idaeus*, fruit-trees and dandelions, and late examples on white Umbelliferae. The second brood occurs on *Rubus*, yellow Composites, daisies and *Melilotus*, and sometimes on ragwort and *Potentilla*. Saunders mentions bryony as a flower visited by this brood, and Mr. Morice informs me that it is frequent on this flower in his garden. The species is found on the commons near London, and is abundant locally in Norfolk and Suffolk, and very common in numerous Devonshire localities, both on the coast and inland, to an altitude of nearly 1000 ft. above the sea. It is also found in Hampshire and Essex, and must occur in several other counties in the south. I have never seen any large compact colony of this bee, but only scattered ones. No *Nomada* appears to attack it, nor is it infested by Stylops.*

A. similis Sm. is also local, but occurs on a number of commons close to London; was found commonly at Oxford in 1886, and is widely distributed, and in some places abundant, in Devonshire. It is recorded from Denbighshire and Essex, and is found in Hampshire. Some examples from Colchester sent by W. H. Harwood for my inspection many years ago had the face beneath the antennae clothed with pale fulvous hairs, instead of the usual white ones, this being the usual form in some N. European localities. Walcott first discovered it, at Bristol, and supplied Smith with specimens. Sometimes it forms compact and fairly large colonies, and the males will be seen flying over the soil and settling, for the purpose of

* Recently my brother has sent me a stylopised female from East Devon, captured on March 26th, 1919.

feeding, on ground-ivy or bugle, if these happen to be growing there, as well as on daisies and *Veronica*. The females also visit these plants, and also trefoil and clovers, and they collect great loads of yellow pollen from the flowers of *Ulex*. Various papilionaceous plants attract them. No *Nomada* appears to breed in their burrows, nor have I been able to secure a single stylopised * example, although, according to Alfken, this is one of the species of *Andrena* most subject to attack in Germany.

A. ovatula, better known as *afzeliella*, is by no means of universal distribution, but is widely distributed in the neighbourhood of London, and abundant in many counties, where there is heath land with a gravelly or sandy soil. It is not partial to meadowland and highly cultivated districts with heavy soils. It differs both from the preceding and the following species in being frequently and in some counties, *e.g.*, Devonshire and Hampshire, regularly double-brooded, but it is not certain whether it has not a special single-brooded race, which appears between the two others. It visits the same flowers as *A. similis*, but appearing earlier is also taken on *Salix* and on blackthorn. The second brood is extremely fond of *Calluna*, gathering pollen from this often in company with *A. fuscipes*, and is sometimes numerous on *Ononis*. This *Andrena* is not subject to the attacks of *Nomada* in this country, but it is sometimes stylopised, much less frequently, however, in my experience than *A. wilkella*. Most of the supposed stylopised *afzeliella* I have seen belong to the other species, but I have bred the ♂ *Stylops* from the present one as well.

The variation in this species is of an unusual kind in that the hind tibiae of the female may be either clear yellow, like those of its close allies, which never vary, or entirely black. This last form was named *fuscata* by Kirby (before he described his *afzeliella*), and it is found in both broods. Both names, however, are preceded by *ovatula* K., which is the ♂ of *afzeliella*.

Saunders merely tells us that *afzeliella* is widely distributed, but I do not possess any northern examples myself, though one would expect it to occur in both Scotland and Ireland. The following species, however, occurs in the north and the two are not always accurately separated by collectors.

* Since this was written a stylopised ♂ has been taken.

A. wilkella is of very different distribution from that of the preceding, since it often occurs in extraordinary numbers on heavy clay soils and in highly cultivated meadowlands. It is true that it is found not infrequently in the same localities, frequenting exactly the same flowers as *ovatula* and *similis*, but where these two species are most abundant *wilkella* is often inferior to them in numbers. *N. hillana* (*ochrostoma*) is its special parasite, and does not appear to affect the others. Sometimes the *Andrena* forms colonies of huge extent and very compact, at others its burrows are scattered over a large extent of land. We have seen tennis lawns covered with little hillocks of soil thrown up by these bees in the same way as *A. fulva* is well known to do in similar places, where the soil is lighter.

Stylopised specimens are very common, and females affected by the parasite are often found in dandelions, even when few healthy ones are to be seen on those flowers. It is always single-brooded, and though both fly together, it appears rather later than *ovatula* under normal conditions of weather.

There remain to be considered those species, which have the clypeus in the ♂ white, and along with these one without that peculiarity, but evidently closely related to one of the others.

This black-faced little bee, *A. nitidiuscula* (*lucens*), is amongst the most local of all our species, being restricted to a few southern counties, but almost certain to occur in at least one or two others from which it is not yet recorded. It is found on heaths or commons in Surrey, Sussex and Dorset flying over the heather, the ♀ visiting the blackberry blossoms. On the Continent it is said to be partial to Umbelliferae, as its ally *A. chrysosceles* is with us. This latter is a more or less local species, but occurs at times in the utmost profusion. It is on the whole more partial to meadowland than to more barren localities. It is found near London and probably in all or nearly all the southern counties, either locally or generally distributed, in Cambridge, Essex, Suffolk and Norfolk in the east, in Gloucestershire, Devon and Monmouthshire in the west, in Dorset Berks and Hants, Oxford and Warwick, and in Glamorgan, and no doubt other Welsh counties. Though not one of the earliest bees, in forward seasons it may appear in April, and is commonly found from May into June, and may remain even into August in wet and cold summers. At first it visits daisies and dandelions and not infrequently buttercups and *Veronica*. Later it is particularly attached to white Umbelliferae, and it is much attracted by *Euphorbia* in some places. No *Nomada* parasitises it, and only very locally or one may say rarely is it stylopised, though it is found thus affected in localities so distant as Oxford, Devon and Essex. From the latter county Mr. L. Walford kindly sent me several such examples, including a ♂ with black face and ♀ with this part white-marked.

A. tarsata (*analis*) is a local bee, and probably absent from those counties in the south which have no extensive heaths on a peat or sandy soil. It is still found just outside London, as well as on the more distant of the Surrey commons, and commonly in Hants and Devon. In the northern counties it is often abundant, and it occurs (no doubt abundantly) in Scotland and Ireland. It is extremely fond of *Potentilla*, gathering most of its pollen from this, but is also found on heather and *Rubus*. It is parasitised by *Nomada tormentillae*, which I have taken entering and leaving the burrows of compact and pure colonies of this little *Andrena*. Probably it is parasitised also by *N. obtusifrons*, at least it certainly is so, if one trusts old records. Smith, entirely misinterpreting Kirby's description, applied the name *xanthosticta* K. to that species, and under this name we read of *obtusifrons* as being parasitic in colonies of *tarsata* in the north. On one occasion this *Nomada* was taken sparingly, in company with a few of the *Andrena* in N. Devon, but not at the burrows of the latter, and it is, of course, possible that the following species may have been present, but overlooked.

A. coitana is not infrequently found in company with the preceding, but is, I think, more widely distributed in the south, though quite local. It is common in some places in the north of England, and occurs in Scotland. In the south it frequently occurs on the coast, and it is probably to be found somewhere in most of the counties. It occurs in the Cambridgeshire fens, and at Oxford, and in Devonshire on Dartmoor and Exmoor, as well as at lower elevations. It is common also on some of the Surrey commons and in the New Forest, and is found in Norfolk, Essex and Kent in the east. It is partial to the flowers of bramble, and in some localities (like *A. gwynana bicolor* and *Cilissa haemorrhoidalis*) visits the flowers of *Campanula* and

Malva, also white Umbelliferae and others. It is parasitised by *N. obtusifrons*, but not, I think, by *tormentillae*. At any rate, where we have found *A. coitana* and *tarsata* together, the last-named *Nomada* was certainly attached to the latter, and was not seen at the burrows of the former.

A. hattorfiana is widely distributed in the more southern counties, but local, and by no means always common, where it does occur. In the east it has been found numerously in Kent, and has occurred at Colchester and near Norwich; in the Isle of Wight, Dorsetshire, Devonshire (where it is widely distributed but local and in some localities and places few in numbers) and various localities in Cornwall, in S. Wales and near Oxford. Its favourite flower seems to be *Knautia*, but it also visits *Scabiosa*, and will hardly ever be seen on any other plant than these, or on the first one only. The red-marked varieties are said to be abundant on the east coast in some seasons, but in Devonshire are extremely rare; near Oxford less so.

Nomada armata is parasitic on this species and also frequents the same flowers. Judging from the fact that Smith, who found this *Andrena* so abundantly on the east coast, hardly obtained any of the parasite there, and Saunders none at all, it would appear to be unexpectedly rare there, but otherwise it seems generally to occur more or less freely in nearly all the districts recorded for its host. Yet it will not be found with every colony, even though these are of long standing. Once I saw it really numerous in S. Devon in a large pasture field sprinkled over with scattered plants of scabious, where it was flying strongly in a brisk wind from plant to plant, but not settling on the swaying flowers. Being occupied in salmon fishing and without a net I was unable to secure even a single specimen, and though I knocked down and so obtained some of the *Andrena*, the harder *Nomada* was not to be thus stunned. When, in another year, I was able to revisit the spot, the field had been ploughed up and planted with corn.

A. marginata in its habits is very similar to the preceding, being most partial to and often found only on the common scabious, but I have taken it on *Centaurea* and frequently on the devils-bit scabious, and Hallett took the ♂♂ on *Lapsana*. Not infrequently it is found in company with *hattorfiana*, being similarly local. I have seen specimens only from the more southern counties, where it occurs in Cambridge, Essex, Suffolk, Norfolk, Kent, Surrey, Berks, Hants, Dorset, Devon and Glamorgan, and no doubt in other counties, but it is always local. Sometimes it is very abundant, as on one occasion eighteen years ago, on the border of Suffolk and Cambridge, when I found a bank grown over with scabious with nearly every flower occupied and often two or three bees on a single blossom. All our colour varieties were present, but no trace of any parasites was found. In Devon I have not found highly coloured specimens, but they occur freely in Dorset. *Nomada argentata*, a very local and generally rare species, is the special parasite of *marginata*, but it has only been recorded from a few localities, in Surrey, Sussex, Berkshire and Kent.

A. cingulata is a widely distributed bee, probably to be found in nearly all the more southern counties at least, and it also occurs in the north of England, but is by no means always common. It not only frequents sandy commons, but is also partial to well-cultivated districts and is found high up in hilly districts, *e.g.*, the Cotswolds and Dorsetshire hills. It used to be extremely abundant in suburban localities, and this probably led to its being considered a much commoner species than is really the case. Thus Shuckard makes the obviously very erroneous statement, that it is perhaps the commonest species of the whole genus! In several extensive districts, where I have collected, it occurs very sparingly and even rarely. In some it forms large colonies, but these are generally local. All observers note its attachment to the flowers of *Veronica*, but the female sometimes collects pollen from the dandelion and the common buttercup, and the males also visit these.

Kirby records that he took the females on *Ranunculus bulbosus* in May, but his statement that the males occur in the autumn must be an error, and (although, of course, he knew this sex well) may perhaps be due to some momentary confusion between this and the males of *Sphecodes*. Hallett found this bee abundantly on *Aubretia* in a garden. Of very wide distribution, but apparently nearly always rare, is its special parasite *Nomada guttulata*; but as this occurs in suburban localities, in the eastern counties, and so far west as Devonshire, it may reasonably (being an obscure little species) be expected to occur, if specially searched for, in many localities, where the host thrives. Kirby described the ♀ as a variety of *ruficornis*, and Smith's earliest description of *flavoguttata* ♀ was also made from *guttulata*.

A. humilis is a very local species, widely distributed, but probably absent from a good many counties, and in some so extremely local that one may expect that it is to be found in a number of others from which it has not yet been recorded. Its wide distribution is shown by its abundance here and there in Surrey, Kent, Hants, Devon and Cornwall, Gloucestershire, Oxford and Lancashire. It is particularly attached to *Hieracium*, but visits also other plants, *e.g.*, daisies, buttercups and dandelions. Often it forms enormous colonies in hard-trodden pathways. Its special parasite *Nomada ferruginata* is often found at these colonies, and is also of very wide distribution, but not always present, even where the host is abundant. On the Continent this bee is much stylopised in some localities, but I have seen no British specimens affected.

A. labialis is found in many localities in the south; from the eastern counties to Gloucestershire and Cornwall in the west, and in Cheshire and Lancashire in the north. Its abundance in some places seems to depend on the fact that it forms large and compact colonies, often in some vertical cutting or bare exposed surface of a hedge bank, and where these colonies are found it is naturally very abundant. V. R. Perkins records several such colonies at Wotton-under-Edge in Gloucestershire in 1879, and states that the species subsequently entirely disappeared. In that neighbourhood I found this bee at various times from 1886 to 1907, but always singly, and also its burrows, but these too were isolated ones on grass-covered slopes. It certainly has a way of appearing and disappearing suddenly, as I have noticed in other localities. I have taken the ♀ on *Trifolium*, *Lotus*, *Veronica* and *Hieracium*, and in gardens on sage and seringa, and, no doubt, it visits numerous plants. Hallett takes it on *Salix* and *Cornus sanguinea*. Compact colonies sometimes become badly infested with *Stylops*, but no *Nomada* attacks it in this country. On the Continent a form of *N. cinnabarina* is said to be found with it. There seems to be little doubt that *Sphecodes rubicundus* is its special parasite, this having been found in connection with it, in such different localities as Suffolk, the New Forest, and the fens of Cambridge.

SYSTEMATIC.

Position of Andrena and Nomada amongst British Bees.

Andrena and *Nomada* are both very distinct genera, the latter indeed is so peculiar in appearance and structure that it has been entirely misplaced by some Hymenopterists. Their position amongst our bees may be briefly shown as follows:—

1. (2) Hind tibiae without calcaria at the apex. . . . *Apidae.*
2. (1) Hind tibiae with calcaria.
3. (4) First cubital cell divided transversely by a vein or streak. *Bombidae.*
4. (3) First cubital cell not divided.
5. (6) Labrum long, reflexed in repose, the mandibles closed over it, so that at most a little of the base is exposed. *Megachilidae.*
6. (5) Labrum not thus concealed, the mandibles closing round its apical margin.
7. (10) Labrum large and without a specialised glabrous area or raised tubercle on its basal portion, often nearly evenly punctured or pubescent over its whole surface.
8. (9) Species nearly glabrous to the naked eye and without conspicuous pubescent bands (often metallic); abdomen without a definite pygidial area. . . . *Ceratinidae.*
9. (8) The nearly glabrous species have a definite pygidial area in both sexes; many are well-clothed and have conspicuous pubescent bands. . . . . *Anthophoridae.*
10. (7) Labrum often small, or with a special glabrous area or raised tubercle at the base; sometimes it is concealed beneath a dense regular fringe of special hairs springing from the apical margin of the clypeus.
11. (12) Tongue acute at the tip. . . . . . . *Andrenidae* (incl. *Panurgidae* of some authors).
12. (11) Tongue blunt or emarginate at the tip (except in males of some exotic forms).
13. (14) Three cubital cells in front wings; hind tibiae with a scopa. . . . . *Colletidae.*
14. (13) Two submarginal cells in front wings; hind tibiae without a scopa. . . . . *Prosopidae.*

Anthophoridae.

1. (6) Face of ♂ yellow or with yellow markings and the tooth on the tarsal claws always long and sharp; ♀ with well-developed scopae on the hind legs.

2. (5) Three cubital cells in front wings.
3. (4) Seventh dorsal segment of ♂ without a longitudinal median carina; ♀ with or without distinct abdominal bands; if these are present the face is black. . . *Anthophora.*
4. (3) Seventh segment of the ♂ with a distinct median carina; ♀ with banded abdomen and yellow-marked face. *Saropoda.*
5. (2) Two cubital cells; ♂ antennae very long. . . *Eucera.*
6. (1) Face of ♂ either without yellow markings or if with these, the tarsal claws have a blunt, truncated * basal tooth; ♀ without a scopa.
7. (10) Marginal cell rounded at the apex, which lies below the margin of the wing.
8. (9) Thorax very hairy, scutellum with two prominent spines posteriorly, concealed amongst the hair. . . *Melecta.*
9. (8) Thorax nearly bare except for tomentose markings, the axillae forming a projecting angle on each side of the posterior margin of the scutellum. . . . *Epeolus.*
10. (7) Marginal cell pointed at the apex, ending in an acute angle on the marginal vein. . . . . *Nomada.*

ANDRENIDAE.

1. (10) Two cubital cells in the front wings.
2. (3) Marginal cell truncate at the apex. . . . *Panurgus.*
3. (2) Marginal cell pointed at the apex.
4. (9) First cubital cell on the lower side subequal to that of the 2nd in length. (The length is measured as if the lower side were straight.)
5. (8) Face not yellow in the ♂, hind metatarsus not extraordinarily dilated and clothed.
6. (7) Abdomen without dense appressed hair-bands on the apices of the segments ♀ with the calcaria simple. *Dufourea.*
7. (6) Abdomen with dense hair-bands; calcaria of ♀ spinosely serrulate, apex of hind metatarsus produced over the second tarsal joint in the form of a strong spine. *Rhophites.*
8. (5) ♂ face largely yellow; ♀ metatarsus of hind legs excessively

* This character unfortunately cannot be used alone to separate the males of our parasitic genera from the non-parasitic, as the ♂ of *Melecta luctuosa* has the claws formed much like those of *Anthophora* and different from those of *M. armata*. It will, however, distinguish the females of the two groups, but the absence of scopae is more readily observed.

dilated and so densely clothed that its outline is seen with difficulty; (abdomen in both sexes short or subglobose; legs of ♂ very incrassate). . . *Macropis.*

9. (4) First cubital cell on its lower side notably longer than the second (form elongate, abdomen banded; ♀ with the scopae of hind tibiae and metatarsi yellow and extremely long). . . . . *Dasypoda.*

10. (1) Three cubital cells in the front wings.

11. (14) Basal nervure very strongly curved.

(Third antennal joint in ♂ very short transverse or nearly square in outline when viewed from in front; ♀ either with a median "*rima*" on the 5th abdominal segment or the hind tibiae are spinose and lack a scopa.)

12. (13) ♀ with well-developed scopa and with long plumose hairs at the base of the hind femora beneath; ♂ genital opening distinctly ventral. . . . . . *Halictus.*

13. (12) ♀ without scopae, ♂ genital opening at the tip of the abdomen or almost so. . . . . . . *Sphecodes.*

14. (11) Basal nervure oblique, but nearly straight.

15. (16) ♂ with the 6th ventral abdominal segment widened on each side at the base with a hairy lobe, which is not covered by the deflexed margin of the dorsal segment above it; ♀ without a special sensory groove on the upper part of the face along the eye margins; apex of hind metatarsus outwardly with a lamella of hairs extended over the 2nd tarsal joint. . . . . *Cilissa.*

16. (15) ♂ with the 6th ventral segment not thus modified. ♀ with a sensory groove, bearing a dense tomentum, on each side of the face above; apex of hind metatarsus without the special lamella. . . . . . *Andrena.*

With regard to *Andrena* and its allies, I consider that in the Andreno-Panurgine group are to be found the most primitive types of existing bees, from which have originated all other groups. The Prosopidae and Colletidae are derivatives of this group in one direction, the Anthophoridae in another; the two former are not primitive in the form of their tongue, but this has become modified for a special purpose in all females, and the males of most species have inherited this form from the latter. In many Prosopidae from the Australian region the tongue in the ♂ is pointed and may be excessively lengthened, and these represent the more primitive members of the family. Our *Colletes* is an extreme form, some exotic genera having a very

Andreniform *habitus*, with the ordinary triangular pygidial area.

As to *Nomada* it was correctly placed by the old Hymenopterists Kirby and Jurine next to *Epeolus*, and is Anthophorid, not in the least allied to the Megachilidae as Pérez concluded, and also very remote from existing Andrenidae, where Edward Saunders finally placed it. The genital armature of the male is to my eyes essentially Anthophorid, and is not at all like either *Megachile* or *Andrena*, and the form of labrum is conclusive, not to mention other characters. At the most one might allow that its ancestors left the Panurgine branch of *Andrena* at a time when these were not well differentiated, but I think this unlikely.

Of great interest is the condition of the ♀ ventral abdominal segments in the three parasitic genera. In *Melecta* the 6th segment is extremely narrow and compressed; in *Epeolus* and *Nomada* it is capable of entire retraction beneath the 5th and has a special armature, so that one may sometimes count only 5 ventral segments. In all our Nomadas it is armed on each side at the apex with some close-set strong spines, and it differs in thickness in different parts. In *Epeolus* it is produced on each side into two long processes, which are serrated on the edge. If one imagines the apical and median thinner portion of the segment in *Nomada* removed, two armed processes would be formed in this genus also.

Whilst *Nomada* still remains connected with the Anthophoridae by the parasitism of *N. sexfasciata* on the Anthophorid *Eucera*, *Epeolus*, so far as I know, has become parasitic only on *Colletes*, which is almost as far removed from the Anthophoridae in one direction as can be imagined.

CHARACTERS OF GROUPS AND SPECIES.

The characters given in the tables have been taken not from selected single examples of each sex supposed to be typical, nor yet from any special series of specimens, but are those which in a period of study extending over thirty years, during which great numbers of individuals have been examined, I have found most constant. Smith and Saunders, on the other hand, based their descriptions essentially on individual specimens, and placed special labels on those selected. In some cases this method seems to me to have resulted in characters being considered as of specific value, when in reality they are far from constant. Since the tables were completed, I have myself verified them by the examination of individuals of all the species. They have also been tried out to some extent by Mr. F. D. Morice, and more completely by Mr. H. M. Hallett, such a test by others being, I think, of much greater value than one made by the writer.

Though neither groups nor species can be altogether satisfactorily placed in a linear arrangement, the following order is suggested.

Group of A. TIBIALIS.

A. albicans Müll., *carbonaria* L. (*pilipes*), *bimaculata* K., *tibialis*, K.

Group of A. FLAVIPES (FULVICRUS).

A. flavipes Panz. (*fulvicrus*), *gravida* Imh. (*fasciata*), followed by *florea* F.

Group of A. NIGROAENEA.

A. thoracica F., *nitida* Geoffr., *cineraria* L., *vaga* Panz. (*ovina* Kl.), *nigroaenea* K., *gwynana* K., *ruficrus* Nyl., *angustior* K.

Group of A. TRIMMERANA.

A. trimmerana Auct. (nec K.), *rosae* Panz. var. *eximia*, Sm., *rosae* Panz., *trimmerana* K. var. *spinigera* K., *trimmerana* K. (*anglica* Alfk.), *bucephala* St., *ferox* Sm.

Group of A. VARIANS.

A. fucata Sm., *lapponica* Zett., *varians*, *synadelpha* Perk. (*ambigua*), *helvola* L., *fulva* Schr., *clarkella* K., *apicata* Sm., *praecox* Scop.

Group of A. NIGRICEPS.

A. fuscipes K., *simillima* Sm., *nigriceps* K., *tridentata* K., *denticulata* K.

Group of A. ARGENTATA.

A. sericea Chr. (*albicrus*), *argentata* Sm.

Group of A. FULVAGO.

A. fulvago Chr., *polita* Sm.

Group of species with white clypeus in the ♂, with NITIDIUSCULA.

A. labialis K., *humilis* Imh., *coitana* K., *tarsata* Nyl. (*analis*), *hattorfiana* F., *marginata* F. (*cetii*), *chrysosceles* K., *nitidiuscula* Sch. (*lucens*), *cingulata* F.

Group of A. NANA.

A. nana K. (nec Sm. Saund.), *alfkenella* Perk. var. *moricella* Perk., *alfkenella* Perk., *spreta* Pérez, *saundersella* Perk. (*nana*), *falsifica* Perk., *nanula* Nyl., *minutuloides* Perk. var. *parvuloides* Perk., *minutuloides* Perk., *minutula* K. var. *parvula* K., *minutula* K., *subopaca* Nyl., *proxima* K.

Group of A. WILKELLA.

A. ovatula K. (*afzeliella*), *wilkella* K., *similis* Sm., *dorsata* K.

The group of species with a white or yellow clypeus in the ♂ is composite, but need not on that account be rejected in dealing with our small fauna. Otherwise the groups are natural, though they would, of course, require modifications in their definition if a world, or even European fauna were under consideration, and also subdivision would be necessary. Even as they are here defined, many foreign species and some even from such distant localities as California or the Far East can be readily placed.

The species of *Nomada* might be arranged as follows :—

N. germanica Panz. (*ferruginata*), *argentata* H.-Sch. (*atrata*), *armata* H.-Sch., *guttulata* Sch., *obtusifrons* Nyl., *tormentillae* Alfk. (*roberjeotiana*), *rufipes* F. (*solidaginis*), *flavopicta* K. (*jacobaeae*), *sexfasciata* Panz., *fucata* Panz., *goodeniana* K. (*succincta*), *lathburiana* K., *marshamella* K. (*alternata*), *lineola* Panz., *bifida* Thoms., *baccata* Sm. (*alboguttata*), *hillana* K., *xanthosticta* K. (*lateralis*), *leucophthalma* K. (*borealis*), *bucephalae* Perk., *signata* Panz., *flava* Panz. (*ruficornis part.*), *ruficornis* L., *fabriciana* L., *conjungens* H.-Sch., *flavoguttata* K., *furva* Panz.

Group of A. TIBIALIS.

A distinct and well-marked group characterised by the strong rugosities of the anterior area of the propodeum, this area posteriorly, where it becomes declivous, always bounded or closed by a raised line or transverse rugosity.

In the males the abundance of hairs often interferes with a view of the area, and the following characters are very useful.

The clypeus is never white or yellow, the mandibles when closed always lie the one on the other, the tips not forming a cross, the third antennal joint (so far as British species are concerned) is always short, just equal to or sometimes a little shorter, but never at all longer than the 4th. In the ♂ genital armature the inner angles of the lobes of the stipites are always greatly and acutely produced, forming strong divergent spines. Comparatively few of our Andrenas have antennal characters as above, the 3rd joint being usually at least slightly longer than the 4th.

The females have the floccus of the hind trochanters perfect, and the abdomen never bears a special adornment of dense, short, white hairs on the apices of the intermediate segments forming conspicuous bands or lateral streaks. Except in *A. albicans*, the inner calcar of the hind tibiae is unusually long and curved and distinctive in appearance accordingly.

Group of A. flavipes (fulvicrus).

The two species *flavipes* and *gravida* (*fasciata*) might perhaps be included in the group of *nigroaenea*, but the appearance of the females is very distinct. Short decumbent white (or almost white) hairs form 3 dense and complete pale abdominal bands, covering the apical impressions on the 2nd, 3rd and 4th segments. When these bands are abraded the impressions exhibit a very dense and fine distinct puncturation, and this combined with the clear and copious or dense puncturation of the basal segment, renders old and worn examples not less easily determinable than fresh ones. The surface of the abdomen is practically glabrous apart from these bands. The scopae are red or yellow and the appressed hairs of the 5th abdominal segment black or dark fuscous. The, floccus is imperfect, the hairs of the basal part of the trochanter conspicuously different from the apical ones. The pygidial area is flat, without a raised median triangular portion.

The males are often less distinct in appearance, but are easily known by the definite minute sculpture on a large part at least of the surface of the lobes of the genital armature. The armature itself in its general form is commonplace, the inner angles of the lobes of the stipites either subrectangular or slightly produced. The head is without special characters, and the 3rd antennal joint is about equal to the next two together. The abdomen beneath has a general clothing of long hairs, and no special dense ciliation at the apices of the segments.

Andrena florea.

The position of this species is uncertain, the male genital armature being very remarkable. The sparsely clothed, shining and clearly punctured abdomen, which is usually more or less marked with red is characteristic of both sexes. The pygidial area is of the simple or flat form. Even if it cannot be included in either, it is clear that this species comes close to the group of *flavipes* and to that of *nigroaenea*. It is more remote from the group of *trimmerana*. The ventral segments of the ♂ have a specialised apical ciliation, and the floccus of the ♀ is not perfect.

Group of A. NIGROAENEA.

This group is typically represented by *nigroaenea*, *nitida*, *thoracica*, *cineraria*, *vaga*; less typically by *gwynana* and probably *ruficrus*, and with these may be included the more aberrant *angustior*.

The species are chiefly distinguished by negative characters. In the males the head is never of striking form, and the labrum is ordinary, not upturned, the mandibles never armed with a tooth at the base, nor are the lower occipital angles acutely produced backwards. The second abdominal segment in fresh examples has some distinct pubescence extending to the middle either in front or posteriorly or on the disc, or else the first segment has long hairs not confined merely to the sides. These hairs, however, are so thin and sparse in several species that they are easily abraded. There is no conspicuous adornment formed by minute dense hairs forming apical pale bands or lateral streaks on the dorsal abdominal segments.* In the females the floccus is never perfect, though in *cineraria* and *ovina* it is nearly so, and the appressed hairs

* Apparently a slight appearance of this is found in *ruficrus* and in some specimens of the second brood of *gwynana*.

of the 5th segment are dark or obscure, never clear yellow or golden, while the hind tibiae and their scopae are normal. As in the ♂♂ the abdomen lacks the pattern exhibited by the *wilkella* and *sericea* groups. The male genital armature is not remarkable, but *vaga* and *angustior* differ from the others in having the lobes of the stipites more or less broadly rounded at the apex.

It is convenient to consider our species as forming two subgroups, the first consisting of the (normally) large species, the males of which always have the 8th ventral segment showing a conspicuous hump or projection beneath before the apex when viewed laterally (*vaga*, *cineraria*, *nigroaenea*, *thoracica*, *nitida*): the other of (normally) medium-sized species, in which the outline of the 8th ventral segment beneath is at most a little sinuate (*gwynana*, *ruficrus* and *angustior*).

It must be remembered that the aberrant species *angustior* has close allies on the Continent with similar head-characters (lower occipital angles much produced backwards, mandibles long and strongly crossed at the tips, etc.), and of course the removal of such species to a group of their own would simplify the definition of the *nigroaenea* group.

Group of A. TRIMMERANA.

A very distinct group, the males distinguished at once by the fact that either the mandibles are simple at the apex, lacking the anteapical tooth seen in all our other species, or, if the mandibles are toothed, then the 3rd antennal joint is very short while the 4th is long and slender, appearing almost twice as long as the preceding on its shortest side, and the flagellar joints are shining beneath. The cheeks at the apex beneath always form a distinct slight angle, or else are there produced into a spine. In the females the 4th antennal joint is never transverse, generally appearing subelongate or at least a little longer than its width at the base, while the 5th is always distinctly elongate. In all the forms but one, the floccus is notably small and imperfect, but in *ferox* it is well-developed and perfect or almost so. The pygidial area is without a sharply raised median triangular area. Abdomen always with dense minute surface sculpture all over, never polished, the puncturation feebly impressed or subgranulate, sometimes practically effaced.

A. bucephala is remarkable for its highly aberrant genital armature in the male, while its ♀ is quite normal; *ferox* for the highly developed *floccus* and scopa in the female, while its male is comparatively closely allied to *spinigera*.

Group of A. varians.

This group is rather well represented with us, and the chief character of the males is to be found in the head and mandibles. The latter are always long and falcate, the tips forming a very distinct cross, never resting one along the other. In most of the species the mandibles are also armed with a distinct angulation or tooth on their lower edge at the base, and the lower occipital angles of the head are strongly produced backwards in a pointed form, the latter character being conspicuous also in those which lack the basal mandibular tooth.

But in *A. clarkella* the form of the head is less remarkable, though after removal of the pubescence it can easily be seen that the structure approaches that of the other members of its group, the lower occipital angles being hardly at all rounded off. Alfken wrongly separates this species from the *varians* group and places it next to *nigroaenea*, Saunders places it next to *fulva*, but then separates these from their proper allies by interposing *nigroaenea gwynana* and *angustior*, an unnatural arrangement. The species is best placed next to *apicata*, in my opinion. Some of the males of this group have the tubercle of the labrum upturned, as in the next following, but the different shape of the head and other characters readily separate them. The females are also quite distinct as a group by the entirely rugulose surface sculpture of the abdomen, nowhere polished, its feeble puncturation, long pubescence on the 1st and middle part of the 2nd segment at the least, together with the characters afforded by the perfect floccus, and the sharply raised triangular middle part of the pygidial area. The genital armature of the male has the lobes of the stipites well produced at the inner apical angle, but not acutely, and the sagittae are always widened by a rounding of their sides at the base. The 5th antennal joint is never very short and often slightly elongate.

The males of this group show some affinity to that of *trimmerana*, but it is probably more closely allied to the following.

Group of A. NIGRICEPS.

The males are easily characterised by the upturned tubercle of the labrum, combined with the fact that the head lacks the occipital characters of the preceding group and the mandibles are never armed with a basal tooth. Further the abdomen is distinctly banded with pubescence. The females also differ from those of the *varians* group in the distinctly banded abdomen, the less perfect floccus, some of the hairs at the base of the trochanter being comparatively thick and not much curved. In *fuscipes* alone the floccus is nearly perfect. All the species have the hind tibiae unusually wide apically, and the scopa on the outer surface of these is formed of hairs that are finer than usual, while those springing from the lower side are much less conspicuously curved up round the outer side of the joint.

Group of A. SERICEA (ALBICRUS).

We have but two species of this group. They are remarkable for the pale clothing of the males, which frequent sandy places, where the females form their colonies. Though not very long and falcate, the mandibles cross at the tips; the head and tubercle of the labrum are of ordinary form. The apical margins of the intermediate abdominal dorsal segments bear short white or pale hairs forming bands or lateral streaks. The inner apical angles of the lobes of the stipites are considerably, but not acutely, produced, and well separated from one another, the sagittae wide at the base from the rounding of the sides. In both sexes the basal abdominal segment is shining. The females have a perfectly formed *floccus*, and the abdomen has white apical bands on the intermediate segments; the scopa outwardly consists of silvery white hairs or of dark fuscous and silvery ones together, and the pygidial area is definitely and triangularly raised in the middle. There is a dense and distinct apical ciliation of the ♂ ventral segments.

Group of A. FULVAGO.

The alliance between the two species *fulvago* and *polita* is doubtful and certainly not very close, the differences between the male genital armatures being considerable and perhaps important. The flagellum in the ♂ of both species is shining beneath, in *fulvago* remarkably so. The 3rd joint of the antennae is subequal to or else much longer than the 4th. The abdomen has a very distinct puncturation, and the basal segment is shining or polished. The females have very large yellow scopae of plumose hairs, and the appressed hairs of the 5th segment of the abdomen are entirely yellow or golden. The floccus is perfect in form. As in the ♂, the abdomen is shining, the 2nd segment practically glabrous, except at the sides, and densely and distinctly punctured.

Group of A. WILKELLA.

Excluding the aberrant species *A. dorsata*, the members of this group are easily recognised and closely allied to one another. The males are commonplace in structure with short mandibles resting one on the other, and not forming a cross at the tips. The head has no peculiarities of form, and the tubercle of the labrum is ordinary. The 3rd antennal joint is at most rather longer or rather shorter than the 4th, never approaching the length of 4 and 5 united in any of our species. The 4th is more or less elongate, an important character to distinguish the males from some others in which this joint is either transverse or just as long as wide. The abdomen is rugulose all over, with very feebly impressed punctures, the basal segment never smooth and polished between these, 2nd segment with only very short hairs on the middle parts, the ventral segments with long apical cilia. The propodeum is well clothed with long hairs except on the anterior area itself. Male genital armature commonplace, the inner angles of the lobes of the stipites are not notably produced, and the sagittae basally are not dilated from a rounding of their sides.

The appearance of the females is more distinctive in this small group, the general surface of the abdomen almost glabrous, and bearing dense narrow bands (sometimes widely interrupted in the middle) of short white or almost white hairs on the apical margins of the intermediate segments. The sculpture is as described for the males, and the band of the 2nd segment is never entire. Floccus perfectly developed over the whole trochanter.

A. dorsata is in a wide sense a member of this group, but were we considering foreign species it might well be separated therefrom as a subgroup. Closely allied species resembling it in all important characters occur in Europe and N. America, and probably elsewhere. At first sight the male is a commonplace and obscure insect, not infrequently confused with other species in collections. It has most of the characters of the typical males of the *wilkella* group, but the 1st segment is sometimes quite shining, varying in different individuals, as does the puncturation, and the colour of the facial hairs and legs. It is remarkable for the long slender hind tarsi and rather thick hind tibiae, the whole length of the tarsi (excluding the pulvillus and claws) being not less than $1\frac{1}{2}$ times the length of the tibiae, whereas in the ♂♂ of other members of the group the tibiae are normal and the tarsi are not $1\frac{1}{2}$ times their length. The female is quite peculiar in its pollinigerous organs, though otherwise exhibiting the normal *wilkella* characters. The hairs of the propodeum are very long, plumose and strongly curved so that they form a pollen-basket almost completely closed in, the hind tibiae are strongly clavate, being very wide at the apex and with a very short fringe formed by the scopa on their upper edge; on the outer side the scopal hairs are fine, so that the dense puncturation of the tibia is easily seen beneath them; the hairs of the lower margin are comparatively little curved upwards over this surface. The floccus is decidedly imperfect, the hairs on the basal portion of the trochanter being much less curved and thicker and less plumose than those on the apical.

Group of A. NANA.

With one exception all of this group are minute in size, only one or two of our other species approaching them so closely in this respect that they could be mistaken. Clearly the group itself is closely allied to the preceding one.

The males have short mandibles closing one on the other, and no peculiarities of the head or labrum. The 3rd joint of the antennae is never greatly elongated, though distinctly longer than its apical width, longer too than the 4th which is generally wider than long, rarely about square in outline. The propodeum is unusually bare above though hairy at the sides, so that not only the anterior area is glabrous but the parts adjoining this are only slightly less exposed to view. The basal abdominal segment is minutely rugulose under a strong lens (except in one species), and the second, except at the sides, is bare except for the presence of very short hairs. In some of the species the anterior area of the propodeum is distinctly and densely rugose over its whole surface. The clypeus is never white or yellow, though often clothed with white hairs.

It should be impossible to mistake the ♂♂ of the minute species of this group for those of any other, because of the latter any the least liable to be confused either have a white clypeus or else the mandibles form a slight cross at the apex. As to the one larger species (*proxima*), its well-exposed propodeum with the anterior area densely and distinctly rugose right up to the posterior declivity, combined with the subglabrous abdomen, which has white apical lateral streaks on the intermediate segments, gives it a most distinct appearance.

The females resemble miniatures of the *wilkella* group, but are at once separable by the thin and imperfect floccus.

From small species in other groups the rugulose abdomen, not polished on the basal segment, separates most of these females, or if this is polished, the area of the propodeum is distinctly rugose to the declivity. The hind tibiae are black (sometimes pallid from immaturity), the scopae never conspicuously yellow.

Group of species with white clypeus in the males together with A. NITIDIUSCULA.

This is not a natural group as compared with the others, but, as said already, in our small fauna it is convenient to keep the species together. In my opinion the Andrenas with a white clypeus are primitive forms, some of which have given rise to groups of species with the ordinary black clypeus. We have not even a pair of species in this group which can be said to be very closely allied, the white-faced *chrysosceles* and black-faced *nitidiuscula* alone being comparatively nearly related to one another. *A. analis* bears to *A. coitana* somewhat the same relationship as *dorsata* does to the rest of the *wilkella* group. Apart from these, each other species appears to me to be isolated, and Morice has shown how *A. humilis* represents a considerable number of species on the Continent. In addition to the fact that the clypeus is white or yellow in all but one of our species, all the ♂♂ have a strongly elongated 3rd antennal joint (as compared with the 4th), this rarely being less than twice as long as the latter, and sometimes as much as three times the length.

A. chrysosceles and *nitidiuscula* are representatives of a well-marked group. The head of the ♂ is deeply emarginate behind, so that the lower occipital angles (seen from above) are quite strongly produced, the mandibles are rather long and form a distinct cross at the tips. The clypeus is remarkable in having a much more widely upturned apical margin than is normal in the genus. This is best seen when it is viewed from the base. The tubercle of the labrum is ordinary. Propodeum above sparsely clothed, so that not only on the anterior area but on a large space on each side the sculpture is easily seen. Scutellum with sparse or at least remote punctures, not very convex, rugulose all over; abdomen with the general clothing consisting of only very short hairs, shining and to the naked eye appearing nearly bare, the basal segment polished. Intermediate ventral segments with extremely dense specialised ciliation on their apical margins. Genital armature with the lobes of the stipites much rounded off at the angles, short or subglobose; sagittae expanded by rounding of the sides. Female in general characters like the ♂, the apical white fringes of the dorsal segments forming a more conspicuous pattern of bands or lateral streaks. Pygidial area without a sharply raised median triangular area. Floccus imperfect, the hairs of the basal portion of the trochanter comparatively short and little curved.

A. coitana and *tarsata*. In general facies, and in the greatly and somewhat sharply produced inner apical angles of the lobes of the stipites, as well as in the long hairs that clothe the ventral abdominal segments, a very dense and highly specialised apical ciliation being absent, these species resemble each other and are more closely allied to one another, than is either to any other species.

The following great differences are notable in the males. In *tarsata* the clypeus is somewhat widely margined, as in *chrysosceles*, the tubercle of the labrum is upturned, but does not rise above the curved apical margin of the clypeus, the mandibles are rather short and wide and repose one on the other, while the hind tibiae are more than usually wide or thick. In *coitana* the clypeus is very narrowly margined, the tubercle of the labrum ordinary, the mandibles longer and forming a distinct cross at the tips in some aspects, while the hind tibiae are long and slender.

In *tarsata* ♀ the hind tibiae are comparatively strongly clavate, very wide at the apex, the scopal fringe dense above them, and its longest hairs appear only about half the width of the tibiae at their apex. The floccus is imperfect, the hairs on the basal part of the trochanter much stiffer and straighter than the apical ones.

In *coitana* ♀ the hind tibiae are slender, with a very long and less dense scopal fringe above, the longest hairs appearing about equal in length to the width of the apex of the tibiae. The pollinigerous basket at the sides of the propodeum is quite rudimentary (in *tarsata* it is very fairly developed), but the floccus is perfect in form.

A. marginata (*cetii*) is not at all closely allied to *hattorfiana*, next to which it is placed, and with which it agrees in its habits and variability of coloration.

Head of ♂ deeply emarginate and the lower occipital angles rather strongly produced backwards, but not at all sharp. Apical margin of clypeus with the lateral angles forming strong prominent teeth, the tubercle of the labrum very wide, upturned above the clypeal margin between the teeth of which it forms a well-curved outline. Mandibles long and slender crossing at tips. Propodeum at sides of the area with long hairs. Abdomen with dense special ciliation on the ventral segments. Genital armature small, inner apical angles of lobes of stipites not the least produced, but obtuse, sagittae very narrow at the base.

Female well clothed with long hairs on the parts adjoining the anterior area of the propodeum; floccus rather thin but perfect, all the hairs very slender and plumose; hind tibiae slender, with very long scopal fringe above, this being also somewhat lax.

A. hattorfiana. Head ordinary, clypeus not produced into strong prominent teeth on each side, the tubercle of the labrum not upturned, emarginate apically. Ventral abdominal segments with a specialised and dense apical ciliation. Inner angle of lobes of stipites strongly produced, the production obliquely truncate or feebly rounded at the apex. Hind tibiae somewhat strongly clavate.

Female with the surface of the propodeum adjoining the anterior area sparsely clothed, the lateral pollen-basket very rudimentary, much as in *coitana*. Scopal fringe above the tibiae shorter and denser than in *marginata*, the floccus perfect.

Abdomen in both sexes polished, finely and remotely punctured, scopae and appressed hairs of 5th segment in the ♀ clear golden.

A. cingulata is entirely distinct in facies from any other of the genus, the pattern of colour and dense even punc-turation of the abdominal segments being distinctive. In the ♂ the head, together with the labrum and mandibles, is not at all modified; the latter when closed rest one on the other.

The genital armature is very large and remarkable, the lobes of the stipites only touching for a small space, the inner apical angles rounded off and receding, the processes in dorsal view divergent at their apices with an obliquely truncate or very faintly rounded margin, forming an apical acute angle.

In the ♀ the floccus is perfect, the surface of the pro-podeum above well exposed, the abdomen almost glabrous, though dull.

A. humilis. Head and tubercle of labrum ordinary in the ♂, the mandibles resting one on the other to the apex. Propodeum above (adjoining the anterior area) with long pubescence. Abdomen conspicuously pubescent to the naked eye, without special pattern, the basal segment with notably granular puncturation. Genital armature with the inner apical angle very strongly produced, forming long subdivergent processes.

Female with the basal abdominal segment at least towards the sides with granular punctures, no distinct abdominal pattern formed by the pubescence, 5th and 6th segments with golden hairs. Hind tibiae with long scopal fringe of evidently plumose hairs above, the scopae large and golden, the floccus perfect, of plumose hairs throughout.

A. labialis. Not related to any other of the species with white clypeus and should probably be placed closer to the group of *nigroaenea* with the larger species of which and to that of *flavipes* it shows affinity. Head of ♂, and tubercle of labrum ordinary, the mandibles resting one on the other, not forming a cross at the apex. Genital arma-ture with the inner angle of the lobes of stipites not pro-duced, nearly rectangular, the lobes polished, not rugulose as in the *flavipes* group. Eighth ventral segment with its process much like that of *vaga*. The intermediate ventral segments with special ciliation, excessively dense on the 5th.

Both sexes with the abdominal surface shining between the distinct punctures, the apical impressions of the 2nd and 3rd densely and distinctly punctured, a distinct pattern of narrow and interrupted bands formed by dense short white or whitish hairs on the apices of segments 2–4.

Scopa of the ♀ normal, floccus almost perfect, much as in *vaga* or *cineraria*.

In the following tables the natural sequence of the species is not kept in the case of the Andrenas, while the species of *Nomada*, on the other hand, follow in almost natural order, excepting *N. fabriciana*, which might probably be best placed next to *flavoguttata*.

The antennal characters are most easily observed in specimens which have these organs more or less at right angles to the long axis of the head, and the measurements are always to be taken from the front or lower side of the joints, the insect being held with its head towards the observer.

The floccus is best seen when the specimen is held as above, but with the back downwards. Bees that carry a load of pollen should be boxed alive and allowed to free themselves from this.

A "perfect" floccus is one in which the hairs that spring from the basal part of the trochanter are soft, plumose and much curved, and differ very little from those on the more apical part. If the basal hairs are stiffer or straighter and do not adapt themselves to the curve of the others, the floccus is imperfect. These differences will be at once appreciated if such a species as the common *A. trimmerana* is compared with any member of the group of *A. varians*. In other countries there are species in which there is no true floccus at all, but we have no such forms in Britain.

Table of ♂ Andrena.

1. (16) Clypeus yellow or white.
2. (3) Second and 3rd abdominal segments red, forming a broad band between the black basal and apical segments; a large white spot on either side of the white clypeus. *cingulata.*
3. (2) Second and 3rd segments not all red.
4. (5) Clypeus with the anterior angles forming strong prominent

teeth, the labral tubercle upturned and forming a curved outline between the teeth of the clypeus (easily seen if the head be viewed from beneath). . . . *marginata.*

5. (4) Clypeus and labrum otherwise.
6. (7) A very large species with strongly infuscated wings, shining abdomen and thorax and the clypeus only yellow (no lateral spots outside this). . . . . . *hattorfiana.*
7. (6) If large, the species have a dull thorax and abdomen, or else a large lateral yellow spot on either side of the clypeus.
8. (11) Mesonotum and scutellum conspicuously shining or polished between the punctures; small species.
9. (10) Clypeus and a spot on either side of it yellow, hind tarsi dark, the hind tibiae slender. . . . . . *coitana.*
10. (9) Clypeus only pale, hind tarsi clear testaceous, hind tibiae thick. . . . . *tarsata.*
11. (8) Mesonotum and scutellum with rugulose sculpture between the punctures, not polished.
12. (13) Basal abdominal segments with many of its punctures set in conspicuous granulations. . . . . . *humilis.*
13. (12) Basal abdominal segment not granulately punctate.
14. (15) Basal abdominal segment strongly punctured, well clothed with longish hairs all over; lateral facial spots large. *labialis.*
15. (14) Basal abdominal segment very finely punctured, to a large extent nearly glabrous; lateral facial spots small or absent. . . . . *chrysosceles* K.
16. (1) Clypeus black.
17. (24) Anterior area of the propodeum more or less coarsely rugose and always bounded behind at the middle (on or near the edge of the posterior surface) by a raised line or transverse rugosity. (The mandibles are always short and lie one on the other, the tips not crossed; the 3rd antennal joint is never at all longer than the 4th.)
18. (19) Second abdominal segment clothed only with very short hairs, the hind tarsi and the hind tibiae (to a large extent at least) clear testaceous or yellow. . *albicans.*
19. (18) If the hind tarsi and tibiae are largely clear testaceous the abdomen has abundant long hairs. (In all the following species of the section the 2nd segment has long or longish hairs on the middle, except in abraded examples.)
20. (21) Hind tibiae with black hairs. . . *carbonaria* (*pi ipes.*)
21. (20) Hind tibiae with pale hairs.
22. (23) Hind tarsi and tibiae dark, black or pitchy. . *bimaculata.*

23. (22) Hind tarsi and usually the apices of the tibiae (except in some stylopised examples) conspicuously red or yellow. *tibialis.*
24. (17) Anterior area of propodeum not bounded posteriorly by a raised line or rugosity, or if conspicuously rugose all over, the 3rd antennal joint is at least slightly longer than the 4th.
25. (36) Third joint of antennae extraordinarily short, seen from in front only from $\frac{1}{2}$ to $\frac{2}{3}$ the length of the strongly elongated 4th, and not or hardly longer than its own apical margin; flagellum shining beneath.
26. (35) Mandibles ordinary, having a more or less distinct tooth before the apex.
27. (34) Cheeks usually forming merely a small prominent angle at the base of the mandibles, rarely with a distinct elongate spine; if the latter is present the face beneath the antennae is largely clothed with pale hairs.
28. (31) Abdomen without evident red or yellowish markings above or beneath, at most the apices of the segments subtestaceous.
29. (30) Face beneath the antennae with the hairs brown and black or often nearly all brown (fading to pale ochreous). *trimmerana* Auct.
30. (29) Face beneath the antennae with black hairs. *trimmerana* var. *scotica.*
31. (28) Abdomen either above or beneath or on both surfaces with evident red or yellowish markings, at least on some of the basal segments.
32. (33) Apices of hind tibiae more or less pale. *spinigera* var. *anglica* (= *trimmerana* K.)
33. (32) Apices of hind tibiae not pale, but concolorous. . *rosae.*
34. (27) Cheeks with an elongate spine at the mandibular articulation and the face densely black-haired, sometimes with a few greyish ones intermixed. . . *rosae* var. *eximia.*
35. (26) Mandibles simple, without a distinct tooth before the apex. . . . . *spinigera* K.
36. (25) Third joint of antennae not extremely short as in the above section.
37. (40) Mandibles simple, no tooth on the upper margin towards the apex.
38. (39) Third antennal joint shorter than the 4th, hind tibiae yellow. *ferox.*
39. (38) Third antennal joint not shorter than the 4th, hind tibiae at least for the most part dark. . . . *bucephala.*

40. (37) Mandibles always with a tooth before the apex.

41. (52) Mandibles at the base always armed with a distinct angular tooth on the lower margin, the mandibles themselves always very long, falcate, strongly crossing at the tips.

42. (43) Third joint of the antennae very elongate, about twice as long as the short 4th joint, this latter nearly square in outline (thorax and abdomen in fresh examples with fulvous hairs). . . . . *fulva.*

43. (42) Third joint sometimes considerably longer than, but not nearly twice as long as, the 4th, and the latter is itself quite elongate.

44. (49) Propodeum clothed with pale fulvous hairs, fading to pale ochreous or whitish; very few or no black hairs; thorax above in fresh specimens with fulvous clothing.

45. (48) Hind tarsi often entirely or at least with the apical joints clear testaceous; or else the mandibular basal tooth is short and wide, forming a simple angulation.

46. (47) Ventral abdominal segments with excessively dense fringes of white or almost white decumbent hairs, so that the abdomen beneath has very conspicuous and beautiful dense bands; tubercle of labrum, viewed from above when the clypeus is in the horizontal plane, narrower in comparison to the width between the angles of the front margin of the clypeus, and not distinctly emarginate. . . . . *helvola.*

47. (46) Ventral abdominal segments with the fringes less dense and distinct, the tubercle of the labrum wide and distinctly emarginate. . . . . *fucata.*

48. (45) Hind tarsi blackish or dark brown; mandibular basal tooth comparatively long and narrow, strongly prominent, except as an unusual aberration. . *lapponica.*

49. (44) Propodeum clothed with pale hairs and on some part at least with many black hairs, the whole thorax above in fresh examples much less bright, more grey than in the preceding.

50. (51) Process of 8th ventral segment of the abdomen distinctly emarginate at apex; mandibular tooth usually broader and blunter and the 3rd antennal joint rather less elongate than in *apicata*. . . . . *praecox.*

51. (50) Process of 8th ventral segment rounded or truncate at apex, not distinctly emarginate. . . . . *apicata.*

52. (41) Mandibles at the base not armed with a distinct tooth on the lower margin, but at most with the margin somewhat rounded at that point.

53. (56) Lower occipital angles of the head very strongly acutely produced backwards, the abdomen clothed with long pale hairs on the basal segment and on the middle of the second, forming more or less of a tuft there, the rest inconspicuously hairy from the shortness of the hairs, and never with pale bands or fasciae.

54. (55) Third antennal joint very much longer than the 4th, which is short, nearly square in outline, as seen from in front. . . . . *varians.*

55. (54) Third antennal joint somewhat longer than the 4th, which in the same aspect as above appears very distinctly elongate. . . . . *synadelpha.*

56. (53) Lower occipital angles very seldom strongly and subacutely produced, and if so formed, then the abdomen is quite different in clothing from that of the above section.

57. (66) Tubercle of the labrum upturned, so that in an apical view of the head it interrupts the apical margin of the clypeus.

58. (63) Head seen from above with the hind angles simply rounded off, normal.

59. (60) Clypeus well clothed, but if viewed somewhat from the side the surface and sculpture beneath the hairs is easily seen; apical hair-bands of abdominal segments 3 and 4 almost perfectly decumbent concealing the surface beneath (3rd antennal joint hardly longer than the fourth). . . . . *fuscipes.*

60. (59) Clypeus * very densely clothed, so that, viewed somewhat from the side, the surface is not, or hardly at all, visible; apical hair-bands of 3rd and 4th segments less appressed and the surface beneath, which is smooth and often shining, is easily seen.

(In normal examples the 3rd antennal joint is conspicuously longer than the 4th, the latter often nearly square in outline or very little elongate.)

61. (62) † Abdomen very pubescent, so that to the naked eye its

* I know no other character that can be of much use in a table, and it is necessary to have well-preserved specimens. The antennal joints, the reflexed margin of the 6th ventral segment and apex of the 8th all vary in this group. Normally *fuscipes* has the abdomen less distinctly punctured than the two following species.

† These two species are generally easy to distinguish, but very difficult to tabulate, as most of the characters vary. In normal examples *simillima* is the smaller species, with more elongate and slender 3rd antennal joint, and with the dense white fasciae formed

black colour is not very noticeable; hairs of clypeus, those beneath the cheeks and on the thorax beneath and basal parts of the legs, or on some of these parts distinctly fulvescent. . . . . *nigriceps.*

62. (61) Abdomen much less pubescent to the naked eye and the abdomen much blacker; hairs of clypeus, those beneath the cheeks, and on the underparts of the thorax, coxae and trochanters usually white (unless stained by pollen). *simillima.*

63. (58) Head seen from in front of abnormal shape, the hind angles a little prominent or turned outwards.

64. (65) Third and 4th abdominal segments, viewed laterally, clothed with very short erect pale hairs in front of the apical bands; cheeks ordinary. . . . . 3-*dentata.*

65. (64) Third and 4th segments with very short erect black hairs; cheeks forming a small prominent angle at the mandibular articulation . . . . *denticulata.*

66. (57) Tubercle of labrum not upturned.

67. (90) Extremely small species, the mandibles always short, the one resting on the other and not forming a cross at the tips; general surface of 2nd abdominal segment nearly glabrous, with only very minute hairs.

(Fourth antennal joint short, generally transverse, rarely as long as broad, never elongate.)

68. (71) First two abdominal segments shining or polished between the punctures, the 2nd densely and distinctly punctured, sometimes so closely that hardly any surface remains between the punctures.

69. (70) Abdomen beneath dull or hardly at all shining; claw joint of hind tarsi dark. . . . . *nana* K.

70. (69) Abdomen beneath shining, claw-joints clear yellow, stigma of front wings very conspicuously pale. . . *alfkenella.*

71. (68) First two segments of the abdomen not distinctly shining, but one or both are largely dull from the minute sculpture of the surface.

72. (75) Whole face clothed with blackish or sooty grey hairs.

73. (74) Stigma very pale even when viewed on the undersurface, claw-joints of tarsi clear yellowish; 2nd abdominal segment with numerous distinct but shallow punctures. *moricella.*

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by the apical ciliation of the ventral segments rather more clearly defined than in *nigriceps.* The latter often has numerous black hairs on the basal part of the 5th and sometimes of the 4th abdominal segments.

74. (73) Stigma much more obscurely pale in the middle, often darkish brown, especially when viewed from beneath, claw-joints of tarsi usually dark and the 2nd abdominal segment often impunctate or nearly so, or with extremely feeble punctures. . . . . *parvula.*

75. (72) Whole face not clothed with black or sooty grey hairs, the clypeus at least with pale brown, yellowish, or white hairs.

76. (79) Face at the sides beneath the insertion of the antennae, generally the median space between the antennae and base of clypeus, and some other parts of the head quite evidently bearing black hairs, easily seen in lateral aspect of the head.

77. (78) White streaks of short hairs on the apices of the 2nd and 3rd abdominal segments much less conspicuous or hardly noticeable in dorsal aspect; mesonotum more remotely punctured (♂ not found after the beginning of June). . . . . *parvuloides.*

78. (77) White streaks conspicuous in dorsal aspect; mesonotum generally closely and evenly punctured (♂ not before the middle of June). . . . . *minutula* var.

79. (76) Face with few or no black hairs beneath the antennae.

80. (81) The impressions on the apices of the 2nd and following segments are deep, dull and very densely sculptured, with the appearance of excessively close, minute punctuation; the basal segment is similarly sculptured along its apical margin; stigma pale, clypeus with white hair. . . . . *spreta.*

81. (80) Sculpture of apices of the first three abdominal segments not dense enough to make them dull as in the preceding, often the apices of some or all of them are shining in some aspects.

82. (83) Second and 3rd abdominal segments with strong apical impressions (especially the 3rd) which in most aspects are brightly shining or highly polished, the surface sculpture feeble or hardly visible; stigma pale; long snow-white hairs on the clypeus. . . . *saundersella.*

83. (82) Second and 3rd segments with the impressions shallower and the surface sculpture much more evident, so that in most aspects the surface is much less polished than in the preceding.

84. (85) Fifth antennal joint short, transverse, not much longer than the 4th, the 3rd as long, or all but as long, as 4 and 5 together. . . . . *falsifica.*

85. (84) Fifth antennal joint more nearly square, not appearing transverse, in outline, differing notably from the 4th.
86. (87) Mesonotum very dull, the punctures remote and very fine, sometimes wanting, or hardly visible amid the surface sculpture; scutellum never polished, at most rather less dull than the mesonotum. . . . . . . *subopaca.*
87. (86) Mesonotum generally either very conspicuously or more or less closely punctured, sometimes more or less shining, the scutellum often, in part at least, with polished surface.
88. (89) Mesonotum normally closely and evenly punctured, the face beneath the antennae in fresh examples with yellowish or yellowish-brown hairs. . . . *minutula.*
89. (90) Mesonotum normally more irregularly punctured, often more or less highly polished, the scutellum usually with some part at least polished; hairs of the face white. *minutuloides.*
90. (67) Species generally at least medium-sized, those comparable in size and appearance with the *minutula* group have the mandibles forming a distinct cross at the tips in apical view.

    (Many but not all species have the 4th antennal joint longer than wide.)
91. (92) Hind tibiae and metatarsi translucent yellow, the former at most partly subinfuscate; basal abdominal segment polished and clearly punctured. . . . . *fulvago.*

    (Flagellar joints of antennae shining beneath and in some aspects with narrow basal pubescent bands; mandibles short, not crossing at the tips; ventral abdominal segments with long specialised ciliations.)
92. (91) Hind tibiae usually dark or pale only at the apex; if as above the basal abdominal segment is not polished.
93. (94) Normally a large species, with white-haired clypeus, the abdomen polished and clearly and copiously punctured all over, the apical impressions conspicuously pale and without dense white hair-bands. . . . . . *polita.*

    (Antennae with the flagellum more or less shining beneath, the 3rd joint strongly elongated, about twice as long as its apical width; mandibles not forming a cross at the tips; ventral segments with long specialised ciliation.)
94. (93) Those of the following species that are large and have a white-haired clypeus, have not all the abdominal characters of *polita,* as given above.
95. (96) Sides of head behind the eyes with the hind margin conspicuously raised or thickened. . . . *nitidiuscula.*

(A small species with the lower occipital angles strongly produced backwards, the clypeus abnormal, its apical margin strongly reflexed or upturned, and behind this flattened (or impressed) smooth and shining.)

96. (95) Sides of head behind the eyes normal.

97. (112) Third joint of antennae as long as the two following together and about twice as long as its apical width, or still longer in some species.

98. (99) A small or rather small species, the apices of the apical impressions of the abdominal segments 2–4 with dense white fasciae, their general surface practically glabrous, except for very minute hairs. . . . . . *argentata.*

99. (98) Abdomen with long hairs on some of these segments or without dense white fasciae.

100. (101) Abdomen under a strong lens dull, minutely rugulose all over, the puncturation effaced, clothed all over with long hairs. . . . . *clarkella.*

(Mandibles long, crossing at tips; lower posterior angle of the head behind the eyes in lateral view subrect-angular, at most a little rounded off.)

101. (100) Abdomen either more or less shining or considerably punctured or both.

102. (109) Clypeus with white hairs, at most very slightly tinged with yellow; abdomen without red markings.

103. (104) A large species, the thorax clothed with white or whitish hairs, the abdomen shining nearly glabrous and impunctate above, and without special apical ciliation of its segments beneath. . . . . *vaga.*

104. (103) Abdomen clothed with a good deal of pubescence or punctured or both.

105. (106) Head seen from above deeply emarginate, its lower angles strongly and subacutely produced, but the angles themselves are rounded off. . . *angustior.*

106. (105) Head ordinarily emarginate.

107. (108) Basal abdominal segment polished, generally with some shallow, often ill-defined, longitudinal fluting on its apical portion; ventral segments with apical bands of dense white cilia. . . . . *sericea.*

108. (107) Basal segment punctured; ventral segments with long fine hairs and no conspicuous apical ciliation. *fasciata.*

109. (102) Clypeus with distinctly yellow, brown or black hairs or with these mixed.

110. (111) Abdomen black, the apical impressions of the 2nd and

following segments bearing short dense pale hairs, forming bands. . . . . *flavipes.*

(Ventral segments without highly specialised ciliations.)

111. (110) Abdomen red-marked, nearly glabrous to the naked eye. *florea.*

(Ventral segments with highly specialised apical ciliations.)

112. (97) Third antennal joint evidently shorter than 4th and 5th together, often very much shorter.

113. (113*a*) Legs and face both with black hairs. . . *thoracica.*

113*a*. (113) Legs and face not both with black hairs.

114. (117) Clypeus with white hairs, 1st and disc at least of 2nd segment with long or longish pubescence, apices of 3rd and 4th segments without short hairs forming pale lateral streaks.

(Species large in normal specimens.)

115. (116) Thorax with fulvous hairs in fresh examples; hind tibiae fringed with pale hairs above. . . . . . *nitida.*

116. (115) Thorax with white or whitish hairs, generally mixed with black; hind tibiae with black hairs. *cineraria.*

117. (114) If the clypeus is white-haired the 2nd abdominal segment is glabrous (or bears only very short or few hairs) on the disc; abdomen in some species with distinct pale fasciae or lateral streaks of short hairs on the 2nd and following segments.

118. (121) Clypeus never white-haired, often clothed largely or wholly with black; if covered with brown or fulvous hairs the 2nd abdominal segment has conspicuous long hairs on the middle.

119. (120) Mandibles in apical view of the face with the tips crossing when closed, 3rd antennal joint seen from in front under a strong lens, without distinct projecting hairs beneath. . . . . *nigroaenea.*

120. (119) Mandibles in apical view not forming a cross at the tips, when closed; 3rd antennal joint under a strong lens with distinct short black hairs projecting in the arch beneath. . . . . *gwynana.*

121. (118) Clypeus in some species white-haired, never black-haired; when clothed with brown or fulvous ones the 2nd segment bears only short hairs in the middle or may appear nearly glabrous there.

122. (123) Clypeus with white hairs, those on the sides of the face bordering it, as is easily seen in lateral view, are black. . . . . *ruficrus.*

(Size of *gwynana*, abdomen with the puncturation nearly effaced, the surface dull, 2nd, 3rd, and 4th segments beneath with dense conspicuous ciliation of white hairs on their apical margins.)

123. (122) Clypeus often with fulvescent or brown hairs if it is white-haired, it is not bordered with black ones along its sides.

124. (125) Fourth joint of antennae short, nearly square in outline or even transverse in some examples; area of the propodeum conspicuously and evenly rugose all over, the wrinkles waved or vermiculate. . . *proxima.*

(Clypeus with white or almost white hairs, sometimes slightly brown-tinged basally.)

125. (124) The 4th antennal joint appears distinctly elongate, sometimes as long as the 3rd; propodeum never sculptured like that of *proxima.*

126. (127) Hind tarsi long and slender, in dorsal aspect the 3rd joint is twice as long as its apical width. . *dorsata.*

127. (126) Hind tarsi with the 3rd joint in dorsal aspect not twice as long as its apical width.

128. (129) Fourth abdominal segment without an entire or almost unbroken narrow apical band, this and the 3rd having at most remnants of bands towards the sides. *similis.*

(Hairs of clypeus white in fresh examples, 3rd antennal joint a little longer than the 4th.)

129. (128) If not abraded the 3rd and 4th segments of the abdomen have pale fasciae, that on the 3rd either entire or interrupted on the middle 3rd of the segment, that on the 4th entire or at least almost uninterrupted in the middle.

130. (131)* In good specimens the 3rd segment has a distinctly entire or hardly perceptibly broken band, and the antennae are always shorter than in the following, but vary in details. . . . . *ovatula.*

131. (130) The band on the 3rd segment is interrupted or very indistinct for a space about equal to one-fourth or one-third the width of this segment; the antennae are more elongate. . . . . *wilkella.*

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* I cannot satisfactorily tabulate these species from worn examples, as they can be distinguished only by slight characters (differing only in degree) if abraded.

TABLE OF ♀ ANDRENA.

A. (B) Very small (at most about 7 mm. long) black-bodied species, with dark hind tibiae; abdomen with the general surface above glabrous, the basal segment in nearly all dull from the surface rugulosity, as seen under a strong lens; if it is polished as in *nana* K. the propodeum has dense and (for the size of the insect) strong rugosities over the whole of its anterior area.

(Scopa pale, floccus imperfect, area of propodeum well exposed, the hairs around it being sparse.)

1. (2) Basal abdominal segment polished and with a copious distinct puncturation, the 2nd clearly and finely punctured, the punctures as dense as possible except on the apical impression, which has only sparse and shallow puncturation. . . . . *nana.*

2. (1) Basal segment rugulose, rarely shining, the 2nd with very feeble punctures amidst the rugulosities of the surface or without punctures.

3. (4) Nearly the whole flagellum beneath and the apical joint at least above red; basal abdominal segment distinctly shining on the disc, the minute surface sculpture hardly visible under a strong lens, except on the apical margin. *nanula.*

4. (3) If the antennae are coloured as above, there is a dense surface sculpture on the basal abdominal segment, making it quite dull on the disc.

5. (6) A dense snow-white band occupies the whole apical impression of the 4th abdominal segment, concealing the surface, except that there may be a slight interruption in the middle. . . . . *spreta.*

(Apical impressions of 2nd and 3rd segments with very dense sculpture or minute puncturation, the 3rd segment with the impression deep; stigma pale yellow.)

6. (5) Apical impression of 4th segment not so concealed, the hairs being so spaced that the surface is visible between them, and in some species there is only a scanty fringe.

7. (8) Apical impression of 3rd segment deep, this and often that of the 2nd brightly shining or polished in some aspects, the surface sculpture being faint or hardly visible. *saundersella.*

(Stigma pale in the middle; the anterior area of the propodeum nearly always with the rugosities failing posteriorly, where the surface appears merely granulate.)

8. (7) Minute sculpture of apices of 2nd and 3rd segments distinct, the apical impression of the 3rd never polished as in *saundersella*, and generally only shallow.

9. (12) Second abdominal segment always with more or less numerous punctures, often excessively faintly impressed, and difficult to see definitely amongst the surface sculpture, nevertheless always to be distinguished in one position or another.

10. (11) Basal abdominal segment along the apical margin with excessively dense sculpture (almost as in *spreta*) and quite dull, the surface there of normal form, only ordinarily convex.

(Stigma pale with dark lower border.)

alfkenella and *moricella*.

11. (10) Apical portion of basal segment with the minute sculpture very fine or feeble, so that in some aspects this part appears more or less shining; the surface is unusually convex and gives to the apical margin an appearance of being thickened (anal appressed hairs darkish fuscous).

falsifica.

12. (9) Second abdominal segment impunctate or nearly, never with an extensive system of obsolescent puncturation as in the preceding, often a few very feeble punctures at the sides.

13. (14) Mesonotum and scutellum rugulose all over, dull, with excessively fine punctures usually hardly visible as minute points amidst the sculpture on the former, the appressed hairs of 5th segment always dark, sometimes with more or less golden tint. . . . . . . *subopaca*.

14. (13) Mesonotum and scutellum with closer or larger punctures, the scutellum (and sometimes the mesonotum) more or less shining in some forms, appressed hairs of 5th segment in some golden.

15. (16) Abdomen in dorsal view with distinct dense apical fringes of short hairs on the sides of the 2nd and 3rd segments in fresh examples. . . . . *parvula* and *minutula*.

16. (15) Abdomen in dorsal view with the lateral streaks not or hardly noticeable, and appearing extraordinarily free from any special marking in consequence.

parvuloides and *minutuloides*.

B. (A) Species rarely only 7 mm. long; one or two agree in most of the characters, and these small ones have the basal abdominal segment polished as shown in *nana* K. alone of the preceding group, but have not the dense even rugosity over the whole anterior area of the propodeum as in that species.

1. (12) Anterior area of the propodeum strongly rugose and always bounded posteriorly just on the brow of the declivity by a raised edge or transverse rugosity; the species that have the 2nd abdominal segment glabrous on the disc lack a pattern formed by dense short pale hairs on the apical margins of the 3rd and 4th segments.
(Very distinct and copious abdominal punctures always present.)
2. (5) Appressed hairs of 5th abdominal segment golden or golden red.
3. (4) Thorax densely clothed with bright brown or fulvous hairs. *albicans.*
4. (3) Thorax not thus clothed. . . *carbonaria* var. *praetexta.*
5. (2) Appressed hairs of 5th segment black or dark fuscous.
6. (7) Thorax beneath and propodeum at the sides with black or sooty hairs, scopae beneath silvery white. . *carbonaria.*
7. (6) Thorax beneath propodeum at sides not black-haired, scopae not silvery white beneath.
8. (9) Hind tibiae clear yellow or reddish beneath the scopa. *tibialis.*
9. (8) Hind tibiae dark.
10. (11) Abdomen more or less red-marked above or beneath. *bimaculata* and var. *decorata.*
11. (10) Abdomen not red-marked. *bimaculata* var. *conjuncta* and var. *vitrea.*
12. (1) Anterior area of the propodeum rarely strongly rugose (the rugosities often fading out posteriorly) and not bounded on the brow of the declivity by a raised edge or transverse rugosity. When this area is strongly rugose all over, the abdomen has an almost glabrous 2nd segment, and the two following have dense pale pubescent streaks on their apical margins.
13. (14) Hind tibiae translucent yellow, the mesonotum and scutellum to a large extent at least with black hairs. *tarsata.*
(Hind tibiae unusually wide at the apex and with short scopal fringe above, abdomen nearly glabrous above with more or less distinct bands or streaks of short pale hairs.)
14. (13) When the tibiae are clear yellow, the thorax is not largely clothed with black hairs.
15. (16) General surface of the abdomen glabrous, the 2nd, 3rd, and 4th segments with dense pale streaks or narrow

fasciae of short hairs on the apical margins, the hind tibiae abnormally wide at the apex and with dense short scopal fringe above. . . . . *dorsata.*

(The scutellar-post-scutellar region very densely hairy, the hairs on each side of the propodeum forming a pollen basket almost completely closed in and more perfect than in any other species.)

16. (15) When the abdomen is as above, the tibiae are normal in shape and the scopal fringe long.

17. (26) General surface of the abdomen glabrous, basal segment never polished between the punctures, but rugulose under a strong lens, the 2nd, 3rd, and 4th segments with a pattern formed by dense, narrow apical bands or lateral streaks of pale hairs, and covered with fine, shallow punctures; these bands are formed only on the hind margin of the apical impressions of the segments. Scopae yellow or golden.

(Floccus of hind trochanters perfect.)

18. (19) Hind tibiae wholly or for the most part dark. *ovatula* var. *fuscata.*

19. (18) Hind tibiae clear yellowish.

20. (21)* Scutellum posteriorly and post-scutellum very densely clothed with bright brown hairs (in fresh examples) hardly less densely than at the sides of the former. *similis.*

(Apical band of 3rd abdominal segment always widely broken, appressed hairs of 5th segment always golden, wings fulvescent.)

21. (20) Clothing of hind margin of scutellum and that of the post-scutellum not unusually dense, less dense than that at the sides of the former.

22. (23) Appressed hairs of 5th segment fuscous or sordid. *ovatula.*

23. (22) Appressed hairs of 5th segment golden.

24. (25) Wings clear or almost clear hyaline; band of 3rd abdominal segment entire in fresh examples. . . . *ovatula* var.

25. (24) Wings subfulvescent; band of 3rd segment broken in the middle. . . . . *wilkella.*

26. (17) Species with a glabrous abdomen and a distinct pattern of narrow bands or streaks, as described in 17, have the surface of the basal segment shining between the punctures or lack the dense puncturation.

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* Although this and the following species are distinguishable in worn examples by slight differences in sculpture, etc., I am unable to satisfactorily tabulate them on these characters.

27. (30)* Second and 3rd abdominal segments as densely punctured as possible, with the general surface glabrous, and complete pale fasciae of dense minute hairs filling (or almost filling) the whole of their apical impressions; scopae yellow or golden, the appressed hairs of the 5th segment black.

(Floccus of hind trochanters imperfect, the hairs on the basal portion too straight and stiff to form a part of it.)

28. (29) Pubescence of thorax beneath and the basal parts of the legs with pale brown or ochreous hairs; face beneath the antennae not white-haired. . . . . . *flavipes.*

29. (28) Pubescence of thorax beneath and basal parts of the legs as well as the face beneath the antennae with white hairs. . . . . *gravida.*

30. (27) If appressed hair-bands fill the apical impressions of the 2nd and 3rd segments, either the 2nd segment is pubescent or the puncturation is not as dense as possible.

31. (32) Abdomen more or less marked or banded with red or yellow; basal abdominal segment polished, remotely but distinctly punctured on the disc; scopal fringe above the tibiae and appressed hairs of 5th abdominal segment dark. . . . . *florea.*

32. (31) If the abdomen is marked with red or yellow either the basal abdominal segment is not polished or the anal fringe is golden.

33. (42) The abdomen has broad pubescent apical bands on the segments, and the tibiae and their scopae are evidently abnormal; the former wide at the apex and therefore more clavate than usual (Pl. XII, f. 10), the scopal fringe above them dense and short in proportion to the apical width of the joint, while on its outer side the hairs are less dense and finer than usual and those that curve upwards from beneath less curved and conspicuous.

(Floccus in most species distinctly, but in *fuscipes* hardly, imperfect.)

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* It is important to notice that the bands are formed of hairs that spring from almost the whole surface of the apical impressions, as otherwise some *ovatula* might be confused with the species falling under the above head. When worn and abraded, *flavipes* and *gravida* remain easily distinguishable by the extremely dense and fine puncturation of the apical impressions considered in conjunction with the other characters given above. Not infrequently the bands are slightly interrupted in the middle in caught specimens, but this is not the natural condition.

34. (41) Mesonotum clothed with fulvous or bright brown hairs and without black ones.
35. (36) Face with black or sooty hairs; hind coxae and at least the basal part of the trochanters beneath with dark hairs. . . . . *nigriceps.*
36. (35) Face with much pale hair; that on the hind coxae beneath and the trochanters pale.
37. (40) Appressed hairs of 5th abdominal segment black or fuscous, not nearly concolorous with the apical pubescent band of the 4th segment.
38. (39) Under a strong lens the 3rd abdominal segment has a shallow but dense and distinct (often granulate) punc-turation on most of its surface; floccus notably imper-fect, many thick stiff white hairs on the basal part of the trochanter beneath. . . . . *simillima.*
39. (38) Under a strong lens the 3rd abdominal segment has a very feeble puncturation often appearing merely as minute granules, its apical hair-band entirely appressed (not formed partly of subdecumbent or suberect ones as in the preceding species); floccus pale ochreous, very dense and all but perfect. . . . . *fuscipes.*
40. (37) Appressed hairs of 5th abdominal segment quite pale and concolorous (or almost so) with the preceding hair-band; scopae pale brownish, or yellow. . . . *tridentata.*
41. (34) Mesonotum and often the scutellum clothed to a consider-able extent with black hairs. . . . . . *denticulata.*
42. (33)* Hind tibiae not abnormal as described under 33; many of the species are without wide and distinct hair-bands.
43. (44) Basal abdominal segment strongly and densely punctured, shining between the punctures, and with a clothing of long thin pubescence; 2nd, 3rd, and 4th segments with dense pale narrow streaks on the apical margins, forming a conspicuous pattern. . . . . *labialis.*

(A large species with smoky wings, hind tibiae dark scopal fringe above them yellow or sometimes nearly white; appressed hairs of 5th abdominal segment fuscous or sordid, often with underlying paler hairs.)

44. (43) Species without the above combination of characters.
45. (46) Appressed hairs of 5th abdominal segment quite pale, yellow or golden, without admixture of dark fuscous or sordid hairs.

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* Perhaps the nearest approach to the *nigriceps* group in this respect is to be found in *A. praecox.*

45*a*. (53) Scopa yellow or golden.

46. (47) Basal abdominal segment with distinctly granulate punctuation, the punctures (or many of them) set in small tubercles or granules; hind tibiae dark beneath the scopae. . . . . *humilis.*

47. (46) Basal segment usually with ordinary punctures; if these are inclined to be granulate the hind tibiae are clear yellow beneath their scopae.

47*a*. (48) A very large species with dark wings, the basal segment with sparse and very remote punctures. . *hattorfiana.*
(Abdomen either black or more or less red.)

48. (47*a*) Small or medium-sized species, or, if rather large, the basal abdominal segment has a dense and almost even puncturation.

49. (52) Hind tibiae and tarsi entirely or almost entirely clear yellow.

50. (51) Mesonotum and scutellum finely rugose all over under a strong lens and dull in consequence. . . *chrysosceles.*
(Intermediate abdominal segments with dense white apical streaks.)

51. (50) Mesonotum and scutellum conspicuously shining between the punctures. . . . . *fulvago*
(Scopal fringe above the tibiae extraordinarily long.)

52. (49) Hind tibiae dark beneath the scopae. . . . . *polita.*

53. (45*a*) Scopa forming a dark or sooty-grey fringe above the tibiae when these are viewed on the inner surface. *marginata.*
(Abdominal colour very variable, from nearly all black to nearly all yellow through banded forms.)

54. (45) Appressed hairs of 5th abdominal segment not all pale yellow or golden, often dark, sometimes fuscous with golden or reddish tinge in part, or the segment has some yellow and some dark hairs.

55. (56) A small species with red 2nd and 3rd segments of the abdomen, the 1st and 2nd very distinctly and densely (for the most part evenly) punctured all over. *cingulata.*

56. (55) Species quite unlike the preceding.

57. (76) Scopa forming a yellow or golden fringe above the tibiae when these are viewed inwardly, seen with the naked eye the scopa appears conspicuously red, yellow or golden. Hind tibiae in some of the species clear translucent red or yellow.

58. (59) Whole abdomen very densely clothed with long pubescence (either all black or partly or even almost wholly pale)

hairs of face black, the floccus sooty or sordid; hind tibiae pale. . . . . *clarkella.*

59. (58) Abdomen seldom densely clothed, and then not as in *clarkella*; the floccus is pale.

60. (67) Fifth antennal joint distinctly elongate, not square in outline, still less transverse.

61. (62) Hind tibiae clear translucent yellow. . . . . . *ferox.*

62. (61) Hind tibiae dark beneath the hairs.

63. (64) Floccus very imperfect, small and thin; even in the finest examples the whole disc of the basal abdominal segment is hairless or nearly so, having at most a few fine and long hairs. . . . . *bucephala.*

64. (63) Floccus quite perfect, long curved hairs occupying the whole trochanter; in fresh specimens the basal segment is clothed all over rather thinly with long hairs or is densely clothed apically and with thinner long hairs more basally.

65. (66) Clypeus except for a smooth median line with rather even and close, distinct punctures; minute surface sculpture of basal abdominal segment not extraordinarily dense under a strong lens, so that at the sides it generally appears rather shining, and to the naked eye the whole abdomen appears somewhat shining and for a large part bare. . . . . *fucata* var.

66. (65) Clypeus with a wide median space of irregular punctuation, the punctures themselves often vague in outline; minute surface sculpture of the very dull basal segment extremely dense; abdomen dull and pubescent to the naked eye. . . . . *helvola.*

67. (60) Fifth antennal joint, viewed beneath (or in front) generally wider than long, at most so long as to appear about square in outline.

68. (69) Hind tibiae clear translucent yellow and nearly concolorous with the scopal fringe above.

68*a*. (68*b*) Abdomen nearly glabrous above, basal segment without a definite apical impression. . . . . *ruficrus.*

68*b*. (68*a*) Abdomen with longish pubescence, in fresh specimens forming distinct apical bands on the segments; basal segment with a distinct apical impression. *angustior* var.

69. (68) Hind tibiae dark beneath the scopal fringe.

70. (75) Rather small or medium-sized species with the basal segment widely rugulose along the apical margin and on this part (at least on the middle of the segment) almost impunctate.

71. (72) If the insect be viewed from beneath parts of the sides of the thorax have more or less black hairs; the hairs on part of the hind trochanter more or less (and often those on the coxae and the curled ones of the floccus) black or at least sordid; facial hairs often black. *gwynana* and var. *bicolor.*

72. (71) Sides of thorax and trochanters with pale hairs only; floccus pale.

73. (74) Clypeus with a faint longitudinal median impressed line on its basal part, quite noticeable in some aspects. *angustior.*

74. (73) Clypeus without an impressed line, sometimes with a slight smooth one, not impressed. *gwynana* var. *bicolor* ab.

75. (70) A large species, the puncturation of the basal abdominal segment is distinct on the apical portion, and though the punctures are finer and less numerous than more basally they come rather near to the apical margin itself. . . . . *nigroaenea.*

76. (57) Scopa not forming a distinctly yellow or golden fringe above the tibiae, often dark, more rarely greyish (from a mixture of pale and dark hairs) or nearly white and viewed in the natural position from above with the naked eye not conspicuously golden, yellow, or red. Hind tibiae never translucent red or yellow in any species.

77. (86) Large species, the abdomen nearly wholly shining and glabrous above to the naked eye (except that in one species some of the segments bear in parts some white tomentum in fresh examples), the apices of the segments never with apical bands or lateral streaks of dense short white hairs, forming a distinct pattern.

78. (83) Thorax with bright brown or fulvous hairs.

79. (80) Under parts of thorax and whole of the scopae with black hairs, basal abdominal segment finely and not very closely punctured. . . . . *thoracica.*

80. (79) Under parts of thorax and the scopae beneath with white or almost white hairs; basal segment very densely punctured, the 2nd and 3rd with some dense white tomentum or short hairs visible at least at the sides except in much-worn examples.

81. (82) Face beneath the antennae with pale hairs. . . *nitida.*

82. (81) Face beneath the antennae with black or dark fuscous hairs. . . . . *nitida* var. *baltica.*

83. (78) Thorax clothed with whitish, or with white and black hairs.
84. (85) Thorax clothed with whitish hairs all over. . . . *vaga.*
85. (84) Thorax with a transverse band of black hairs. . *cineraria.*
86. (77) If the abdomen is glabrous and shining, it has a distinct pattern formed by narrow apical bands or lateral streaks of dense pale hairs on the intermediate segments.
87. (88) Anterior area of propodeum well exposed on its dorsal face (owing to the paucity of hairs surrounding it) rather strongly and evenly rugose all over, the rugosities dense and sinuous or reticulate; 2nd segment practically glabrous and distinctly rugulose under a strong lens (excepting generally the apical impression) and with very few and feeble punctures. . . . . *proxima.*
88. (87) View of propodeal area often interfered with by dense hairs about it; in many the first two segments of the abdomen are conspicuously hairy, in others the 2nd segment is not distinctly rugulose or the sculpture of the propodeal area is quite different.
89. (95) Basal abdominal segment polished; 5th antennal joint very short (viewed from in front or beneath) transverse or subtransverse.
(The intermediate abdominal segments always have narrow apical bands or lateral streaks of white or almost white hairs, forming a pattern.)
90. (91) First two segments of abdomen with a general (but thin) clothing of longish pale hairs. . . . . . . *sericea.*
(Second segment with the punctures nearly effaced, these being remote and extremely minute.)
91. (90) First two segments without a general clothing of long hairs.
92. (93) Thorax well clothed with yellowish brown or fulvescent hairs; the view of the anterior area of the propodeum interfered with by the surrounding hairs. . *argentata.*
(Floccus large, perfectly developed on the whole trochanter).
93. (92) Thorax sparsely hairy above, the dorsal surface of the propodeum well exposed, bearing only scanty pubescence; floccus either small or imperfectly formed.
94. (94*a*) Scutellum densely punctate round the margins at least and generally shining on the disc; scopa with many fuscous hairs, white or silvery beneath. . . *coitana.*
94*a*. (94) Scutellum flatter, rugulose over its whole surface and very sparsely punctured; scopa almost white throughout. . . . . *nitidiuscula.*

95. (89) Basal abdominal segment not polished, but with fine rugulose sculpture under a strong lens, so that the surface is opaque or subopaque; 5th antennal joint generally distinctly elongate, very rarely appearing about square in outline and never very short.

96. (110) Floccus large and absolutely perfect.

96*a*. (97) Scopae entirely black as also the curved hairs at the sides of the propodeum. Abdomen very densely clothed with beautiful fulvous hairs which in fresh examples are of a paler colour than those of the thorax. . *fulva.*

97. (96*a*) Scopae always pale beneath.

98. (99) Apical impressions of 3rd and 4th abdominal segments abnormal, only defined at the sides and widely obliterated in the middle, but their position can be distinguished (best when the insect is viewed from behind with its head downwards) by a row of fine piliferous punctures, and they are then seen to be extraordinarily wide in this part, occupying nearly the whole segments if these are moderately extended, or the whole if they are at all strongly contracted.

(Punctures of clypeus for the most part sparse or irregular, and often with ill-defined outlines; colour of abdominal pubescence variable, the two basal segments with fulvous hairs, the two following sometimes both with dark or both with pale (whitish or partly fulvous and partly white) pubescence). . . . . *synadelpha.*

99. (98) Apical impressions of 3rd and 4th segments often feeble and sometimes narrowly obliterated in the middle; but their position is still discernible in some aspects, when they are seen to be not of extraordinary width. In some species they are quite distinct throughout, though shallow.

100. (103) Hairs on the middle and hind coxae more or less sordid in colour, not clear white nor pale ochreous (face often, but not always, with black or sooty hairs).

101. (102) First and 2nd segments of the abdomen very densely haired in part, the surface on the basal middle part of the 2nd hidden by the dense covering, unless the specimen is abraded. The abdomen dull, from the close, minute sculpture and dense pubescence. *varians.*

102. (101) First and 2nd segments with a thin clothing of long fine hairs, abdomen distinctly shining to the naked eye. *lapponica.*

103. (100) Hairs of the middle and hind coxae not sordid, but white or pale ochreous.
104. (105) First and 2nd abdominal segments thinly clothed with long fine hairs, the following appearing nearly bare to the naked eye and the abdomen shining. *fucata.*
105. (104) Abdomen copiously hairy.
106. (107) Hairs which spring from the punctures of the 5th segment (in front of the decumbent apical fringe) pale. *praecox.*
107. (106) Hairs of the 5th segment (except sometimes at the sides) dark, rarely with one or two pale hairs amongst them.
108. (109) Thorax with ochreous or brownish-ochreous hairs, a large species, rather resembling the common *A. trimmerana* Auct.; hairs of coxae beneath and floccus pale brownish yellow or ochreous, 4th and 5th segments not densely clothed with decumbent white or almost white hairs. . . . . *apicata.*
109. (108) Thorax in fresh examples with dense bright brown or fulvous hairs, hairs of coxae and floccus white; sides of 2nd, the 3rd and 4th abdominal segments, densely clothed with more or less decumbent white or pale hairs. . . . . *varians* var. *mixta.*
110. (96) Scopae small and very imperfect.
111. (114) Thorax above for the most part bare or very little hairy, though well clothed in front and behind and at the sides, the abdomen also largely glabrous above.
(Abdomen generally more or less marked with red or yellow.)
112. (113) Hairs of face about the antennae and below these mostly yellowish brown or ochreous. . . . . . . *rosae.*
113. (112) Hairs of face darker, generally much mixed with blackish or sooty brown. . . *eximia* (= *rosae* spring brood).
114. (111) Thorax above well clothed with pubescence, as also is the abdomen.
115. (118) Abdomen more or less marked with red or yellow either above or beneath on the 1st or 2nd segment or on both; scopae with yellow hairs beneath, not silvery white ones.
116. (117) Face either entirely clothed with black hairs or more commonly with a few brown or yellow ones about the insertion of the antennae.
spinigera=*trimmerana* K. (nec Auct. *caet.*) 1st brood.

117. (116) Face with many pale hairs especially in the antennal region. . . . . . . *trimmerana* K. 2nd brood.
118. (115) Abdomen black, at most with the apices of some of the segments a little discoloured or pallid; scopae generally silvery white beneath.
119. (120) Face more or less considerably clothed with pale hairs; the pale hairs of the abdomen not confined to the first two segments. . *trimmerana* Auct. nec Kirby.
120. (119) Face entirely or almost entirely clothed with black or blackish fuscous hairs; abdomen behind the 2nd segment clothed with black hair.
trimmerana Auct. var. *scotica.*

TABLE OF ♂ NOMADA.

1. (2) Labrum black, the mandibles bidentate at apex.
fabriciana.
(Abdomen normally with two pairs of small lateral yellow spots.)
2. (1) If the labrum is black the mandibles are simple at the apex.
3. (6) Abdomen without any yellow or white markings, labrum black.
(Medium-sized or rather small species with short antennae, many of the flagellar joints produced into a minute tubercle behind; abdomen, especially towards the sides, with silvery pubescence, very noticeable in some aspects.)
4. (5) Hind femora beneath for the greater part dull and densely punctured and pubescent. . . . . . *germanica.*
(Flagellum of antennae pale beneath.)
5. (4) Hind femora beneath for the most part polished and glabrous, very little punctured except at the extreme base. . . . . *atrata.*
(Flagellum dark or infuscate beneath.)
6. (3) Abdomen with at least small lateral yellow spots on one or more of the basal segments, often conspicuously spotted or banded.
7. (8) Species large (8·5–11 mm. long) labrum black, armed with a strong median triangular tooth anteriorly, 3rd antennal joint beneath as long as the 4th. . . . . *armata.*
(Front femora dilated, the basal half or more in front occupied by a great ovate impression; hind femora at the extreme base beneath clothed posteriorly with long curved hairs, much longer than those on the trochanter; adjoining this, with an area very densely clothed

with more decumbent hairs; flagellum of antennae fulvous, its second joint with a black stripe behind.)

8. (7) If the labrum is black the species are small or medium-sized, 7·5 mm. or less.

9. (12) Scape black in front (as well as behind) the 3rd antennal joint beneath as long or longer than the 5th.

10. (11) Labrum pale (yellow or dull red) the hind femora beneath very densely finely punctured and clothed with dense short hairs. . . . . *guttulata.*

(Yellow spots of 2nd and 3rd abdominal segments small and lateral, sometimes each of them divided into two; front and middle femora beneath with well-developed moderately long fringe.)

11. (10) Labrum wholly or partly black, the hind femora beneath polished, almost bare, and very sparsely punctured. *obtusifrons.*

(A small species 7·5 mm. or less, the 3rd antennal joint beneath slightly but distinctly longer than the 4th or 5th, which are hardly longer than broad; face not compressed into a sharp carina between the antennae, but sometimes with a raised median line there; middle femora with a distinct hair fringe beneath; labrum sometimes pale on the basal half.)

12. (9) Scape in most species more or less pale in front; if black the 3rd antennal joint on its lower side is shorter than the 5th.

13. (14) Scutellum with a single bright yellow marking; 2nd abdominal segment with well-separated yellow spots, which do not form a band. . . . . *rufipes.*

(Front femora with a thin fringe beneath, that on the middle ones hardly noticeable, hind ones much as in *obtusifrons.*)

14. (13) Scutellum with a single bright yellow spot only in one species, which has an entire (or almost entire) yellow band on the 2nd segment of the abdomen.

15. (16) A single (or indistinctly divided) red or orange-red spot on the scutellum; 3rd antennal joint beneath subequal to the 4th. . . . . *tormentillae.*

(Scape of antennae yellow in front; propodeum only with short inconspicuous hairs on each side; middle and hind femora without a fringe beneath; spots of 2nd abdominal segment separated by a distance about equal to the length of one of these or by a greater distance.)

16. (15) Scutellum rarely with a single red marking (often with 2 red or yellow spots or all black) if with a single large red marking the 3rd antennal joint beneath is much shorter than the 4th.

17. (18) A somewhat robust black and yellow (bicoloured) species, with the apical margin of hind tibiae without distinct spines or fringe. . . . . *flavopicta.*

(Labrum and front of scape yellow or pale, the antennae practically all black above; thorax clothed only with very short hairs and with two large round yellow spots on the scutellum; front and middle femora without a fringe beneath; yellow spots on each side of 2nd and 3rd segments of abdomen widely separated.)

18. (17) Apical margin of hind tibiae above with spines or conspicuous fringe or both; many species have tricoloured abdomen.

19. (20) A large robust bicoloured species, the 3rd antennal joint viewed from beneath (or in front) as long as the 4th. 6-*fasciata.*

(Cheeks longer than in any other species, the face produced anteriorly; hind tarsi unusually thick, the 2nd joint seen on the outer side not much longer than wide, front and middle femora with long fringe beneath, the apical margin of hind tibiae with well-developed fringe; yellow spots of 2nd abdominal segment wedge-shaped and well separated; flagellar joints of the antennae shining beneath and in some aspects showing a narrow pale pubescent band at the base.)

20. (19) Such species as are bicolorous have the 3rd antennal joint distinctly shorter than the 4th, when viewed from in front or beneath.

21. (24) Hind femora at the extreme base beneath with a highly specialised area clothed with extremely dense and short hairs and entirely different from the rest of the surface, the trochanters with a dense fringe or tuft of longer hairs.

22. (23) Basal abdominal segment bicoloured, the basal joints of the flagellum of antennae posteriorly black-marked. *goodeniana.*

23. (22) Basal abdominal segment tricoloured, basal and apical joints of flagellum pale behind, some of the intermediate ones with black markings. . . . . *fucata.*

24. (21) Hind femora and trochanters not thus clothed.

25. (26) The flagellar joints of the antennae seen with a strong lens

have small but conspicuous tubercles behind, projecting like small thorns. . . . . *lathburiana.*

(A tricoloured species of good size, the middle femora without a distinct fringe beneath, the hind ones shining beneath, copiously punctate, the punctures irregular in size; 3rd joint of antennae seen from beneath as long as the 4th.)

26. (25) Antennae not conspicuously tuberculate.

27. (30) Abdomen black and yellow, bicoloured to the naked eye, the scape of the antennae pale in front or with pale area.

28. (29) Third antennal joint viewed from in front very short on the lower side, its length there being shorter than the same side of the 5th joint. . . . . . . *lineola.*

29. (28) Third antennal joint, viewed as above, with the lower side about equal to that of the 5th. . . . *marshamella.*

(These two species vary in important characters, but the shape of the apical margin of the hind tibiae seen dorsally from the base is different. Most examples have a different facies from the fact that the yellow spots of the 2nd abdominal segment of *marshamella* are usually blunt or truncate on their inner extremity. The colour of the tegulae and prothoracic tubercles vary, in some examples the relative length of the antennal joints does not greatly differ in these species.)

30. (27) Abdomen definitely brown or ferruginous in part or the scape is black in front.

31. (32) Mandibles distinctly bifid at the apex. . . . *bifida.*

(Species of the same size and resembling in general coloration some varieties of *ruficornis*, *flava* and *signata*.)

32. (31) Mandibles not bifid.

32*a*. (57) Third joint of antennae viewed from in front much shorter than the 4th; species seldom excessively small.

33. (56) Labrum pale at least to a considerable extent.

34. (43) Scape of antennae black in front as well as behind (or above).

35. (40) Scutellum black, not marked with red.

36. (37) Tubercles of pronotum black with a sulphur yellow hind margin. . . . . *xanthosticta.*

37. (36) Tubercles not as above.

38. (39) Third, 4th and 5th abdominal segments with conspicuous yellow bands, not or only slightly interrupted in the middle; species not very small. . . *leucophthalma.*

39. (38) Third, 4th and 5th segments without conspicuous bands; species small. . . . . *flavoguttata* ab.

40. (35) Scutellum with red spots or red marking.

41. (42) Yellow markings of 2nd and 3rd abdominal segments sometimes forming complete bands and never both interrupted for a space equal to one-third the width of the segment. . . . . *ruficornis*, ab.
(Fringe beneath middle femora long; mandibles pointed at apex.)

42. (41) Yellow markings on each side of 2nd and 3rd segments well separated from one another by a distance equal to about one-third the width of the segment viewed dorsally or still more widely than this. . . *hillana.*
(Fringe beneath the middle femora short, not very different from that beneath the hind ones; mandibles in some aspects truncate at apex.)

43. (34) Scape pale beneath (or in front) or at least with a considerable pale area.

44. (55) Middle femora with a distinct fringe beneath.

45. (48) Front tibiae without a black or dark fuscous marking on their outer (or posterior) surface.

46. (47) The whole clypeus and front of the scape of the antennae cream-coloured, mandibles pointed at the tips. *baccata.*

47. (46) The whole of the clypeus and of the front of the scape not cream-coloured; mandibles truncate at apex in some aspects. . . . . *hillana* var. *ochrostoma.*

48. (45) Front tibiae with a dark marking posteriorly.

49. (50) Spots of 2nd abdominal segment well separated, by a space generally about one-third to one-fifth the width of its base, spots of 3rd segment more widely separated than these, and blunt or truncate inwardly; fringe beneath the middle femora short and dense and quite unlike that on the front ones. . . . . *bucephalae.*
(Antennae unusually long and slender; the scutellum without red spots.)

50. (49) Abdominal pattern or segment 1 and 2 rarely resembling the above, if approaching it, then the middle femora have a long fringe beneath not differing greatly from the front ones in this respect.

51. (52) Abdominal bands on segments 2–5 all entire; the yellow apical band on the face not continued back as an orbital line nearly as far as the insertion of the antennae. *signata.*

52. (57) If the abdominal bands on segments 2–5 are all entire then the yellow facial marking is continued back along the orbits as far as the line of the insertion of the antennae.

(N.B.—The band of the 2nd segment at least is usually divided in the middle by a thin streak or else indented above by a wedge of ground-colour, and some of these varieties resemble *signata* in lacking the long yellow orbital lines. The 2nd abdominal band of *signata* is not thus slightly divided or partially divided.)

53. (54)* Wings light shining fuscous, appearing distinctly flavescent; fringe of middle femora beneath usually decidedly shorter. . . . . *flava.*

54. (53) Wings more greyish; fringe of middle femora beneath generally longer. . . . . *ruficornis.*

55. (44) Middle femora beneath with the hairs so extremely short that a fringe is hardly perceptible, the front femora are similar, but a few longer hairs may be observed. *conjungens.*

(Antennae very long and slender, the 3rd joint viewed from in front extremely short; where shortest, not half the length of the very elongate 4th, which appears twice, or more than twice, as long as wide.

56. (33) Labrum black. . . . . *flavoguttata.*

(Antennae like those of *conjungens*, but the fringe beneath the middle femora though short is sufficiently distinct; the abdominal spots are usually considerably less developed and the average size is much less.)

57. (32*a*) Third antennal joint viewed from beneath subequal to the 4th; an extremely small species. . . . *furva.*

Table of ♀ Nomada.

1. (2) Labrum black, the mandibles bidentate at the apex. *fabriciana.*

(Second and 3rd abdominal segments with a small yellow spot on each side, one or both pairs of which may be wanting; antennae, except in rare aberrations, distinctive, the extreme base of flagellum black, following joints pale as also the apical one, the joints between these black.)

2. (1) If the labrum is black the mandibles are simple.

3. (6) Abdomen with no yellow spots or markings; the propodeum is copiously pubescent right up to the margins of the anterior area, the pubescence not forming a restricted patch or tuft.

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* Owing to the great variation in the colour and development of both species I cannot give more satisfactory characters.

(Labrum black, the mesonotum without red lines, though the scutellum has red spots or marking.)

4. (5) Hind femora ferruginous above, the flagellum of antennae pale beneath. . . . . *germanica.*

5. (4) Hind femora nearly entirely black, flagellum mostly dark beneath. . . . . *argentata.*

(Propodeum very densely and conspicuously clothed with silver hairs outside the area.)

6. (3) Abdomen rarely without either yellow spots or bands, and if so, the propodeum is bare along the margins of the area, the pubescence forming a patch or tuft on each side.

7. (8) A large species 8·5–11 mm., labrum black with a strong triangular tooth in the middle towards the apex. *armata.*

(Spots of 2nd abdominal segment lateral, apical margin of hind tibiae with a close series of strong black spines; sides of propodeum with dense silver pubescence outside the area.)

8. (7) When the labrum is black the species are less than 8 mm. long.

9. (10) Apical margin of hind tibiae with 2–4 excessively short, approximated, black spines, which often appear at first sight as a small black spot on the margin. *guttulata.*

(Yellow spots of 2nd abdominal segment small and lateral, the 5th with a pair of triangular ones sometimes approximated basally; scape of antennae black beneath, labrum pale, propodeum with conspicuous tuft of silver pubescence on each side; species small or rather small.)

10. (9) Apical margin of hind tibiae never armed as in *guttulata.*

11. (12) Labrum and scape* both black or pitchy black and the 4th antennal joint seen from in front is only a little longer than wide . . . . *obtusifrons.*

(A small species, the spots of the 2nd abdominal segment widely separated, propodeum only with short inconspicuous pubescence; face between the antennae not compressed into a sharp median carina.)

12. (11) If the labrum and scape beneath are both black, the 4th antennal joint is about twice as long as wide; in most species the labrum is pale.

13. (18) Mesopleura and propodeum outside the area with at

* The extreme base of the scape is sometimes red.

most a short inconspicuous pubescence, sometimes nearly bare; mesonotum never with red markings, scape of antennae pale beneath, the flagellar joints dark at least on one side.

14. (15) Scutellum with a red or ferruginous spot. *tormentillae.*
(Cream-coloured spots of 2nd abdominal segment widely separated; apical margin of hind tibiae with very short spines.)

15. (14) Scutellum with sulphur yellow spot or spots.

16. (17) Scutellum with a single transverse yellow spot. *rufipes.*
(Antennae short, mesopleura almost always with a conspicuous yellow marking, apical margin of hind tibiae with short pointed spines; abdomen very variable in colour, bicoloured or tricoloured.)

17. (16) Scutellum with two round yellow spots. . *flavopicta.*
(Abdomen black with yellow markings, the first segment with a yellow band nearly always slightly interrupted in the middle, second with wedge-shaped spots; apical margin of hind tibiae without spines.)

18. (13) Propodeum outside the area and the mesopleura, or one of those parts usually with more or less long pubescence or hairs; mesonotum in many species with red markings, scape in some black beneath, flagellum of antennae sometimes entirely pale.

19. (20) Face strongly produced anteriorly, so as to be subrostrate. 6-*fasciata.*
(A large, robust, bicoloured species, 1st, 2nd, and 3rd abdominal segments with elongate spots on each side, the pronotum black above; apical margin of hind tibiae with a dense fringe of hairs, with the spines not easily distinguishable amongst these.)

20. (19) Face normal.

21. (24) Hind tibiae with the apical margin peculiarly armed, having the usual apical process or projection and outwardly from this with two or three short stout spines (often so closely apposed as to appear like a single projection) inclined or bent towards the apical process.

22. (23) Abdomen tricoloured, the scutellum with a median yellow spot. . . . . *fucata.*

23. (22) Abdomen bicoloured, the scutellum with a pair of spots, rarely wanting. . . . . *goodeniana.*

24. (21) Armature of hind tibiae otherwise.

25. (56) Labrum pale, at least to a considerable extent; species not excessively minute and without flavous abdominal spots.

26. (27) Third antennal joint seen from beneath distinctly (though not greatly) longer than the 4th. . . . *lathburiana.*
(Scutellum with two yellow spots sometimes suffused with orange; mesonotum with dense erect reddish hair in fresh examples, abdomen tricoloured.)
27. (26) Third antennal joint beneath at most equal to the 4th, often rather shorter.
28. (31) Abdomen black and yellow not definitely tricoloured, the mesonotum without red lines or markings.
29. (30) Apical marking of face not continued up along the margins of the eyes to the height of the antennae; flagellum of antennae unicolorous, not distinctly dark or infuscated on any of the joints in front. . . . *marshamella.*
30. (29) Apical markings continued along the eye-margins up to the line of the antennal insertions, or else the more apical flagellar joints at least are darkened in front. *lineola.*
31. (28) Abdomen obviously brown or ferruginous in part (tricoloured).
32. (33) Pronotum above with yellow band or spots and its tubercles also bright yellow; mesonotum without red markings, scutellum nearly always with a pair of yellow spots. . . . . *lineola* var.
33. (32) Pronotum often red-marked or else black, not yellow-marked.
34. (35) Mandibles bifid at the apex. . . . . . . *bifida.*
(Apex of hind tibiae with elongate very fine spines of nearly equal length amongst the hair fringe; dense rather long white hairs on either side of the anterior area of propodeum; black ocellar area generally entirely surrounded by red.)
35. (34) Mandibles not bifid.
36. (37) Apical margin of hind tibiae armed with several (normally 5) very long, conspicuous black spines, not differing much from one another. . . . . . . *baccata.*
(Abdominal markings cream-coloured; propodeum red with a median black stripe and densely silvery-haired outside the area; greater part of mesonotum red.)
37. (36) Apical margin of hind tibiae otherwise armed.
38. (39) Mandibles truncate * at apex. . . . . . *hillana.*
(Spots of 2nd abdominal segment lateral, very widely separated, apex of hind tibiae with the innermost of

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* This character can only be seen clearly in certain aspects.

the series of spines slender and elongate, the outer ones much shorter and stouter.)

39. (38) Mandibles not truncate at apex.

40. (45) Mesonotum black, without red lines or markings.

41. (42) Prothoracic tubercles bright yellow. . . *xanthosticta.*
(Spots of 2nd abdominal segment lateral, the two together in dorsal aspect not usually as long as the distance between them; they are said to be very rarely obsolete.)

42. (41) Prothoracic tubercles not bright yellow.

43. (44) Mesonotum with a general clothing of longish erect pubescence similar to that on the front of the head. *leucophthalma.*
(Spots of 2nd segment rarely separated by a distance greater than the length of one of them and often by less.)

44. (43) Mesonotum with short and scanty pubescence. *ruficornis* ab.

45. (40) Mesonotum with red lines or markings.

46. (55) Spots of 2nd abdominal segment not minute, together in dorsal aspect they are usually at least as long as one-third the width of the segment, or the segment may have a complete band.

47. (48) Mesonotum clothed with longish erect pubescence like that on the front of the head. . . *leucophthalma* var.

48. (47) Mesonotum with short and scanty hair except at the extreme front.

49. (50) Spots of 2nd abdominal segment lateral, the distance between them greater than the length of one of them in dorsal aspect; antennae unusually long and slender, the flagellar joints behind with a thin fringe of erect hairs, quite distinct. . . . . *bucephalae.*

50. (49) Colour of 2nd segment very variable, often with entire or almost entire band; if with remote spots as in *bucephalae*, the antennae are shorter and their fringe is very sparse or indistinct.

51. (52) Second and following segments with entire broad yellow bands, that on the 2nd not notably excised in the middle of its upper margin; area of black on the posterior two-thirds of mesonotum greater than that of red colour. . . . . *signata.*
(Propodeum usually with a large trilobed yellow spot.)

52. (51) Second and following segments rarely all with wide complete bands as in *signata*, and if so, the posterior two-thirds of the mesonotum is more red than black.

53. (54) Wings light shining fuscous, yellow-tinged, flagellum

unicolorous, fulvous in front and behind; minute hairs on propodeum and on the hind coxae flavescent. *flava.*

54. (53) Wings more grey, the flagellum usually with at least one or two of the more apical joints infuscated in front; minute hairs of propodeum and coxae silvery white. *ruficornis.*

55. (46) Spots of 2nd segment minute, together in dorsal aspect not occupying one-third of the width of the segment, sometimes they are wanting. . . . *flavoguttata* ab.
(Labrum red, the propodeum with a tuft or patch of silvery hair on each side above the insertion of the abdomen.)

56. (25) Labrum black, or the species is very minute and without distinct flavous abdominal markings.

57. (60) Labrum black, 3rd antennal joint beneath shorter than the 4th.

58. (59) Propodeum with a conspicuous patch or tuft of silvery hair on each side posteriorly; large red marking of the mesopleura approaching near the red spot beneath the insertion of the wings, or coalescing with this. *flavoguttata.*

59. (58) Propodeum often entirely without a tuft of hair or with this comparatively less developed; the red mesopleural spot beneath the wings is widely separated from the longitudinal red line or band beneath it. . *conjungens.*
(This species is very closely allied to *flavoguttata*, but is of larger average size and has the yellow abdominal spots larger in normal examples.)

60. (57) Labrum red, the 3rd antennal joint not shorter beneath than the 4th. . . . . *furva.*
(A very minute species, the abdomen without definite flavous spots and with a dense and conspicuous tuft of silvery hair on each side of the propodeum.)

The three species *obtusifrons*, *tormentillae* (*roberjeotiana* Sm. Saund.) and *rufipes* form a quite distinct group, the ♂ genital armature and 8th ventral segment being very different from those of any other. I should consider *flavopicta* as somewhat allied to the latter, but the alliance is very remote.

N. germanica and *atrata* are allied to one another, but not close to any other species; *armata* and *guttulata* are both isolated, and I do not think the latter is really at all closely allied to *hillana*. The large species *N. sexfasciata* parasitic on *Eucera* has no close ally in this country, nor has *lathburiana*. *N. fucata* and *goodeniana* are members of a natural group; but it contains no other British species.

Most of our species belong to the *ruficornis* group, containing besides *ruficornis* itself, *flava*, *signata*, *leucophthalma xanthosticta bucephalae* and *hillana*, and, at any rate in dealing with our small fauna, I should also include in it the following: *lineola* and *marshamella*, *baccata*, *bifida*, *conjungens*, *flavoguttata* and *fabriciana*. *N. furva* is an isolated form.

A series of examples of *N. marshamella* ♀ belonging to the second generation and taken at the burrows of the summer brood of *Andrena spinigera* is interesting in having the propodeum much less clothed than in specimens of the first brood. In some localities examples of the females of *N. lineola* have the flagellar joints of the antennae entirely fulvescent, none of these being darkened behind. I have not found this variety amongst numerous examples taken at the burrows of *Andrena bimaculata* and *carbonaria*, and suspect that it may only occur in those attached to *A. tibialis*, but it is possibly due rather to locality than host.

In conclusion I must express my thanks to my friends, the Rev. F. D. Morice and Mr. H. M. Hallett, to whom I am indebted for many valuable corrections and suggestions, which I have adopted in this paper, and who have put themselves to the great trouble (as I have previously mentioned) of looking into the validity of many of the specific characters, given in the tables of *Andrena*. I regret that I have been unable to make these more simple, but without disregarding variation, I do not see how this can be done.

So far as possible I have endeavoured to supplement the standard works of the late Edward Saunders by using characters which have previously been more or less overlooked or disregarded. I cannot sufficiently express how much I am indebted to our former leading authority on this group of insects not only for constant help by means of correspondence in the early days of my study, but also for the frequent loan of his whole series of difficult species, including the actual specimens, from which he drew up his descriptions.

Explanation of Plate XI.

Andrena, ♂, 3rd, 4th and 5th antennal joints.

1. *Andrena bimaculata.*
2. *A. flavipes.*
3. *A. nigroaenea.*
4. *A. gwynana.*
5. *A. florea.*
6. *A. trimmerana* Auct.
7. *A. ferox.*
8. *A. bucephala.*
9. *A. clarkella.*
10. *A. fulva.*
11. *A. varians.*
12. *A. synadelpha.*
13. *A. lapponica.*
14. *A. nigriceps.*
15. *A. sericea.*
16. *A. lucens.*
17. *A. marginata.*
18. *A. dorsata.*
19. *A. minutula.*

Explanation of Plate XII.

1—9, 3rd, 4th and 5th antennal joints of ♀ *Andrena.*

1. *A. bimaculata.*
2. *A. florea.*
3. *A. nigroaenea.*
4. *A. trimmerana* Auct.
5. *A. varians.*
6. *A. clarkella.*
7. *A. nigriceps.*
8. *A. hattorfiana.*
9. *A. marginata.*
10. Hind tibia of *A. nigriceps.*
11. ,, ,, *A. varians.*
12. ,, ,, *A. tarsata.*
13. ,, ,, *A. coitana.*
14. ,, ,, *A. dorsata.*
15. ,, ,, *A. similis.*

Explanation of Plate XIII.

Characters of ♂ *Andrena.*

1. *A. spinigera,* mandible.
2. *A. eximia* ,,
3. *A. ferox* ,,

4. *A. nigroaenea*, mandibles crossing at the tips.
5. *A. synadelpha* ,, ,, ,,
6. *A. dorsata*, mandibles not crossing.
7. *A. praecox*, apex of 8th ventral segment.
8. *A. apicata* ,, ,, ,,
9. *A. trimmerana*, Auct., cheek and base of mandible.
10. *A. lapponica*, base of mandible.
10*a*. ,, var. base of mandible.
11. *A. fulva*, base of mandible.
12, 12*a*. *A. praecox*, base of mandible.
(12*a* very aberrant.)
13, 13*a*, 13*b*. *A. apicata*, base of mandible.
(13*a* drawn from a Continental example.)
14. *A. fucata*, base of mandible.
15. *A. synadelpha*, base of mandible.

Explanation of Plate XIV.

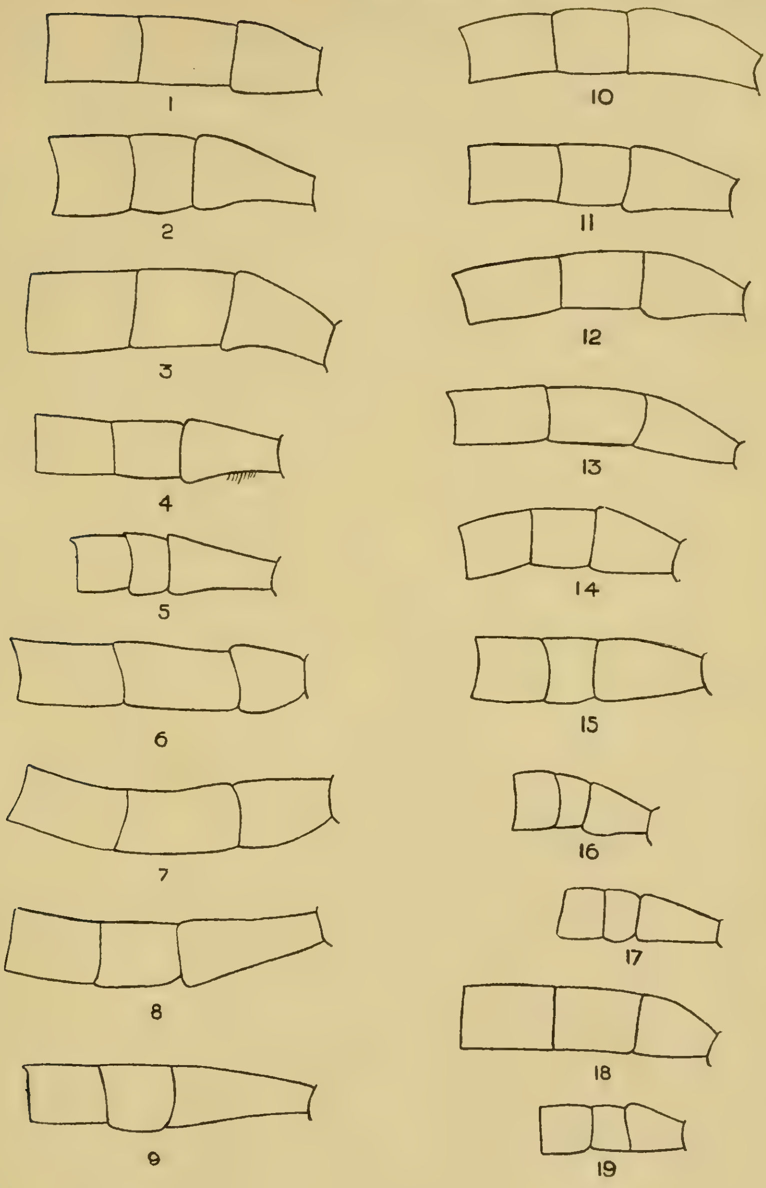
Antennal joints of *Nomada*.

1. *N. armata*, ♂, 3rd, 4th and 5th joints.
2. *N. sexfasciata*, ♂ ,, ,, ,,
3. *N. marshamella*, ♂ ,, ,, ,,
4. *N. lineola*, ♂ ,, ,, ,,
5. *N. lathburiana*, ♂ ,, ,, ,,
6. ,, ,, 3 flagellar joints showing tubercles.
7. *N. hillana*, ♂, 3rd, 4th and 5th joints.
8. *N. guttulata*, ♂ ,, ,, ,,
9. *N. flavoguttata*, ♂ ,, ,, ,,
10. *N. obtusifrons*, ♂ ,, ,, ,,
11. *N. ruficornis*, ♀ ,, ,, ,,
12. *N. lathburiana*, ♀ ,, ,, ,,
13. *N. lineola*, ♀ ,, ,, ,,
14. *N. marshamella*, ♀ ,, ,, ,,
15. *N. obtusifrons*, ♀ ,, ,, ,,
16. *N. flavoguttata*, ♀ ,, ,, ,,

Explanation of Plate XV.

1, 2. *N. ruficornis*, ♀ (two vars.), armature of apex of hind tibiae.
3. *N. sexfasciata*, ♀ „ „ „
4. *N. goodeniana*, ♀ „ „ „
5. *N. armata*, ♀ „ „ „
6. *N. flavopicta*, ♀ „ „ „
7, 7*a*, 7*b*. *N. guttulata*, ♀ (3 vars.) „ „ „
8. *N. bifida*, ♀ „ „ „
9, 9*a*. *N. baccata*, ♀ (2 vars.) „ „ „
10. *N. hillana*, ♀ „ „ „
11. *N. rufipes*, ♀ „ „ „
12. *N. flavoguttata*, ♂, middle femur showing the length of fringe beneath.
13. *N. ruficornis*, ♂, middle femur showing the length of fringe beneath.
14. *N. bucephalae*, ♂, middle femur showing the length of fringe beneath.
15. *N. flava*, ♂, middle femur showing the length of fringe beneath.
16. *N. hillana*, ♂ „ „ „ „ „
17. *N. furva*, ♂, hind trochanter and femur.
18. *N. fucata*, ♂ „ „ base of femur.
19. *N. hillana*, ♂, apex of mandible.
20. *N. bifida*, ♀ „ „
21. *N. fabriciana*, ♀ „ „
22. *N. ruficornis*, ♀, two flagellar joints of antennae showing hairs.
23. *N. bucephalae*, ♀ „ „ „ „ „

August 15, 1919.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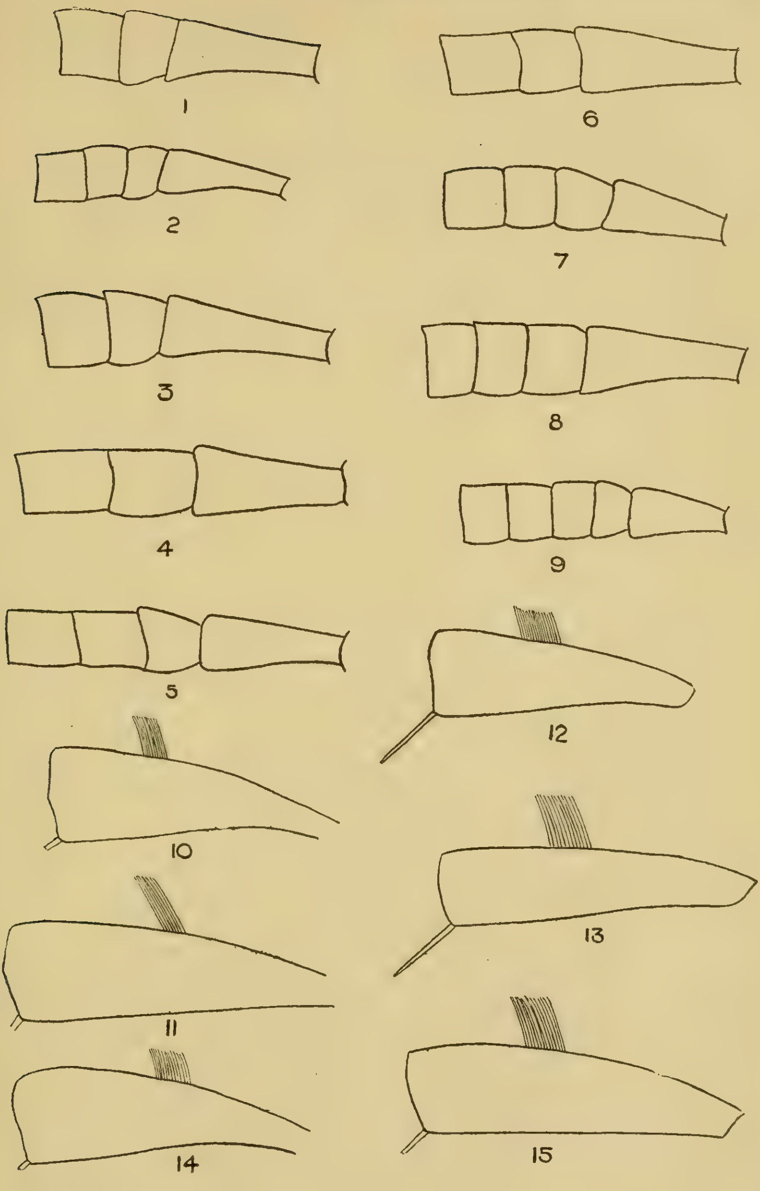
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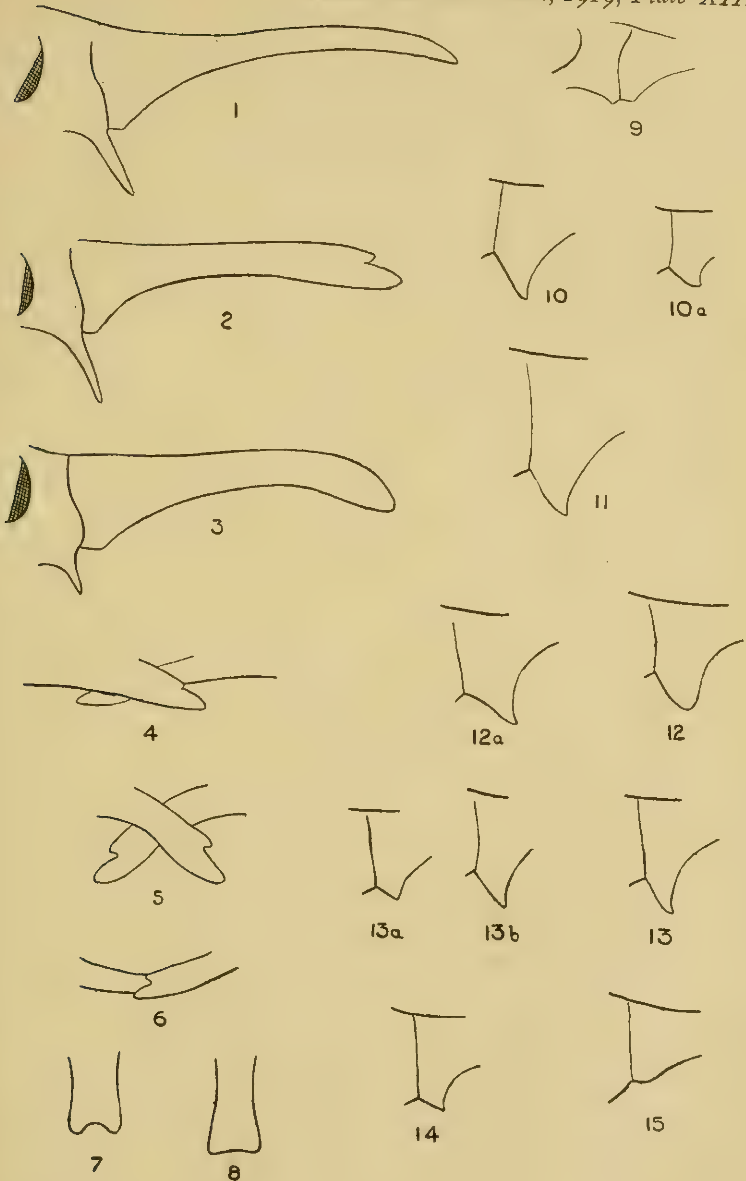
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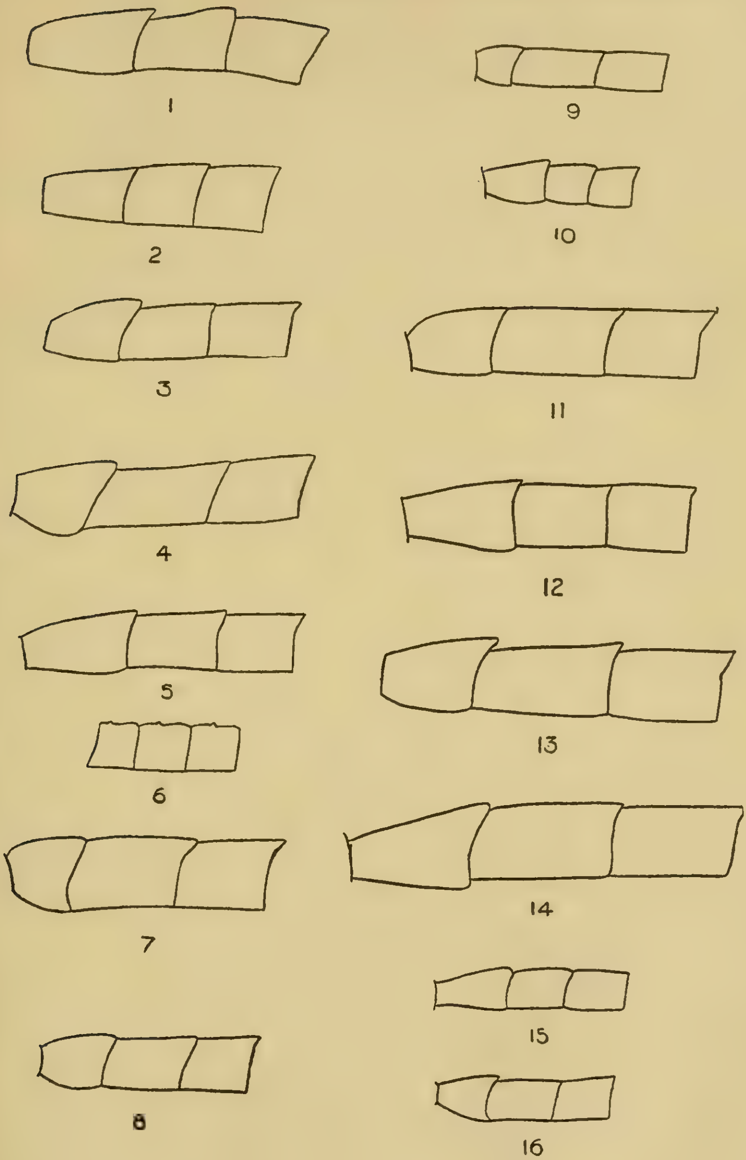
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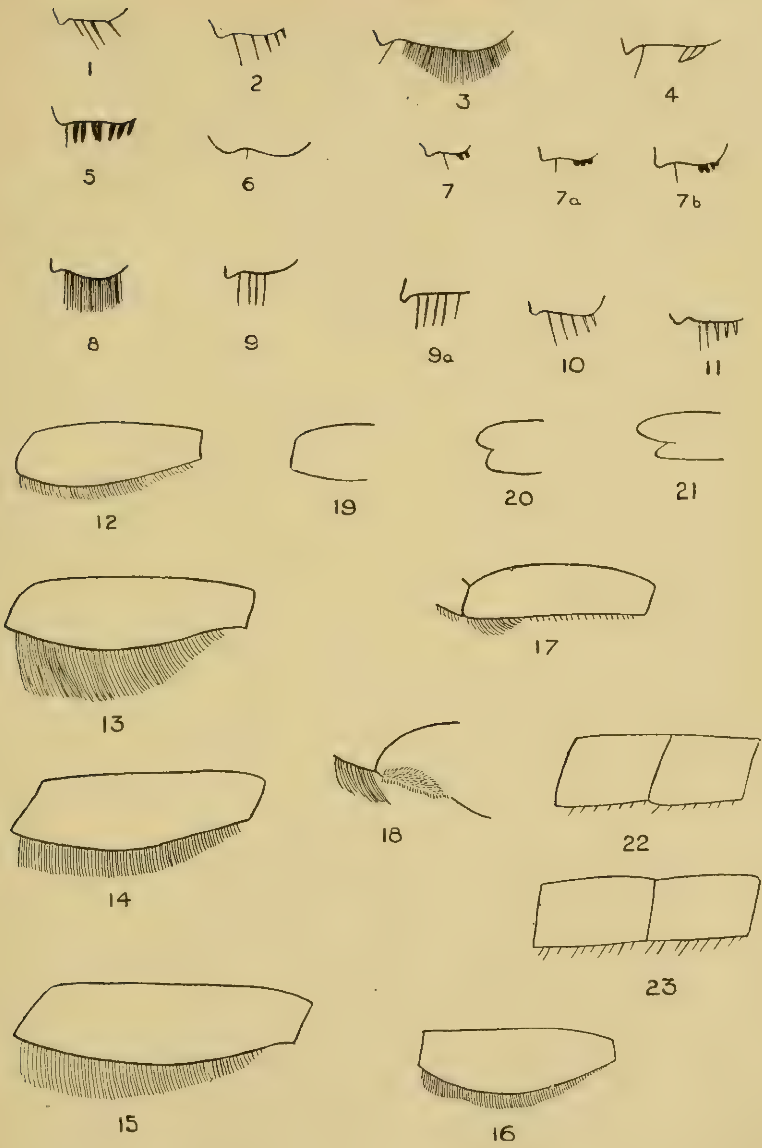
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VIII. *Notes on the Exotic* Proctotrupoidea *in the British and Oxford University Museums, with Descriptions of New Genera and Species.* By ALAN P. DODD. Communicated by S. A. NEAVE, M.A., D.Sc.

[Read June 4th, 1919.]

THIS paper is an attempt to identify the material of the Proctotrupoidea in the British Museum and the Hope Department, Oxford University Museum. Four new genera, sixty-three new species and two new varieties are described. At the same time I have examined other authors' types, and have been able to sink several genera, and rightly place a number of species. The genera are not well defined nor understood, especially in the *Scelionidae*, and too many genera have been erected of recent years without defining their relationships and differences.

Family SCELIONIDAE.

PROSAPEGUS Kieffer.

Kieffer erected this genus to contain *Apegus elongatus* Ashmead, stating that the antennae are filiform in both sexes; but *elongatus* was described from the male sex only. The species described herewith form a natural group, and agree fairly well with Ashmead's description of *elongatus*, except for the presence of false basal and median veins; the raised area on the median segment seems to be a distinctive character. The species are more robust than those of *Macroteleia*. In *violaceus* and *atrellus*, the raised area on the median segment is not well separated from the post-scutellum, and it would be easy to take them for species of *Chromoteleia*. The Australian species described by me in the genus *Cacellus* may also belong here, but this point I hope to clear up later.

Prosapegus violaceus, n. sp.

♂. Dark blue; legs, including the coxae, bright yellow; antennae black, the scape brown.

Head transverse; with large dense punctures; eyes large, bare;

ocelli large, rather close together. Antennae 12-jointed; filiform; scape slender; pedicel rather short, half as long as funicle 1, 2 distinctly shorter than 1, 3 with a distinct excision, 4–9 subequal and subquadrate. Thorax stout; scutum and scutellum with large confluent punctures; parapsidal furrows well determined, wide apart; postscutellum short; median segment at base with a raised triangular area extending almost to posterior margin, the rest of the sclerite obliquely longitudinally striate. Fore-wings long, but not reaching apex of abdomen; sooty; venation fuscous; submarginal vein attaining costa at half-wing length; marginal vein rather shorter than the stigmal which is long and oblique; postmarginal hardly longer than the stigmal; basal vein long, oblique, the median reaching posterior wing margin; radial vein represented by a long dark line parallel with the anterior wing margin. Abdomen long and slender, fusiform; longitudinally rugose, the basal segment striate, the apical segment punctate; apex with two sharp points; lateral margins of basal segments carinate, 2–5 with a distinct median carina; 1 somewhat wider than long, 2–4 longer than wide and subequal. Legs slender; posterior tarsi no longer than their tibiae. Length, 8 mm.

♀. Like the male but the abdomen is pointed at apex; median carina subobsolete on segment 5. Antennae 12-jointed; scape slender; pedicel twice as long as its greatest width; funicle 1 about three times as long as pedicel, 2 one-half as long as 1, 4 as wide as long; club 6-jointed, the joints rather wider than long. Length 11 mm.

Described from one pair labelled "Dore, Dutch New Guinea; Wallace."

Type in the British Museum; cotype in the Hope Collection, Oxford.

This beautiful species is the largest Scelionid I have seen.

Prosapegus atrellus, n. sp.

♀. Black, the head and thorax with a faint aeneous tinge; antennae wholly black; coxae black, the anterior and intermediate legs reddish-brown, the posterior legs dull dusky-red.

Head transverse, no wider than thorax; vertex declivous posteriorly, with large sub-confluent punctures, laterally with two oblique carinae continued down the cheeks; lower half of cheeks with only a few large punctures; no frontal depression; frons with large non-confluent punctures, the lower half with a large smooth mesal area; eyes very large, bare; ocelli large, rather close together, the lateral pair separated from the eyes by nearly their own diameter. Antennae 12-jointed; scape long and slender; pedicel fully twice as long as its greatest width; funicle 1 elongate, twice as long as pedicel, 2 slightly longer than pedicel, 3 quadrate, 4 wider than long; club 6-jointed, 1 the longest, a little longer than wide, 2–5 wider than long. Thorax about twice as long as its greatest width; pronotum with several strong longitudinal striae, its angles rounded; scutum and scutellum with large scattered punctures; parapsidal furrows deep and distinct; median lobe of scutum a little depressed at meson anteriorly where there is a faint median carina; scutellum large, its posterior margin foveate; postscutellum visible as a foveate line; median segment with a raised triangular area at meson, which is rather longer than its basal width and with a median carina; rest of median segment rugose, with two carinae, and with a whitish patch of pubescence laterally; mesopleurae very coarsely striate and sulcate like the pronotum; metapleurae rugose. Fore-wings reaching beyond apex of fourth abdominal; broad; deeply embrowned, the colour darker in the area enclosed by submarginal, basal, and median veins; venation nearly black; submarginal vein attaining costa at half-wing length; marginal vein almost as long as the stigmal which is moderately long and nearly perpendicular; postmarginal no longer than the marginal; basal vein long, very oblique; median vein long; radial vein rather well marked and very long; discoidal vein faintly indicated. Abdomen long and fusiform, not twice as long as head and thorax united; pointed at apex; segment 1 somewhat wider than long, 2 and 3 somewhat longer than wide, 4 a little shorter and as wide as long, 5 a little shorter than 4, 6 shorter than 5; 1–5 with a strong median carina; 1–4 with a strong lateral carina; 1 strongly striate, the rest densely longitudinally rugose; venter of abdomen shining, with large scattered punctures and sparse striae. Length, 7 mm.

♂. Similar to the female but the abdomen is blunt and emarginate at apex; legs sometimes lighter in colour, the coxae more or less reddish. Scape slender; pedicel hardly longer than its greatest width; flagellar joint 1 more than twice as long as pedicel, 2 distinctly shorter than 1, 3 somewhat excised on one margin at apex.

Described from three males, one female in the Wallace Collection from Dore, Dutch New Guinea, and Mysol.

Type and cotypes in the Hope Collection, Oxford; one cotype in the British Museum.

Prosapegus metatarsalis, n. sp.

♂. Black; legs clear yellow, the coxae more or less reddish; antennae black, the scape brown.

Head normal; frons not depressed; eyes moderately large, bare;

ocelli rather wide apart, the lateral pair a little separated from the eyes; upper half of frons and the vertex strongly longitudinally striate (thus between the striae there is a sulcate appearance), toward occipital margin with a rugose tendency; lower half of frons smooth; a few strong striae converging around mouth; cheeks with large dense punctures. Antennae 12-jointed; scape slender; pedicel as wide as long; flagellum filiform, the joints elongate, 1 hardly longer than 2, 3 not excised and hardly shorter than 2, the penultimate joint over twice as long as wide. Thorax plainly longer than its greatest width; pronotum short, foveate-striate; parapsidal furrows deep and foveate, wide apart and almost parallel; median lobe of scutum with large dense punctures; lateral lobes narrow, almost smooth, with a faint median carina; scutellum transverse, its posterior margin straight, with a row of foveae at its base, and with large foveae along posterior margin, thus the central smooth area is quite short; postscutellum visible as a foveate line; median segment with a raised rectangular area at meson which has its lateral margins straight and carinate, its posterior margin concave, its meson with two carinae; median segment laterally pubescent. Fore-wings reaching a little beyond apex of fourth abdominal segment; broad; not greatly embrowned; submarginal vein attaining costa at half-wing length; marginal vein one-half as long as the oblique stigmal vein; postmarginal more than twice as long as the stigmal; radial vein indicated; basal and median veins as thick yellow lines, the former oblique. Abdomen fusiform, about twice as long as head and thorax united; almost pointed at apex; segment 1 rather longer than wide, 2 and 3 subequal, 4 a little shorter, 5 as wide as long, 7 very small, emarginate at apex; 1 somewhat raised at meson, 1 and 2 carinate laterally, 2 and 3 with a blunt median carina; 1 strongly striate, and smooth between the striae, 2 and 3 densely finely rugose and with irregular longitudinal striae, 4 and 5 similar but the striae very fine. Legs slender; basal joint of posterior tarsi very long, three times as long as the remainder united. Length, 7 mm.

Described from two males in the Wallace Collection from Mysol and the Aru Islands, East Indies.

Type and cotype in the Hope Collection, Oxford.

Prosapegus glorianus, n. sp.

♂. Head black; thorax and first abdominal segment brilliant orange; second and third abdominal segments black, the remainder dark violet-blue; legs wholly yellow; antennal scape yellow, next four joints dusky, the apical joints black.

Head normal; vertex smooth and shining, with a very few punctures; cheeks large, with scattered punctures; frons feebly depressed, smooth and shining, laterally with one or two subobsolete striae, with a median carina running for some distance from antennal insertion; eyes large, bare, narrowing ventrally; ocelli large, wide apart, the lateral pair against the eyes; mouth with converging striae. Antennae 12-jointed; scape moderately long and stout; pedicel one-half longer than its greatest width; flagellar joint 1 fully twice as long as the pedicel, 2–10 gradually shortening. Thorax twice as long as its greatest width; pronotum hardly visible from above; scutum and scutellum smooth and shining, with a few scattered punctures; scutum as long as wide, its anterior margin broadly rounded; parapsidal furrows deep and foveate, wide apart and almost parallel; scutellum foveate at anterior and posterior margins, its posterior margin straight; postscutellum short, foveate; raised area at base of median segment rectangular, its lateral margins straight, its posterior margin concave and obtusely bidentate, its surface rugose and with several striae or carinae; laterally the median segment is pubescent. Fore-wings long, extending beyond apex of fourth abdominal segment; very deeply fuscous; venation black; marginal vein barely one-half as long as the oblique stigmal vein; postmarginal over twice as long as the stigmal; basal, median, and radial veins well marked, the basal very oblique. Hind-wings deeply fuscous, the basal third hyaline. Abdomen almost twice as long as head and thorax united; hardly narrowed at base, blunt at apex; segments 1–4 longer than wide, 2 and 3 longest, 5 as wide as long, 6 somewhat shorter than 5; 1–3 irregularly strongly rugulose, the rugae wavy and sublongitudinal; 4–6 densely punctate, 6 with stiff black pubescence. Basal joint of posterior tarsi very long. Length, 7 mm.

Described from one male labelled "Suva, Fiji; R. C. L. Perkins."

Type in the British Museum.

This strikingly beautiful species is closely allied with *metatarsalis*, both having the rectangular raised area on the median segment, the long basal joint of the posterior tarsi, and the straight posterior margin of the scutellum.

Macroteleia gracilicornis, n. sp.

♀. Black; coxae black, the femora dusky, the tibiae and tarsi brownish-yellow; antennae black, the basal six joints a little suffused with brown.

Head subquadrate, finely confluently punctate and coriaceous;

frontal depression shallow, not margined, finely coriaceous; eyes large, bare; ocelli wide apart, the lateral pair close to eye margins. Antennae 12-jointed; scape slender; pedicel about twice as long as its greatest width, as long as funicle 3; funicle 1 much longer, several times as long as wide, somewhat longer than 2; 4 shortest but longer than wide; club 6-jointed, joints subquadrate, 1 a little the largest. Scutum finely densely punctate and with short fine pubescence; parapsidal furrows feeble, failing anteriorly; scutellum semicircular; postscutellum and median segment unarmed. Fore-wings reaching apex of abdomen; broad; subhyaline; venation brown; marginal vein rather longer than the stigmal which is rather short; postmarginal a little longer than the marginal; basal and median veins hardly indicated. Abdomen not twice as long as head and thorax united, slightly narrowed at base, pointed at apex, the apical segments not compressed; an indistinct protuberance on basal segment; segments 1–3 a little longer than wide, 4–6 wider than long, 2 and 3 subequal, 6 quite short; 1–4 densely confluently longitudinally punctate, 5 with scattered punctures, 6 smooth. Legs slender; tibiae as long as their tarsi.

♂. Apex of abdomen blunt; no basal protuberance. Antennae filiform; funicle joints all longer than wide, 3 and 10 longest, 1 as long as pedicel. Length, 3 mm.

Described from two females, one male, labelled "St. Helena; Wollaston."

Type and cotypes in the British Museum.

This species is not typical of the genus on account of the shorter non-compressed abdomen.

Macroteleia emarginata, n. sp.

♀. Black; legs, including coxae, and first six antennal joints bright yellow.

Head subquadrate; rather densely pubescent; densely punctate, the punctures not large; frontal depression shallow, elongate, not margined, smooth; eyes large, bare; ocelli large, well separated, the lateral pair against eye margins. Antennae 12-jointed; scape slender; pedicel slender, fully twice as long as its greatest width; funicle 1 a little longer than pedicel, 2 distinctly shorter than 1, 3 a little longer than wide, 4 wider than long; club 6-jointed, the joints wider than long. Thorax rather densely pubescent; scutum and scutellum densely punctate; parapsidal furrows delicate; scutellum large, its posterior margin feebly yet distinctly emarginate; median segment somewhat shorter than scutellum. Fore-wings long, reaching beyond fourth abdominal segment; broad; subhyaline;

venation brownish; marginal vein a little longer than the stigmal, which is moderately long, straight; postmarginal nearly twice as long as the marginal; basal and median veins not indicated. Abdomen long, about twice as long as head and thorax combined; rather narrower than thorax, the sixth segment compressed laterally; segment 1 no longer than its greatest width, the remainder all longer than wide, 2 and 3 a little the longest; basal segment without a trace of a protuberance; with fine pubescence; wholly longitudinally striate; apical segment punctate. Length, 6·5 mm.

Described from one female from Kuching, Borneo, and labelled "*Macroteleia flavipes* Cameron."

Type in the British Museum.

Macroteleia perkinsiana, n. sp.

♀. Black; legs yellow, the coxae fuscous; antennal scape yellow; funicle a little suffused with yellow, the club black.

Head normal; subquadrate; wholly densely rather finely punctate except for a smooth area above antennal insertion; frons not depressed; cheeks large; eyes large, bare; ocelli small, wide apart, the lateral pair against the eyes. Antennae 12-jointed; scape as long as next four joints combined; pedicel fully twice as long as its greatest width; funicle joints rather narrower than pedicel, 1 more than twice as long as wide, 2 much shorter, 3 and 4 quadrate; club 6-jointed, joints 1–5 a little wider than long. Thorax longer than wide; scutum as long as wide, narrowed anteriorly; the median lobe punctate, densely anteriorly, less so posteriorly, the lateral lobes with scattered punctures; parapsidal furrows distinct and foveate; scutellum semicircular, smooth except for a few minute punctures; median segment short, striate; all pleurae densely punctate, the mesopleurae with a narrow smooth depression. Forewings reaching apex of abdominal segment 4; broad; hyaline; venation fuscous; marginal vein distinctly longer than the stigmal, the postmarginal no longer than the marginal; basal and median veins not represented. Abdomen not twice as long as head and thorax united; slender; no horn or tubercle at base; segment 6 only compressed; wholly densely finely longitudinally striate and with fine pubescence; segment 1 as wide as long, the others longer than wide, 2 and 3 subequal, 4 a little shorter, 5 distinctly shorter than 4, 6 a little longer than 5. Posterior tarsi no longer than their tibiae, their basal joint a little shorter than the following united. Length, 3·5 mm.

Described from two females labelled "Bundaberg, Queensland; R. C. L. Perkins."

Type and cotype in the British Museum.

I have much pleasure in naming this species after the collector, to whom I am indebted for this and other specimens.

Macroteleia erythrogaster Ashmead.

Several females reared from base of grass, *Imperata caudata*, containing *Tomaspis carmodyi*, Issorora, N. W. District, British Guiana, 2.vii.16 (*C. B. Williams*). The type locality is St. Vincent, West Indies.

Macroteleia carinata Ashmead

One female swept from grass, Bon Intento, Betterverwachting, British Guiana, 24.v.16 (*C. B. Williams*). The type locality is St. Vincent, West Indies.

Romilius Walker

Romilius Walker, Ann. Mag. Nat. Hist., vol. 10, 1842, p. 274.

Triteleia Kieffer, Berlin Ent. Zeitschr, vol. 50, 1906, p. 265.

I cannot distinguish any generic distinction in Kieffer's genus; the species *zotale* Walker is unknown to me, but I have examined the type of *duris* Walker, which is a typical *Macroteleia* with a third ill-defined groove on the scutum. But Kieffer has described a variety *trisulcata* of the species *Macroteleia gladiator* Kieffer, which has this third groove; hence both *Romilius* and *Triteleia* should fall, probably, as synonyms of *Macroteleia*.

Romilius duris Walker.

Scelio duris Walker, Mon. Chalciditum, vol. 2, 1839, p. 61.

♂. Black; legs yellow, the coxae blackish; scape brown.

Head subquadrate; densely punctate, the punctures not large; eyes large, bare; lateral ocelli almost touching the eyes. Scape slender; pedicel not much longer than its greatest width; flagellar joint 1 distinctly longer than pedicel, 2–9 shorter than 1. Scutum finely coriaceous, the median lobe punctate except laterally; parapsidal furrows deep and distinct, the median groove shallow; scutellum finely coriaceous and with some punctures, its caudal margin foveate. Fore-wings long but not attaining apex of abdomen; sub-hyaline;

venation dusky; marginal vein as long as the rather long curved stigmal; postmarginal a little longer than the marginal; basal and median veins indicated. Abdomen over one-half longer than head and thorax united; scarcely narrowed at base; bispinose at apex, the spines short; segment 3 a little the longest, longer than wide, 6 short; 1 and 2 striate; the rest densely confluently punctate and with some pubescence. Length, 3 mm.

Described from Walker's type labelled "Tasmania."

I know of no Australian *Macroteleia* with the median groove or impression on the scutum; nor do I know any other *Macroteleia* from Tasmania.

Chromoteleia nigrescens, n. sp.

♂. Black; antennae wholly black; legs, except the coxae, reddish-yellow.

Head transverse, no wider than thorax; coarsely rugo-punctate and with scattered stiff pubescence; cheeks with similar sculpture; frontal depression shallow, not margined, no wider than its distance from the eye margins; between the antennal insertions is a blunt tooth; around mouth with converging striae; eyes large, pubescent; ocelli wide apart, the lateral pair a little separated from eye margins. Antennae 12-jointed; scape slender; pedicel no longer than its greatest width; funicle joint 1 cupuliform, nearly twice as long as its greatest width, 2 shorter, 3 quadrate, 4–9 a little wider than long. Thorax stout; pronotum truncate anteriorly, its angles subacute; parapsidal furrows deep and complete; scutum with large confluent punctures, these not so dense on scutellum; postscutellum rugose, conspicuous, triangular, not much shorter than scutellum; median segment with its posterior margin profoundly excavated, its meson hidden by the postscutellum, distinctly lateral and rather finely rugose; pleurae coarsely rugose. Fore-wings almost reaching apex of abdomen; broad; dusky; venation blackish; submarginal vein attaining costa at fully half-wing length; marginal vein punctiform; stigmal vein long, the postmarginal nearly three times as long as stigmal; basal and median veins indicated by thick brown lines, the former perpendicular; radial vein indicated, running from stigmal vein to wing apex; discoidal and recurrent veins indicated. Abdomen somewhat longer than head and thorax united; hardly narrowed at base, blunt at apex; segments all much wider than long, 2 and 3 a little longer than 1 or 4; 1 in centre at base a little produced; 1 rugo-striate, the rest densely confluently punctate with a longitudinal tendency. Length, 2·75 mm.

Described from one male labelled "Yallingup, S.W Australia, Dec. 1913; R. E. Turner."

Type in the British Museum.

The first Australian member of the genus.

Chromoteleia rufithorax Kieffer.

Two females labelled "Teapa, Tabasco, Mexico; H. H. Smith."

Lapitha Ashmead.

Lapitha Ashmead, Bull. U.S. National Museum, 1893, p. 222.

Acantholapitha Cameron, Soc. Entom., Stuttgart, 27, 1912, p. 70.

I do not think that Cameron's genus ought to be considered distinct; it differs from *Lapitha* only in the slightly different form of the postscutellum.

TABLE OF MALAYAN SPECIES.

(1) Spine on postscutellum simple .	*divina*, n. sp. (Java).
Spine on postscutellum with lateral subacute angles.	(2)
(2) Colour brown and yellow . . .	*citreicoxa*, n. sp. (Borneo).
Colour black.	(3)
(3) Head strongly punctured . . .	*nigricollis*, Cam. (Borneo).
Head finely punctured . . .	*javanica*, n. sp. (Java).

Lapitha citreicoxa, n. sp.

♂. Head black; thorax rich ochreous, the centre of scutum, the scutellum and the postscutellum dusky-black; abdomen dull brown, yellow in centre; legs, including the coxae, pale lemon yellow; scape and pedicel yellow, the rest of the antennae black.

Head transverse; densely rugo-punctate, the sculpture not coarse; occipital margin transversely striate; cheeks striate; mouth with converging striae; lower half of frons with a broad shallow depression, smooth and shining and with a pair of fine median carinae running to antennal insertions; eyes large, bare; ocelli wide apart, the lateral pair against the eye margins. Antennae 12-jointed; scape slender; pedicel short, as wide as long; flagellar joints long and filiform, subequal, several times as long as wide. Thorax a little longer than its greatest width; parapsidal furrows absent;

scutum large, with fine dense pubescence and finely wrinkled or alutaceous; scutellum semicircular, its anterior and posterior margins foveate, with sculpture similar to the scutum; postscutellum a little produced, transverse, its angles sub-acute, produced at meson into a distinct spine, with two curved carinae running from the angles to the meson; median segment short, rugose; propleurae depressed, smooth; mesopleurae with a deep elongate smooth depression; metapleurae rugose. Fore-wings reaching apex of abdomen; broad; a little yellowish; venation fuscous; submarginal vein attaining the costa at fully half-wing length; marginal vein one-half as long as the stigmal which is moderately long and a little curved; postmarginal over twice as long as stigmal; basal vein distinct, perpendicular, the median and radial veins indicated. Abdomen somewhat longer than head and thorax united; fusiform; segments wider than long, 2 and 3 longest, 5 and 6 short; 1–3 striate, 4–6 densely finely punctate. Legs slender; basal joint of posterior tarsi as long as the rest united. Length, 3 mm.

Described from three males labelled "*Acanthoteleia ruficollis* Cam., Kuching, Borneo; J. H. Hewitt."

Type and cotypes in the British Museum.

Lapitha javanica, n. sp.

♂. Black; coxae black, the legs dusky, the anterior and tibiae yellow; scape brown, rest of antennae black.

Head transverse; finely densely punctate and coriaceous; mouth with converging striae; lower half of frons smooth and shining, not depressed, and with a median carina; eyes large, bare; ocelli wide apart, the lateral pair a little separated from the eye margins. Scape long and slender; pedicel short, as wide as long; flagellar joints cylindrical, filiform, pilose, slightly decreasing in length toward apex, 3 with a slight excision at half its length. Thorax stout; parapsidal furrows absent; scutum and scutellum densely granulate and with very short pubescence; scutellum with a foveate line at anterior and posterior margins; postscutellum as in *citreicoxa*; pleurae mostly smooth, mesopleurae with a narrow elongate depression, striate against the tegulae. Fore-wings reaching a little beyond apex of abdomen; broad; infuscate; venation fuscous; marginal vein one-third as long as the stigmal which is a little curved; postmarginal twice as long as the stigmal; basal vein distinct, oblique, the median and radial veins faintly marked. Abdomen a little longer than head and thorax conbined; segments all wider than long, 3 hardly longer than 2; shining; segments 1–3 striate, 4–6 with minute punctures and short pubescence. Length, 2·5 mm.

Described from three males labelled "5000–7000 feet, Tjibodas, Java, Aug. 1913; Dr. Konigsberger."

Type and cotypes in the British Museum.

Belongs to the *Acantholapitha* group and near *nigricollis*, which according to Cameron has the vertex and frons strongly punctured.

Lapitha divina, n. sp.

♂. Dull reddish-brown, the scutum, except posteriorly, and the frons, bright ochreous; coxae dusky, the legs yellow; scape yellow, the antennae black.

Head transverse; vertex, cheeks, and upper half of frons densely coriaceous and with obscure small punctures; lower half of frons with a smooth faint depression traversed by a median carina; on either side of this depression finely wrinkled; mouth with converging striae; eyes large, bare; ocelli wide apart, the lateral pair a little separated from the eye margins. Antennae 12-jointed; pedicel no longer than wide; flagellar joints long and filiform, pilose, 1 a little longer than 2, which is shortest, 4 and 5 longest each twice as long as 2; scutum and scutellum finely wrinkled or alutaceous, and with fine pubescence; parapsidal furrows absent; scutellum with a foveate line at anterior and posterior margins; postscutellum with a triangular tooth that is no longer than its basal width; pleurae as in *javanica*. Fore-wings reaching a little beyond apex of abdomen; somewhat dusky, almost hyaline at base; venation fuscous; marginal vein one-half as long as the stigmal which is rather short; postmarginal twice as long as the stigmal; basal vein distinct, a little oblique; median and radial veins indicated. Abdomen a little longer than head and thorax united; segment 2 as long as its greatest width, 3 as long as 2; 1–3 striate, 3 rather finely so, 4–6 rather finely densely pubescent and finely sculptured. Length, 1·75 mm.

Described from four males labelled "5000–7000 feet, Tjibodas, Java, Aug. 1913; Dr. Konigsberger."

Type and cotypes in the British Museum.

Merriwa, n. gen.

♂. Head normal, transverse; frons with a broad area faintly depressed and margined laterally; eyes large, bare; ocelli wide apart, the lateral pair a little separated from the eye margins. Antennae 12-jointed; scape long and slender; the flagellar joints long and cylindrical. Thorax normal; pronotum hardly visible from above, rounded anteriorly; parapsidal furrows deep and distinct; scutellum semicircular, with a foveate line along anterior and posterior margins, with a short spine against either latero-posterior margin; postscutellum short, with two large teeth; median segment declivous laterally, its posterior margin straight, with three carinae at meson. Fore-wings long and broad; submarginal vein attaining costa at half-wing length; marginal vein one-third as long as the stigmal which is moderately long; a long false radial vein reaches the costa thus forming a long false radial cell; post-marginal vein long; basal vein distinct, the median hardly indicated. Abdomen fusiform; a little longer than head and thorax combined; somewhat narrowed at base; segment 1 as long as wide, 2 gradually widening, a little longer than its greatest width, 3 as long as 2 and as long as wide, the others transverse. Legs slender.

In Kieffer's table of genera (1910), running to *Dichoteleas* Kieffer, from which it differs in having the postscutellum bispinose; agreeing with *Dilapitha* Kieffer, except for the short spines on the scutellum.

Type, the following species.

Merriwa quadridentata, n. sp.

♂. Dull black; coxae fuscous, also the femora and apical half of posterior tibiae, the legs otherwise pale yellow; antennae black, the scape yellow.

Vertex finely granulate, with a few fine transverse striae against occipital margin; eye margins carinate; upper half of frons finely transversely striate, the lower half smooth and shining and with a median carina running from antennal insertions; cheeks finely granulate. Pedicel almost twice as long as its greatest width; flagellar joints pilose, 1 nearly twice as long as pedicel, 2–9 very gradually shortening, 10 a little longer than 1. Scutum and scutellum finely densely punctate and a little pubescent; propleurae and mesopleurae shining, without sculpture, the latter deeply depressed and foveate along its margins; metapleurae smooth. Fore-wings reaching a little beyond apex of abdomen; brownish, hyaline at base; venation fuscous. First abdominal segment striate, 2 striate, the others finely rather densely punctate and with fine pubescence. Length, 2·25 mm.

Described from three males labelled "5000–7000 feet Tjibodas, Java, Aug. 1913; Dr. Konigsberger."

Type and cotypes in the British Museum.

Baryconus Foerster.

Baryconus Foerster, Hym. Stud. Aachen, vol. 2, 1856, p. 101.

Lamproteleia Kieffer, Bull. Soc. Ent. France, vol. 15, 1910, p. 293.

Kieffer has described his genus as having no postmarginal vein; I have examined the genotype, and find that the postmarginal vein is very long, but owing to the colorational characters of the wing, while the marginal vein is very dark, the postmarginal is very faintly coloured, which would account for Kieffer's mistake; *fasciatipennis* Kieffer is remarkably like several of the Australian species, notably *fasciatus* Dodd.

Baryconus pictus, n. sp.

♀. Dull reddish-brown; abdomen clear yellow, marked with dusky black as follows:—basal horn, along lateral margin of segment 2 for apical two-thirds, along lateral margin of segment 3 for apical half, bands across posterior margins of segments 2–4, also tip of abdomen; legs clear yellow, the coxae dusky; antennal scape and club fuscous, the funicle yellow.

Head normal; wholly densely confluently punctate and finely coriaceous; eyes moderately large, with a few long setae; lateral ocelli separated from the eye margins by their own diameter; frons not depressed. Antennae separated at base by a tubercle; 12-jointed; scape long and slender; pedicel nearly twice as long as its greatest width; funicle 1 fully as long as pedicel, 2 a little longer than wide, 3 quadrate, 4 wider than long; club 6-jointed, the joints wider than long, 1 small, 2 a little the largest. Thorax somewhat longer than its greatest width; pronotum short, rounded anteriorly; scutum and scutellum sculptured like the head; parapsidal furrows wanting; postscutellum very short, unarmed; median segment unarmed.

Fore-wings reaching a little beyond apex of abdominal segment 4; broad; rather deeply dusky, with a long hyaline band beneath the second third of the submarginal vein, and an irregular narrow hyaline band beneath marginal and most of stigmal veins; venation fuscous; submarginal vein attaining the costa at fully half wing length; marginal vein one-half as long as the stigmal which is long, oblique; postmarginal one-half longer than the stigmal; no trace of other veins. Abdomen narrowed at base, pointed at apex; one-half longer than head and thorax united; with a basal horn projecting over median segment; 1–3 all longer than wide, 3 a little longer than 2, 4 one-half as long as 3, 5 shorter than 4, 6 conical, nearly twice as long as 5, about three times as long as its basal width; 1–3 rather finely striate, the rest smooth except for a few pin-punctures; basal horn rugose. Length, 2 mm.

Described from one female labelled "Ceylon; Dr. Thwaites."

Type in the Hope Collection, Oxford.

Holoteleia tenuicornis, n. sp.

♀. Fuscous; thorax dull dusky reddish; legs wholly yellow; antennal scape and funicle brown, the club fuscous.

Head normal; smooth and shining, against occipital margin pubescent and finely coriaceous; eyes large, feebly pubescent; ocelli wide apart, the lateral pair well separated from the eyes; frons not depressed. Antennae 12-jointed; scape slender; pedicel hardly longer than its greatest width; funicle joints 1–3 long and slender, pilose, 1 somewhat shorter than 2, 3 hardly shorter than 2, 4 quite short and no longer than wide; club plainly 6-jointed, the joints a little wider than long. Parapsidal furrows distinct and complete; scutum smooth and shining, the anterior half of median lobe finely pubescent and coriaceous, the lateral lobes with a few small punctures; scutellum large, smooth, its anterior and posterior margins foveate; postscutellum unarmed; median segment longitudinally foveate-striate, its caudo-lateral angles subacute. Fore-wings reaching a little beyond apex of abdomen; moderately broad; subhyaline; venation fuscous; submarginal vein attaining costa a little before half-wing length; marginal vein as long as the stigmal which is moderately long and oblique; postmarginal four times as long as the stigmal; basal vein distinct, the median hardly indicated. Abdomen hardly longer than head and thorax united; basal segment distinctly narrowed, somewhat longer than wide; without a horn or protuberance at base; 3 a little longer than 2, as long as the following united; 1 and base of 2 strongly striate, the rest smooth and without sculpture. Length, 1·6 mm.

♂. Antennae filiform; pedicel hardly longer than wide; flagellar joint 1 distinctly shorter than 2 or 3 which are more than three times as long as wide, 4–9 shortening.

Described from two females, one male, labelled "5000–7000 feet, Tjibodas, Java, Aug. 1913; Dr. Konigsberger."

Type and cotypes in the British Museum.

Opisthacantha bifasciata, n. sp.

♀. Dull red-brown; abdomen yellow, its second and fourth segments fuscous; antennae fuscous, the funicle yellow; legs, including the coxae, yellow.

Head normal; wholly densely reticulate and coriaceous; frons not depressed; eyes rather large, a little pubescent; ocelli wide apart, the lateral pair a little separated from the eye margins. Antennae 12-jointed; scape long and slender; pedicel one-half longer than its greatest width; funicle 1 as long as pedicel, 2 a little shorter, 3 and 4 small and transverse; club 6-jointed, the joints wider than long, 2 a little the largest. Thorax a little longer than its greatest width; pronotum very short, rounded anteriorly; scutum and scutellum sculptured like the head; parapsidal furrows absent; postscutellum with a short spine; median segment with its posterior angles with a short tooth. Fore-wings reaching apex of abdomen; moderately broad; base of wing hyaline, a broad fuscous band beneath apex of submarginal and all marginal and stigmal veins followed by a narrow hyaline band, the apex broadly fuscous; submarginal vein attaining the costa at more than half-wing length; marginal vein two-thirds as long as the stigmal which is short and very oblique; postmarginal over twice as long as the stigmal; basal vein well marked, perpendicular. Abdomen a little longer than head and thorax united; narrowed at base, pointed at apex; segments much wider than long, 3 a little longer than 2 and as long as the following combined, 1 with a small protuberance at base; 1 and 2 finely striate, the rest without sculpture. Length, 1·25 mm.

Described from one female labelled "Ceylon; Dr. Thwaites."

Type in the Hope Collection, Oxford.

Probaryconus minor Wollaston.

Scelio minor Wollaston, Ann. Mag. Nat. Hist. vol. 1, 1858, p. 26.

This is not a *Scelio*, but belongs here; the postmarginal vein is short, as long as the stigmal; parapsidal furrows wanting; postscutellum with a short blunt tooth; abdomen narrowed at base, with a distinct basal protuberance in the female.

Sceliacantha subplana, n. sp.

♀. Dull black; legs, except the coxae, clear yellow; antennal scape yellow, the antennae otherwise fuscous.

Body somewhat flattened. Head rather flattened; eyes rather small, with long scattered setae; ocelli small, wide apart, the lateral pair separated from the eyes by more than half their distance from the median ocellus; frons not depressed; vertex, cheeks, and frons (except for a smooth area above antennal insertion), punctate but not densely, and with indications of longitudinal connecting striae or sulci. Antennae separated by a tubercle; 12-jointed; scape long and slender; pedicel one-half longer than its greatest width; funicle 1 hardly as long as pedicel, 2 as wide as long, 3 and 4 wider than long; club 6-jointed, the joints much wider than long, 1 small. Thorax hardly longer than its greatest width; pronotum hardly visible, rounded anteriorly; scutum and scutellum punctate like the head; parapsidal furrows complete; postscutellum as a foveate line, with two small teeth, wide apart; median segment short at meson, its lateral margins with a blunt tubercle at half its length, its posterior angles with a sharp tooth. Fore-wings rather short, hardly reaching apex of abdomen; moderately broad; a little infuscate; venation yellowish; submarginal vein attaining the costa at half-wing length; marginal vein one-third as long as the stigmal which is moderately long, the post-marginal hardly developed, as long as the marginal; no trace of median and basal veins. Abdomen fusiform; somewhat longer than head and thorax united; a little wider than thorax; pointed at apex; segment 1 with a tubercle at base, 3 a little wider than long and as long as 1 and 2 united or the following united; 1 and 2 striate, 3 polygonally reticulate and finely striate, 4–6 punctate. Length, 1·25 mm.

Described from one female labelled "Ceylon; Dr. Thwaites."

Type in the Hope Collection, Oxford.

The type and only other member of the genus is Australian. The present species differs in having the postmarginal vein poorly developed.

Trichoteleia atripes, n. sp.

♀. Coal-black; coxae black, the legs black with a brownish tinge, the tarsi paler, also the knees; antennae wholly black.

Head normal; eyes large, bare; ocelli moderately wide apart, each in a margined depression; frontal depression large, deep, and margined, smooth and shining, very narrowly separated from eye margins; vertex with large shallow punctures, not confluent; occipital margin foveate; cheeks punctate. Antennae 12-jointed; scape long and slender; pedicel one-half longer than its greatest width; funicle 1 rather longer than pedicel, twice as long as its greatest width; 2 as long as 1, 3 a little shorter, 4 longer than wide; club slender, 6-jointed, the joints longer than wide, 2 the longest. Thorax somewhat longer than its greatest width; pronotum very short, its angles rounded; scutum large, opaque, minutely transversely wrinkled; parapsidal furrows deep and complete, wide apart; scutellum semicircular, smooth and shining, its posterior margin foveate; postscutellum foveate, with a short bidentate tooth at meson; median segment short, rugose; propleurae punctate; mesopleurae punctate, with a smooth depressed central area; metapleurae rugose. Fore-wings attaining apex of abdomen; broad; dusky; venation fuscous; submarginal vein attaining costa at half-wing length; marginal vein one-third as long as the stigmal which is long, almost perpendicular; postmarginal fully twice as long as the stigmal; radial vein indicated; basal and median veins as thick yellow lines, the former oblique and almost joining the marginal vein. Abdomen a little longer than head and thorax united; a little narrowed at base, pointed at apex; segments all wider than long, 3 a little longer than 2 and almost as long as the following united; 1 without a horn or protuberance; 1 and 2 strongly striate, 3 and 4 densely punctate in irregular longitudinal rows, 5 less densely punctate. Legs slender. Length, 4 mm.

Described from one female labelled "Dore, Dutch New Guinea; Wallace."

Type in the Hope Collection, Oxford.

I think this species belongs here; the type species is from Madagascar.

Rhacoteleia Cameron.

I have examined the types of *pilosa* Cameron, the type species. I think the genus is synonymous with *Hoploteleia* Ashmead; it differs only in having the third groove on the scutum subobsolete, but this character is found in several of the Australian species of *Hoploteleia*.

Hoploteleia Ashmead.

Hoploteleia Ashmead, Bull. U.S. National Museum, 1893, p. 227.

Apegusoneura Cameron, Soc. Entom., Stuttgart, 27, 1912, p. 69.

Cameron could not have known *Hoploteleia* or he would have seen that his genus was identical with it; he also states that the female antennae are filiform, but he mistook the sexes; I have seen a female of *carinata* Cameron which has typical clubbed antennae. The three species *nigricornis* Cameron, *carinata* Cameron, and *striolata* Cameron, all fall into *Hoploteleia*.

Hoploteleia africana, n. sp.

♀. Black, the antennae concolorous, the first four or five joints more or less brownish; coxae black, femora dusky-black, tibiae and tarsi yellow.

Head subquadrate; finely reticulate or shagreened; vertex also with a few irregular longitudinal striae or carinae; with white pubescence; frons with a large deep margined depression which has fine cross-striae; eyes large, bare; ocelli large, well separated. Antennae 12-jointed; scape slender; pedicel not much longer than its greatest width; funicle 1 rather longer than pedicel, 2–4 shorter than 1; club 6-jointed, joint 2 a little the largest. Mesothorax pubescent; scutum with three well-defined furrows, shagreened; scutellum coarsely rugose; postscutellum with two sharp teeth close together. Fore-wings reaching apex of abdomen; hyaline; venation fuscous; submarginal vein attaining costa at fully half-wing length; marginal vein short, the stigmal moderately long and oblique; postmarginal over twice as long as the stigmal. Abdomen rather stout, not much longer than its greatest width; pointed and with two stout spines at apex; segments wider than long, the third as long as the preceding two united; segments 1 and 2 striate, 3 and 4 finely longitudinally rugose. Length, 1·75 mm.

♂. Legs, except coxae, golden-yellow; differs from the female in that the head is rather coarsely rugose; there is very little pubescence on head and thorax; and the sculpture of the abdomen is rather coarser. Pedicel short and stout, the flagellum filiform, joint 1 a little the longest, 3 slightly excised.

Described from one pair labelled "Durban, Natal; F. Muir."

Type and cotype in the British Museum.

This is the first African species of the genus. The male may be that of another species, the differences possibly being more than sexual.

Hoploteleia orthopterae, n. sp.

♀. Black; legs bright reddish-yellow, the coxae black; antennal scape bright reddish-yellow, next six joints dusky-yellow, the apical five black; tegulae yellow.

Head no wider than thorax; vertex twice as wide as long; vertex and cheeks densely granulate, and also with shallow obscure large punctures which are wanting around ocelli; between ocelli rugose; against occipital margin with a more or less distinct abbreviated median carina; frontal depression large, profound, and margined, finely transversely striate; eyes large, bare; ocelli large, close together, the lateral pair a little separated from the eyes. Antennae 12-jointed; scape slender; pedicel almost twice as long as its greatest width; funicle 1 a little longer than pedicel, almost three times as long as wide, 2 and 3 somewhat longer than wide, 4 quadrate; club 6-jointed, joint 1 small and wider than long, 2 somewhat longer than wide, 3–5 quadrate. Thorax not much longer than its greatest width; scutum densely granulate, the median lobe with indications of shallow punctures; parapsidal furrows distinct, the median groove replaced by an obscure carina; scutellum semicircular, granulate, with a median row of punctures, also punctate around the margins; postscutellum with a short bidentate tooth; median segment, mesopleurae and metapleurae, longitudinally rugo-striate; propleurae granulate. Fore-wings reaching slightly beyond apex of abdomen; broad; hyaline; venation yellowish; submarginal vein attaining the costa at half-wing length; marginal vein short, about one-fourth as long as the stigmal which is long and nearly perpendicular; postmarginal barely twice as long as the stigmal. Abdomen hardly longer than thorax; hardly twice as long as its greatest width; pointed at apex and with two short spines; segment 3 somewhat wider than long, as long as 1 and 2 united, and longer than the following united; 1 strongly striate, 2 striate, and between the striae finely reticulate, 3 irregularly striate and densely reticulate, 5 and apex of 4 finely granulate. Posterior tarsi hardly longer than their tibiae, their basal joint almost as long as the following united. Length, 2·5 mm.

♂. Agreeing in all respects with the female. Antennae testaceous, dusky toward apex; pedicel a little longer than its greatest width; funicle 1 over twice as long as its greatest width, 3 hardly shorter than 1 and a little longer than 2, 4–9 one-half longer than wide.

Described from two females, two males, bred from eggs of an Orthopteron on leaf, Freetown, Sierra Leone, West Africa, 1915 (*A. W. Bacot*).

Type and cotypes in the British Museum.

At once differing from *africana* in lacking the median groove of the scutum. Of the European species nearest *europaea* Kieffer, but the flagellar joints in the male are longer.

Hoploteleia serena, new name.

Hoploteleia carinata Kieffer, Insecta, 1913, p. 368.

Kieffer's name is preoccupied by *carinata* Cameron (1912).

Hoploteleia atricornis, new name.

Hoploteleia nigricornis Dodd, 1913, Trans. Royal Soc. of S. Aust., p. 134.

The name *nigricornis* is preoccupied by Cameron's species (1912).

Hoploteleia mandibularis Kieffer.

Seven specimens labelled "Teapa, Tabasco, Mexico; H. H. Smith."

Hoploteleia rugosiceps Kieffer.

One female labelled "Atoyac, Vera Cruz, Mexico; H. H. Smith"; originally described from Nicaragua.

Hoploteleia erythropa Cameron.

Macroteleia erythropa Cameron, J. R. Agric. Soc., Demerara, 1913, p. 134.

I have examined the type of this species; it is a typical species of *Hoploteleia.*

Cremastobaeus bicolor Ashmead.

One female bred from base of grass, *Imperata caudata*, July 1916, Issorora, N. W. District, British Guiana (*C. B. Williams*). The type locality is St. Vincent, West Indies.

PARASCELIO, n. gen.

♀. Head subquadrate; somewhat produced anteriorly, not emarginate but with numerous fine small tubercles; frons straight from this production to the mouth which is against posterior margin of head; eyes large, bare; ocelli wide apart, the lateral pair against eye margins. Antennae normal, 12-jointed, the club 6-jointed. Thorax normal; parapsidal furrows distinct; scutellum unarmed: postscutellum with a short spine; median segment unarmed. Fore-wings normal; marginal vein as long as the stigmal which is moderately short; postmarginal absent. Abdomen several times as long as wide; fusiform; not narrowed at base; pointed at apex; segments 1 and 2 as wide as long, 3 and 4 subequal and longer than 1 or 2, 5 and 6 short; 1 without a horn or protuberance; 2 at base, 3 at base and apex, and 4 at base, depressed, so that viewed from the side the abdomen has a series of humps or ridges.

With the general habitus of *Macroteleia*; the form of the head and more especially the abdomen, make the genus quite distinct.

Type, the following species.

Parascelio undulatus, n. sp.

♀. Black; legs wholly yellow; antennae fulvous, the club black. Head finely coriaceous and with dense moderately large punctures. Scape slender; pedicel more than twice as long as its greatest width; funicle joints narrow, 1 fully as long as pedicel, 2 distinctly shorter, 4 as wide as long; club joints somewhat wider than long, 2 a little the longest. Scutum and scutellum densely punctate and with short pubescence. Wings hyaline, reaching apex of abdomen. Abdomen hardly twice as long as head and thorax united; segments 1 and 2 strongly striate, 3 and base of 4 striate and also with punctures, the rest rather finely punctate. Length, 2·25 mm.

Described from one female labelled " Frontera, Tabasco, Mexico; H. H. Smith."

Type in the British Museum.

Anteris charmus Walker.

Telenomus charmus Walker, Mon. Chalciditum, vol. 2, 1839, p. 59.

♀. Black; legs brownish-yellow or suffused dusky; antennal scape brown.

Head subquadrate; finely densely reticulate; eyes large, bare; ocelli small, wide apart, the lateral pair against the eyes. Antennae 12-jointed; scape longer than next five joints combined; pedicel one-half longer than wide; funicle joints small, 1 longest but distinctly shorter than pedicel, 2–4 wider than long; club stout, 6-jointed, joints wider than long, 2 a little the longest. Scutum and scutellum finely densely reticulate; parapsidal furrows absent; scutellum foveate at base; postscutellum with a short tooth. Forewings reaching a little beyond apex of abdomen; venation fuscous; marginal vein thickened, as long as the short stigmal; postmarginal absent. Abdomen short; broadly oval; narrowed at base; scarcely longer than its greatest width; pointed at apex; segment 1 very short, transverse; 3 occupying half of surface but wider than long; 1 and 2 striate, the rest finely densely reticulate. Length, 1 mm.

Walker's type from Albany, S. W. Australia.

Sparasion sinense Walker.

I have seen Walker's type, also a second specimen labelled "Hongkong, F. W. Terry." Very similar to *formosum* Kieffer, with which I have compared it, but the scattered punctures on the scutum are more marked in *sinense*, the pleurae are smooth centrally, the abdomen is more slender and with very few hairs (in *formosum* rather densely pubescent), and the first flagellar joint is rather longer, twice as long as the second.

Scelio crassellus, n. sp.

♀. Black; antennae concolorous; coxae deep brown, the legs yellow, the tibiae a little suffused with brown.

Head normal, transverse; very coarsely rugo-punctate, without pubescence; antennal depression narrow, short, deep, and smooth, not as wide as its distance from the eyes. Antennae 12-jointed; scape long and slender; pedicel somewhat longer than its greatest width; funicle 1 hardly one-half longer than its greatest width, 2 wider than long; club at least 7-jointed. Thorax normal; pronotum truncate anteriorly, its angles subacute; scutum and scutellum very coarsely rugo-punctate; postscutellum short, foveate; median segment short at meson, sculptured like the scutellum, the sculpture finer laterally where there is white pubescence; pleurae densely rugo-punctate, but not as coarse as on scutum; parapsidal furrows not evident. Fore-wings not reaching apex of abdomen; broad; fuscous; venation rather distinct; a stigmal spot involves apex of submarginal and base of stigmal veins, the latter rather long and nearly perpendicular. Abdomen conic-ovate; segments wider than long; 3 almost as long as 1 and 2 united, 4 as long as 3; 2 distinctly depressed at base; 1 strongly rugo-striate, 2–4 densely rather finely striate and between the striae finely granulate, 5 with a few striae. Length, 4 mm.

Described from one female from Kuching, Borneo (*J. Hewitt*), and labelled "*Rhopaloscelio rufipes* Cameron." Type in the British Museum.

Scelio wallacei, n. sp.

♂. Black; antennae wholly black; legs wholly black, the knees ferruginous.

Head normal, transverse; eyes large, bare; ocelli large, wide apart, the lateral pair separated from the eyes by their own diameter; frons with a narrow shallow impression which is smooth and shining; vertex with large rather dense punctures, confluent and with a rugose tendency on the frons; mouth with converging striae; cheeks margined and also with two long central carinae, between these carinae punctate. Antennae 10-jointed; scape long and slender; pedicel hardly longer than its greatest width; funicle 1 one-half longer than its greatest width, 2 a little shorter, 3 enlarged and wider than the other joints and as long as wide, 4–7 wider than long. Thorax stout; pronotum rugose, truncate anteriorly; parapsidal furrows distinct for posterior half; scutum with large shallow punctures, subconfluent, with a longitudinal tendency; scutellum coarsely rugose; postscutellum as a foveate line; median segment rather finely rugose, laterally with a pubescent area; all pleurae densely rugo-punctate. Fore-wings almost reaching apex of abdomen; broad; dusky, almost hyaline along margins; venation fuscous; submarginal vein reaching the margin in a punctiform marginal vein; stigmal vein leaving the submarginal, long, faintly curved; radial vein indicated, the basal and median veins represented by thick yellow lines; stigmal spot obscure. Abdomen fusiform; rounded at apex; segments wider than long, 3 a little longer than 2 or 4; 2 a little depressed at base; 1 and 2 strongly striate and finely rugose between the striae, 3 with irregular striae and coarse reticulate rugosity, 4 with more striae and less reticulation, 5 and 6 striate and between the striae opaque. Legs slender. Length, 5 mm.

Described from one male labelled "Dore, Dutch New Guinea; Wallace."

Type in the Hope Collection, Oxford.

Scelio subpolitus, n. sp.

♂. Black; coxae black, the legs dusky black; antennal scape black, the flagellum brown.

Head normal ; frons not depressed; eyes large, bare; ocelli large, wide apart, the lateral pair separated from the eyes by nearly their own diameter; vertex with large scattered punctures, with a smooth impunctate area between the ocelli; punctures dense and in transverse rows against occipital margin; cheeks margined, with two long central carinae and between the carinae rugo-punctate; upper half of frons confluently punctate, the lower half smooth and shining; mouth with converging striae. Antennae 10-jointed; scape long and slender; pedicel a little longer than its greatest width; funicle 1 one-half longer than its greatest width, 2 as wide as long, 3 a little widened and rather wider than long, not much longer than following joints. Thorax normal; pronotum truncate anteriorly, its angles subacute, rugose; scutum smooth and shining, with a few scattered punctures; parapsidal furrows consisting of a row of punctures; scutellum coarsely longitudinally puncto-striate; median segment finely rugose, with a pubescent area laterally; all pleurae coarsely rugo-punctate. Fore-wings reaching apex of abdomen; broad; a little dusky, with a dark area in place of basal and median veins; venation indistinct; submarginal vein not reaching the costa, the stigmal rather long; stigmal spot small. Abdomen fusiform, rounded apically; segments wider than long, 3 rather longer than 2 or 4; 2 plainly depressed at base; 1 strongly striate, the rest finely striate and between the striae coriaceous, 3 and 4 almost smooth at meson, sutures between segments smooth and shining. Length, 3·5 mm.

Described from one male labelled "Mysol, East Indies; Wallace."

Type in the Hope Collection, Oxford.

Scelio erythropus, n. sp.

♀. Head and posterior half of abdomen, black; thorax and basal half of abdomen, orange; scutellum dusky; legs orange, also scape, funicle fuscous, the apical four or five club joints pale yellow.

Head normal, with large punctures, these confluent on frons, sub-confluent on vertex; a few striae around mouth; frontal depression short and narrow, smooth; eyes large, bare. Scutum confluently rugo-punctate, also the scutellum; parapsidal furrows evident; median segment rugose. Fore-wings reaching apex of abdomen; dusky; venation indistinct; stigmal spot distinct, covering base of a stigmal vein. Abdomen about twice as long as its greatest width; segments all wider than long, 3 a little the longest; 1 rugo-striate, the rest rather finely densely striate and finely coriaceous between the striae, apex of 3, 4 and 5 with a semi-smooth narrow mesal area. Scape long and slender; funicle 1 longer than pedicel and distinctly longer than its greatest width, the following all wider than long. Length, 4 mm.

Described from one female labelled "Adelaide River, North Australia."

Type in the British Museum.

Scelio australiensis Kieffer.

Scelio australiensis Kieffer, Bull. Soc. Hist. Nat., Metz, 1905, p. 100.

S. australiensis Kieffer, Ann. Soc. Scient., Bruxelles, 1908, p. 133.

S. australiae Kieffer, Genera Insectorum, 1910, p. 74.

Kieffer has made the strange mistake of describing the same insect twice under the same name, and then finding a new name for the second description of the insect. The type specimen is from Mt. Victoria, New South Wales. Closely allied with *punctaticeps* Dodd, and may be identical.

Scelio semisanguineus Girault, var. **nigrocinctus**, n. var.

♀. Head black; thorax bright red, the scutellum fuscous, centre of thorax ventrally fuscous; abdomen red, margined narrowly with fuscous, segments 5 and 6 fuscous, beneath wholly red; legs reddish yellow, the intermediate and posterior coxae black; first four antennal joints yellow, the others black.

Head normal; vertex twice as wide as long; occipital margin concave; eyes large, bare; lateral ocelli against eye margins; without distinct pubescence; coarsely rugo-punctate, this sculpture disappearing behind anterior ocellus where there are irregular striae; transversely striate against occipital margin; with converging striae around mouth; frontal depression narrow, short, and smooth. Antennae 12-jointed; scape as long as next five joints combined; pedicel one-half longer than its greatest width; funicle 1 one-half longer than its greatest width, 2 rather wider than long; club stout, 6- or 7-jointed. Pronotum truncate anteriorly, its angles rounded; parapsidal furrows evident, but rather obscure; scutum and scutellum coarsely rugo-punctate; median segment moderately long, longitudinally obliquely striate and finely rugose, with fine pubescence laterally, at meson with two straight striae appearing as carinae; all pleurae strongly striate. Fore-wings long; broad; hyaline at base, deeply cloudy for the rest; venation indistinct; stigmal spot obscure; stigmal vein rather long. Abdomen conic-ovate, more than twice as long as its greatest width; segment 3 no longer than 1 and 2 united, 4 a little shorter than 3; 2 distinctly depressed at base; 1 and 2 densely longitudinally striate and between the striae finely coriaceous; 3 densely and finely polygonally reticulate, somewhat irregular and in raised lines; 4 with similar sculpture in centre at base, otherwise finely striate; 5 striate. Length 3 mm.

Described from one female labelled "Yallingup, S.W. Australia, Dec. 1913; R. E. Turner."

Type in the British Museum.

The abdomen is much more red than in the typical form.

Scelio melanogaster, n. sp.

♀. Head and abdomen black; thorax bright red, the scutellum fuscous; legs wholly reddish-yellow; antennae black, the scape fuscous.

Head normal; vertex rather long, not twice as wide as long; without pubescence; with very large confluent punctures; frontal depression smooth, not long, not as wide as its distance from the eye margins; eyes large, bare. Antennae 12-jointed; scape rather stout; pedicel somewhat longer than its greatest width; funicle 2 wider than long; club 6- or 7-jointed. Thorax normal; pronotum truncate anteriorly, its angles rounded; scutum and scutellum coarsely rugo-punctate, with a longitudinal tendency; parapsidal furrows not evident; postscutellum short, faintly emarginate; median segment long, without pubescence, more finely rugo-punctate than the scutum. Fore-wings long and broad; rather deeply infuscate; stigmal spot not large, the stigmal vein moderately long and oblique. Abdomen hardly twice as long as its greatest width; segment 4 as long as 3, which is almost as long as 1 and 2 combined; 2 strongly depressed at base; 1–4 rugo-puncto-striate, apex of 4, and 5 and 6 more plainly striate. Length, 3 mm.

Described from one female labelled "Mackay, Queensland, May 1897; R. E. Turner."

Type in the British Museum.

Scelio gobar Walker.

I have examined the types, and as the original description is very insufficient, I give a short description.

♀. Black, the antennae concolorous, the pedicel brownish; coxae black, femora dusky, tibiae and tarsi yellow.

Frons with large confluent punctures, the lower half with striae converging toward mouth; centre of vertex partly smooth. Scutum and scutellum coarsely rugo-punctate; parapsidal furrows present.

Abdominal segments wider than long, 3 a little the longest, 1 strongly striate, the rest finely striate and granulate, striae absent at meson. Fore-wings ample; dusky; submarginal vein not well determined; a distinct stigmal spot involves almost all the stigmal vein. Pedicel longer than funicle 1 and longer than its greatest width. Length, 4 mm.

♂. Head coarsely rugose, also scutum and scutellum; stigmal spot not marked.

Two females, one male labelled "V.D.L." (Van Diemen's Land).

The male quite probably is that of a different species.

Scelio australis Froggatt.

Scelio australis Froggatt, Farmers' Bull. N. S. Wales, No. 29, 1910, p. 34.

Scelio froggatti Crawford, Proc. U.S. Nat. Museum, 41, 1911, p. 268.

I have sent specimens of *australis* to Mr. J. C. Crawford of the United States National Museum, who has compared them with the types of *froggatti*, pronouncing them to be identical. This is a very common species ranging from the Northern Territory to New South Wales.

Scelio brasiliensis Kieffer.

I have seen a male of what I take to be this species collected by C. B. Williams in British Guiana.

Scelio venezuelensis Marshall.

Several specimens bred from eggs of *Schistocerca paranensis*, 1.ix.17, Kaitima, Barima River, British Guiana (*L. D. Cleare*). I think I have identified the species correctly. The femora are a little brownish; the male antennae are black, the flagellum a little brownish, the third flagellar joint distinctly enlarged.

Discelio Kieffer.

Discelio Kieffer, Ann. Soc. Ent. Bruxelles, 32, 1908, p. 116, 124.

Dichacantha Kieffer, ibidem, p. 118, 147.

I have examined the types of *Discelio thoracicus* Ashmead, *Discelio insularis* Ashmead, and *Dichacantha lutea* Cameron, and they are certainly congeneric; thus *Dichacantha* must fall. The genus differs from *Scelio* only in the bidentate form of the postscutellum. I cannot blame Kieffer for the characters he attributes to *Dichacantha* as Cameron's original description of *lutea* is very faulty.

Sceliomorpha ceylonensis, n. sp.

♀. Black; legs, including the coxae, and first six antennal joints golden-yellow.

Head normal, the frons convex; eyes very large, bare; ocelli large, the lateral pair against eye margins; frons with a deep margined depression; transversely rugo-striate. Antennae 12-jointed; scape slender; pedicel over one-half longer than its greatest width; funicle 1 hardly as long as pedicel, 2 and 3 as wide as long, 4 widened; club joints wider than long, 1 a little the longest. Thorax stout; scutum and scutellum coarsely rugose, with a longitudinal tendency; parapsidal furrows distinct, wide apart, the median lobe with a delicate median carina; postscutellum as long as wide, projecting over median segment which is very short. Fore-wings reaching apex of abdomen; venation yellowish; submarginal vein well separated from the costa which it joins rather beyond half-wing length; marginal vein punctiform, the stigmal long, oblique; postmarginal absent. Abdomen hardly longer than head and thorax united, pointed at apex; segments all wider than long; 2 and 3 subequal; wholly longitudinally rugo-striate. Length, 3 mm.

Described from four females labelled "Ceylon; Dr. Thwaites."

Type and cotypes in the British Museum.

Sceliomorpha mirella, n. sp.

♀. Black; antennal scape and funicle slightly suffused with red; legs orange-yellow, the coxae black; tegulae yellow.

Head normal, twice as wide as long; very coarsely rugose; occipital margin transversely rugo-punctate, and with two irregular transverse striae or carinae; cheeks rugose, with a long carina some distance from eye margins, between this carina and the eye with short cross-carinae; frontal depression large, deep, margined, transversely striate, its margin very shortly distant from eye margin; eyes large, bare; ocelli wide apart, the lateral pair against eye margins; head with some stout setae. Antennae 12-jointed; scape slender, as long as next three joints combined; pedicel fully one-half longer than its greatest width; funicle 1 fully one-half longer than its greatest width, as long as pedicel, 2 rather wider than long, 4 a little widened; club 6-jointed, the joints wider than long, 1 the longest. Thorax normal; pronotum truncate anteriorly, angles subacute; scutum and scutellum coarsely rugo-punctate and shining, the sculpture variable, being dense or partly obliterated; parapsidal furrows deep and foveate; scutum with a distinct median carina; postscutellum projecting at meson as a rugose scale or flat tooth, as long as wide; median segment short, rugose. Forewings reaching to apex of fourth abdominal segment; broad; subhyaline at base; dusky for the rest; venation brown; submarginal vein distant from costa which it joins at half-wing length in a punctiform marginal vein, giving off a short straight stigmal vein before it joins the costa; no trace of other veins. Abdomen somewhat longer than head and thorax united; a little narrower than thorax; three times as long as its greatest width; scarcely narrowed at base; somewhat convex above; six visible segments, 2 slightly longer than 3, all distinctly wider than long; basal segment at its base with two distinct depressions, well separated, their inner margins with a distinct stria or carina; segment 5 a little produced at caudo-lateral angles; 6 on either side with a distinct narrow plate which is slightly convex, its apical margin concave; 1, 2 (except laterally), and medial area of 3 rather finely irregularly longitudinally striate, between the striae finely rugose; the rest more strongly striate and with very shallow obscure punctures; 4 and 5 with a median carina. Length, 3 mm.

♂. Abdomen rather shorter than in the female; 5 and 6 segments very slightly emarginate at caudo-lateral margins; apex emarginate. Antennae 12-jointed; wholly black; pedicel small, as wide as long; funicle 1 cupuliform, somewhat longer than its greatest width, 2–9 subequal, as wide as long. Length, 2·60 mm.

Described from four males, five females, labelled "S.W. Australia, Yallingup, Dec. 1913; R. E. Turner."

Type and cotypes in the British Museum.

A species very distinct from the other Australian forms, the abdominal characters being peculiar.

Hadronotus subfasciatus Wollaston.

Telenomus subfasciatus Wollaston, Ann. Mag. Nat. Hist., 1858, p. 25.

The female antennae are 12-jointed.

Hadronotus divisus Wollaston.

Telenomus divisus Wollaston, Ann. Mag. Nat. Hist., 1858, p. 25.

The female antennae are 12-jointed.

Hadronotus antestiae, n. sp.

♀. Black; abdomen bright orange; legs yellow, the coxae black, the anterior femora broadly black; antennal scape yellow, the funicle fuscous, the club black.

Head a little wider than thorax; vertex not very transverse; occipital margin hardly concave; viewed from the front somewhat wider than deep; frons a little convex; frontal depression extending as far as a line drawn across ventral end of eyes, not margined; eyes large, faintly pubescent; ocelli wide apart, the lateral pair near occipital margin and close to eyes; sculpture rather finely densely reticulate-rugose, on either side of frontal depression finely granulate, the depression itself transversely striate. Antennae 12-jointed; scape slender; pedicel one-half longer than its greatest width; funicle joints distinctly narrower, 1 hardly longer than wide, 2–4 wider than long; club 6-jointed (or 5-jointed, joint 1 much smaller than the others), the joints all much wider than long. Thorax stout; viewed from the side somewhat convex above; scutum and scutellum moderately longitudinally rugose; scutellum semicircular. Fore-wings long and broad, reaching well beyond apex of abdomen; hyaline; submarginal vein attaining costa at half-wing length; marginal vein as long as the stigmal which is moderately long and oblique; postmarginal reaching almost to wing apex. Abdomen broadly oval, no longer than its greatest width; segments transverse, 2 a little the longest and not occupying more than one-third of surface; 1 strongly longitudinally striate, 2 and 3 more finely striate, the rest smooth. Legs slender; posterior tarsi no longer than their tibiae, their basal joint not as long as the others combined. Length, 1·10 mm.

♂. At once differing from the female in having the abdomen wholly black; otherwise the same. Flagellum moniliform, the joints subquadrate except the first which is distinctly longer than its greatest width and hardly shorter than the pedicel.

Described from a series bred from eggs of the coffee-bug, *Antestia variegata*, Nairobi, British East Africa (*T. J. Anderson*).

Type and cotypes in the British Museum.

Hadronotus chrysolaus Walker.

Telenomus chrysolaus Walker, Mon. Chalciditum, 1839, p. 80.

This is a male *Hadronotus*; I have examined the type.

Hadronotoides rugostriatus, n. sp.

♀. Black; legs red, the coxae and femora somewhat brownish; first six antennal joints yellow, the others black.

Head transverse, a little wider than thorax; coarsely densely rugose; cheeks finely rugose; eyes large, somewhat pubescent; ocelli wide apart, the lateral pair against eye margins; frontal depression large, margined, smooth and shining. Antennae 12-jointed; scape long and slender; funicle 1 twice as long as its greatest width, 2 shorter, 4 rather wider than long; club large, 6-jointed, the joints quadrate, 2 the longest and a little longer than wide. Thorax stout, no longer than its greatest width; scutum and scutellum very coarsely rugose; parapsidal furrows wanting; scutellum projecting over postscutellum and median segment, its posterior margin emarginate and feebly concave; from lateral aspect a small tooth is visible on postscutellum. Fore-wings attaining a little beyond apex of abdomen; broad; a little dusky; venation fuscous; marginal vein one-third as long as the stigmal, which is rather long, oblique; postmarginal a little longer than the stigmal; basal and median veins not indicated. Abdomen short, not one-half longer than its greatest width; pointed at apex; somewhat convex above; strongly longitudinally rugo-striate; segment 2 nearly twice as long as the following united. Length, 1·25 mm.

Described from one female labelled "Ceylon; Dr. Thwaites."

Type in the Hope Collection, Oxford.

The genus has hitherto been known only from Australia.

Mantibaria Kirby.

Mantibaria Kirby, Mon. of Christmas Island, 1900, p. 82.
Rielia Kieffer, Boll. Lab. Zool. Portici, 1910, p. 107.
Rieliomorpha Dodd, Trans. Royal Soc. of S. Aust., 1913, p. 155.

The type material of *anomala* Kirby is in the British Museum; Kirby states that the wings are rudimentary, but on examination I think they have been destroyed.

Rieliomorpha is undoubtedly synonymous, and I think that *Rielia* is only the other sex. The types of each genus were bred from Mantid oothecas, and while Kirby and myself had female material, Kieffer's specimens were all males. The female antennae in *anomala* are 10-jointed, the flagellum 8-jointed. The position of the genus is certainly anomalous; Kirby thought it was related to the *Dryinidae*, but I agree with Kieffer that it should be placed in the *Scelionidae*.

Trissolcus laeviventris Cameron.

Hadronotus laeviventris Cam., J. R. Agric. Soc., Demerara, 1913, p. 132.

The antennae are 11-jointed; scutum with three short grooves; I have examined the types.

Trissolcus metallicus Cameron.

Trissolcus metallicus Cam., J. R. Agric. Soc., Demerara, 1913, p. 132.

This is a Chalcid of the family *Encyrtidae*; I have seen the types.

Telenomus Haliday.

Telenomus Hal., Ent. M. Mag., 1833, p. 271.
Immsia Cameron, Indian Forest Records, 4, 1913, p. 104.

Cameron has based his genus on the long articulate joint of the scape; I consider this a very variable character and only a specific detail. The same character is mentioned in the original description of *comperei* Crawford.

Telenomus truncativentris, n. sp.

♀. Black; legs, except the coxae, yellow; antennal scape yellow. Head transverse, somewhat wider than thorax; occipital margin somewhat concave; eyes large, bare; ocelli wide apart, the lateral pair against occipital margin and close to eyes; frontal depression faint; vertex finely reticulate or granulate; frons smooth and without sculpture. Antennae 11-jointed; scape slender, as long as next four joints combined; funicle 1 as long as pedicel and twice as long as its greatest width, 2–4 subquadrate; club 5-jointed, the joints somewhat wider than long, 2 the largest. Thorax stout; scutum with fine pubescence; median segment finely rugose. Fore-wings reaching well beyond apex of abdomen; moderately broad; hyaline; submarginal vein attaining costa a little before half-wing length; marginal vein one-third as long as stigmal which is long and straight;

postmarginal hardly twice as long as stigmal. Abdomen hardly longer than its greatest width; from dorsal aspect abruptly truncate at apex of segment 2; segment 1 and base of 2 strongly striate, otherwise smooth. Length, 1 mm.

♂. Antennae 12-jointed; brownish-yellow, the apical joints dusky; pedicel hardly longer than its greatest width; flagellar joints moniliform, 1–3 subequal and nearly twice as long as wide, 4–9 shorter.

Described from a series bred from eggs of the coffee-bug, *Antestia variegata*, Nairobi, British East Africa, 1917 (*T. J. Anderson*).

Type and cotypes in the British Museum.

Telenomus piceipes, n. sp.

♀. Black; coxae black; femora black, yellowish at base and apex; tibiae and tarsi brownish-yellow; antennal scape yellow.

Head somewhat wider than thorax; occipital margin faintly concave; eyes large, bare; ocelli wide apart, the lateral pair against occipital margin and close to eyes; frontal depression feeble; wholly finely granulate, more or less smooth below anterior ocellus; antennae 11-jointed; scape slender; pedicel nearly twice as long as its greatest width; funicle 1 almost as long as pedicel, 2 quadrate, 3 wider than long, 4 a little widened; club joints wider than long, 1 somewhat the largest. Scutum and scutellum with fine pubescence, finely coriaceous, the posterior half of the latter more or less smooth; median segment very short at meson. Fore-wings reaching beyond apex of abdomen; moderately broad, but not as broad as in *truncativentris*; hyaline; submarginal vein attaining costa rather before half-wing length; marginal vein two-thirds as long as stigmal which is long and slender; postmarginal fully twice as long as stigmal; venation brownish. Abdomen somewhat longer than its greatest width; pointed at apex; segment 2 a little longer than the following united; segment 1 (except along posterior margin) and base of 2, strongly striate, the striae continuing very feebly at meson of the latter, the remaining segments each with a transverse row of fine hairs. Length, 0·70 mm.

♂. Antennae 12-jointed; brownish, the apical joints piceous; pedicel no longer than wide; flagellar joints 1 and 2 over twice as long as wide, 3–9 shorter.

Described from a series bred from undetermined eggs on coffee, Songhor, British East Africa, Sept. 1917 (*T. J. Anderson*).

Type and cotypes in the British Museum.

The dusky legs and less truncate abdomen together with antennal and wing differences distinguish this species from *truncativentris*.

Telenomus striaticeps, n. sp.

♀. Black; coxae black, femora brown, tibiae and tarsi yellow; antennal scape yellow, the funicle fuscous, the club black.

Head transverse, somewhat wider than thorax, its occipital margin feebly concave; eyes large, bare; ocelli wide apart, the lateral pair separated from eyes by rather more than their own diameter; vertex longitudinally rugo-striate and finely coriaceous; frons laterally more distinctly longitudinally striate, in centre with a median carina that branches above antennal insertion, on either side of this carina with short cross-striae; mouth with converging striae and between the striae smooth and shining. Antennae 11-jointed; scape as long as next five joints combined; pedicel twice as long as its greatest width; funicle joints shorter and narrower than pedicel, 1 almost twice as long as its greatest width, 2 as wide as long, 3 a little wider than long, 4 transverse; club 5-jointed, joint 1 very transverse, 2–4 somewhat wider than long. Thorax as wide as long; scutum and scutellum densely reticulate-punctate; median segment not visible from above; margins of pleurae foveate, their centre smooth. Fore-wings reaching well beyond apex of abdomen; moderately broad; hyaline; venation yellowish; submarginal vein attaining costa a little before half-wing length; marginal vein two-thirds as long as the stigmal which is moderately long; postmarginal twice as long as the stigmal. Abdomen stout, not much longer than its greatest width; segment 1 very short and transverse, 2 as long as wide, the rest very short; 1 strongly striate and foveate; 2 foveate at extreme base, for the rest closely densely striate and between the striae finely granulate, its posterior margin smooth; remaining segments with a few fine setae. Legs slender; posterior tarsi distinctly longer than their tibiae, the basal joint hardly as long as the three following united. Length, 1 mm.

Described from several females bred from Pentatomid eggs, Mt. Mlanje, Nyasaland, 5.vi.1913 (*S. A. Neave*).

Type and cotypes in the British Museum.

The sculpture of the head easily distinguishes this species.

Telenomus carinifrons Cameron.

Immsia carinifrons Cameron, Ind Forest. Rec., 4, 1913, p. 105.

♀. Black; legs yellow, the coxae black; antennal scape and funicle yellow.

Head transverse, a little wider than thorax; occipital margin somewhat concave; frontal depression very shallow; eyes large, bare; ocelli wide apart, the lateral pair against occipital margin and also against the eyes; strongly rugose and between the rugae finely granulate; frontal depression strongly transversely striate, with a distinct median carina. Antennae 11-jointed; articulate joint of scape fully one-third as long as the scape itself; scape slender, as long as next three joints combined; funicle 1 rather longer than pedicel, fully twice as long as its greatest width, 2 as wide as long, 3 wider than long; club 6-jointed, joint 2 quadrate, the others wider than long. Thorax stout; scutum and scutellum coarsely rugose. Fore-wings reaching a little beyond apex of abdomen; not very broad; hyaline; venation pale; marginal vein one-half as long as the long slender stigmal vein; postmarginal nearly twice as long as the stigmal. Abdomen broadly oval, no longer than its greatest width, not truncate posteriorly; segment 2 fully twice as long as the following united; 1 and base of 2 strongly striate, the striae continued delicately for two-thirds length of the latter; 3 and following minutely punctured. Length, 1·75 mm.

Five females from "Dehra Dun, Northern India."

Type in the British Museum.

Allied to *comperei* Crawford from China, but its much larger size and coarse sculpture of the head distinguish *carinifrons*.

Telenomus barrowi, n. sp.

♀. Black; coxae black, femora brown, tibiae and tarsi yellow; antennal scape brown.

Head transverse, a little wider than thorax; occipital margin feebly concave; vertex densely granulate, the frons densely punctate; frontal depression non-carinate, transversely striate; eyes large, bare; ocelli almost in a line, the lateral pair against eye margins. Antennae 11-jointed; articulate joint of scape short; scape slender, as long as next three joints combined; pedicel hardly twice as long as its greatest width; funicle 1 distinctly longer than pedicel and nearly four times as long as its greatest width, 2 one-half as long as 1, 3 quadrate; club 6-jointed, the joints wider than long, 2 the widest. Thorax stout; scutum and scutellum densely somewhat longitudinally rugose and with some pubescence; pleurae smooth and shining in centre, foveate around margins. Fore-wings reaching somewhat beyond apex of abdomen; broad, the apex broadly rounded; hyaline; venation yellow; marginal vein one-third as long as the stigmal vein which is long and slender; postmarginal not twice as long as the stigmal. Abdomen broadly oval, no longer than its greatest width; segment 2 occupying most of surface; 1 and base of 2 strongly striate, 2 otherwise finely striate, its posterior margin smooth, the others finely punctate. Length, 2 mm.

Described from one female bred from egg of a Sphingid, Dalhousie, N.W. India, Sept. 1906 (*H. J. W. Barrow*).

Type in the British Museum.

At once differing from *comperei* and *carinifrons* in the short articulate joint of the scape. A fine large species.

Telenomus frenchi, n. sp.

♀. Black; coxae black, femora piceous, tibiae and tarsi yellow; antennae piceous.

Head a little wider than thorax; occipital margin faintly concave; eyes large, with a little short pubescence; ocelli wide apart, the lateral pair near the eye margins; frontal depression shallow; vertex finely reticulate or coriaceous, the frons smooth and shining. Antennae 11-jointed; scape as long as next four joints combined; pedicel twice as long as its greatest width; funicle 1 as long as pedicel, 2 shorter, 3 and 4 quadrate; club 5-jointed, the joints wider than long, 1 small, 2 the largest. Scutum and scutellum with fine pubescence, the former finely coriaceous, the latter practically smooth; median segment rugose at meson, smooth laterally. Fore-wings reaching well beyond apex of abdomen; broad, the apex broadly rounded; hyaline; submarginal vein attaining the costa at about half-wing length; marginal vein one-third as long as the stigmal which is long and slender; postmarginal nearly twice as long as the stigmal. Hind-wings rather broad, their longest discal cilia equal to about two-thirds greatest wing width. Abdomen somewhat longer than its greatest width; segment 2 no wider than long, three times as long as the following united; 1 and base of 2 strongly striate, the rest smooth. Length, 0·70 mm.

Described from eight females labelled "Melbourne, Victoria; C. French."

Type and cotypes in the British Museum.

Hoplogryon Ashmead.

Hoplogryon Ashmead, Bull. U. S. Nat. Museum, 1893, p. 200.
Hemimorus Cameron, Soc. Ent. Stuttgart, 1912, p. 77.

I have examined the type of *Hemimorus*, and the genus is identical with *Hoplogryon*. Cameron's description is quite at fault; the marginal vein is long, the stigmal short, the postmarginal absent; postscutellum toothed; abdominal segments 1 and 2 short, 3 long.

Hoplogryon rotundus, n. sp.

♀. Clear yellow-brown, the head black, the base and apex of abdomen dusky; legs wholly testaceous; antennal scape brown, the rest black.

Head transverse, a little wider than thorax; wholly finely rugose or coriaceous; eyes large, faintly pubescent; ocelli small, very wide apart, the lateral pair against the eyes; frons not impressed. Antennae 12-jointed; scape long and slender; pedicel one-half longer than its greatest width; funicle 1 as wide as pedicel and slightly longer, almost twice as long as wide, 2 as long as 1, 3 and 4 small, wider than long; club 6-jointed, the joints wider than long. Thorax hardly longer than its greatest width; pronotum not visible from above; parapsidal furrows not indicated; scutum and scutellum finely coriaceous and with fine short pubescence; scutellum transverse; postscutellum with a short acute spine; median segment short, its posterior angles with a short spine. Wings wholly absent. Abdomen broadly rounded; much wider than thorax; not more than one-half longer than its greatest width; segment 1 very short and transverse, 3 occyuping half of surface; 1 striate; 2 with a few fine striae at meson; rest of 2 and all the other segments finely densely alutaceous and with short fine rather dense pubescence. Length, 1·5 mm.

Described from one female labelled "Madeira; Wollaston."

Type in the British Museum.

Hoplogryon pilosiceps, n. sp.

♂. Black; prosternum, tegulae, anterior edge of mesopleurae, postscutellum, apex of thoracic spines, mandibles, and antennal insertions, deep red; base of abdomen slightly reddish; coxae fuscous, posterior tibiae and tarsi fuscous, rest of legs pale yellow; antennal scape yellow or brown, the antennae black.

Head no wider than thorax; vertex very thin; frons a little convex, with a distinct carina running from antennal insertion to anterior ocellus; eyes moderate, a little pubescent; ocelli large and close together; head with fine rather dense white pubescence; vertex not sculptured; frons finely longitudinally striate. Antennae 12-

jointed; nearly twice as long as the body, inserted on a level with centre of eyes; scape no longer than flagellar joint 2; pedicel very short, wider than long; flagellar joints long and filiform, pilose, 1 somewhat shorter than 2, 2–9 subequal. Thorax slightly longer than its greatest width; scutum and scutellum with some pubescence; scutum finely densely punctate and with several oblique fine sulci and carinae on either side extending for one-third its length from posterior margin; scutellum very fine punctured at base, its posterior half smooth and shining, its posterior margin foveate; postscutellum foveate, with a very long central spine that is almost as long as the scutellum; median segment rugose and pilose, with a distinct short spine laterally; mesopleurae foveate along margins, striate against tegulae and sternum, smooth centrally. Fore-wings reaching somewhat beyond apex of abdomen; broad; faintly dusky; venation fuscous; marginal vein long, the stigmal short and a little oblique; postmarginal absent. Abdomen broadly rounded at apex; segment 1 a little longer than its greatest width; 3 longest, wider than long, twice as long as the following united; 1 with four striae; 2 striate, smooth laterally and against posterior margin; 3 striate at extreme base, smooth mesally, laterally with fine pubescence and with traces of fine striae, 4–6 with fine pubescence. Legs slender. Length, 2·5 mm.

Described from two males labelled "5000–7000 feet, Tjibodas, Java, Aug. 1913; Dr. Konigsberger."

Type and cotype in the British Museum.

Trimorus politiceps, n. sp.

♂. Black; postscutellum deep red; base of abdomen somewhat reddish; mandibles and antennal insertions yellow; legs, including the coxae, yellow a little suffused dusky; antennae black, the scape brown.

Head transverse; vertex very thin; smooth and shining, without sculpture or pubescence; lower half of frons longitudinally striate; no carina on frons. Antennae 12-jointed, nearly twice as long as the body, inserted on a level with lower eye margins; scape no longer than flagellar joint 1; pedicel very short, wider than long; flagellar joints long, filiform, pilose, and subequal. Parapsidal furrows delicate, complete, and almost parallel; median lobe of scutum rather coarsely confluently punctate, also base of scutellum; lateral lobes of scutum and the scutellum (except at base) smooth, shining, without sculpture; postscutellar spine acute, not long; median segment with blunt lateral teeth; pleurae smooth centrally, foveate along margins. Fore-wings reaching beyond apex of abdomen;

broad; a little dusky; venation fuscous; marginal vein long, the stigmal short. Abdomen broadly rounded posteriorly; segment 1 hardly wider than long; 3 longest, wider than long, a little longer than the following united; 1 and 2 striate, the latter smooth against posterior margin; 3 striate at meson at base, with a few small setigerous punctures; 4 and 5 with a row of setigerous punctures at base. Legs slender. Length, 2·25 mm.

Described from one male labelled "5000–7000 feet, Tjibodas, Java, Aug. 1913; Dr. Konigsberger."
Type in the British Museum.

Trimorus politus, n. sp.

♂. Black; basal abdominal segment yellow; antennae black, the scape suffused with yellow; legs yellow, a little dusky.

Head transverse, the vertex thin; smooth and shining, without sculpture; frons with a median carina that does not reach anterior ocellus. Antennae rather longer than the body; 12-jointed; scape normal; pedicel no longer than its greatest width; flagellar joints long, filiform, pilose, 1 and 2 a little shorter than 3, 3–10 about subequal, 3 a little excised on one margin. Thorax smooth and shining, without sculpture; parapsidal furrows distinct and complete; scutellum finely foveate at anterior and posterior margins; postscutellar tooth very short; median segment with a small blunt tooth at posterior angles. Fore-wings extending well beyond apex of abdomen; moderately broad; faintly tinted; venation yellowish, terminating not much beyond half-wing length; marginal vein about as long as the submarginal, the stigmal quite short. Abdomen short; broadly rounded posteriorly; segment 1 rather wider than long; 1 and most of 2 striate, the rest smooth and shining. Length, 1 mm.

Described from one male labelled "5000–7000 feet, Tjibodas, Java, Aug. 1913; Dr. Konigsberger."
Type in the British Museum.

Gryonoides, n. gen.

Head transverse, the vertex thin; frons not depressed; eyes large, bare; ocelli well separated from the eyes. Antennae inserted well above the mouth, 12-jointed; in the female the funicle joints elongate, the club 6-jointed; in the male the flagellum very long and pilose. Thorax stout; parapsidal furrows present; *scutellum with two long spines*, wide apart and near posterior margin; postscutellum with a long spine; posterior angles of median segment acute. Fore-wings long; marginal vein long, several times as long as the short stigmal vein; postmarginal, basal, and median veins absent. Abdomen narrowed at base; broadly rounded posteriorly; segment 3 somewhat the longest; basal segment without a horn or protuberance in the female. Legs slender.

At once differing from the other genera of the *Teleasinae* in having the scutellum spined.

Type, *G. pulchellus.*

Gryonoides pulchellus, n. sp.

♀. Head black; thorax rich reddish-brown; abdomen black, the third segment orange; legs yellow; antennal scape black, red at base, pedicel fuscous, funicle 1 and 2 fulvous, 3 paler yellow, 4 fuscous, the club black.

Vertex and occiput smooth; frons with dense silvery pubescence, the lower half with striae converging toward mouth; lateral ocelli farther from the eyes than from the median ocellus. Articulate joint of scape rather long; scape long and slender; pedicel one-half longer than its greatest width; funicle 1 twice as long as pedicel, 2 as long as 1, 3 shorter, 4 a little longer than wide; club slender, the joints quadrate. Scutum and scutellum rather coarsely rugose with a longitudinal tendency; parapsidal furrows not easily discernible on account of the sculpture; spines on scutellum long but much shorter than the very long spine on postscutellum. Fore-wings reaching somewhat beyond apex of abdomen; broad; hyaline; venation fuscous; marginal vein somewhat shorter than the submarginal. Abdomen one-half longer than its greatest width; basal segment fully as long as its greatest width, 3 longer than the following united; 1, 2 (except posteriorly), and extreme base of 3, striate, the rest smooth; sides and apex of 3 and the following segments with fine scattered pubescence. Length, 2 mm.

Described from one female labelled "Teapa, Tabasco, Mexico; H. H. Smith."

Type in the British Museum.

Gryonoides glabriceps, n. sp.

♂. Black; thorax and base of abdomen slightly suffused reddish; legs wholly yellow; antennal scape yellow.

Vertex, occiput, and frons smooth, the latter not pubescent except for a few setae around mouth; lower half of frons with a few converging striae. Antennae very long, over twice as long as the body; scape somewhat thickened at middle; pedicel very short; flagellar joints very long and slender, pilose; 3 with a slight excision at base; 2 one-half longer than 1, 3 the longest and a little longer than 2. Structure of thorax and wings as in *pulchellus*. Abdomen as in *pulchellus*, but the striae at meson of segment 3 are continued for some distance, and only a few setae are present on apical segments. Length, 1·75 mm.

Described from two males labelled "Teapa, Tabasco, Mexico; H. H. Smith."

Type and cotype in the British Museum.

Gryonoides scutellaris, n. sp.

♂. Black; spines on thorax, and the legs, yellow; base of scape red.

Structurally similar to *pulchellus*. Antennae as in *glabriceps* but rather stouter, the hairs on the flagellum shorter. Length, 2 mm.

Described from two males labelled "Atoyac, Vera Cruz, Mexico; H. H. Smith."

Type and cotype in the British Museum.

Owing to the very great colorational differences, I cannot consider this species to be the other sex of *pulchellus*; as far as my experience goes, the sexes do not usually differ in colour to any great extent.

Acolus diversus Wollaston.

Telenomus diversus Woll., Ann. Mag. Nat. Hist., 1858, p. 26.

Telenomus flavicornis Woll., ibidem, p. 26.

I have seen the types; the species certainly should belong here; *flavicornis* is the male sex of *diversus*.

Ceratobaeoides (Ceratobaeus) turneri, n. sp.

♀. Dull black; base of second abdominal segment yellow; legs brown, the tibiae and tarsi yellow; antennae brown, the club black.

Head transverse, wider than the thorax; occipital margin concave; very finely and densely rugose or coriaceous; eyes large, bare; ocelli wide apart, the lateral pair close to the eyes; frons not depressed. Antennae short; scape long and slender; pedicel about twice as long as its greatest width; funicle joints distinctly narrower, 1 a little longer than wide, 2–4 much wider than long; club large, oval, twice as long as its greatest width, apparently 4-jointed, the divisions oblique and indistinct. Thorax short, hardly longer than wide; scutum large, without furrows; scutellum short, transverse; scutum and scutellum sculptured like the head; median segment hidden by the abdominal horn, unarmed. Fore-wings hardly reaching apex of abdomen; moderately broad; slightly fumated; discal cilia fine and dense; marginal cilia quite short; venation yellowish; marginal vein rather more than half as long as the stigmal, which is rather long; postmarginal and basal veins not developed. Abdomen depressed; elongate conic-ovate, distinctly longer than head and thorax united; basal segment short, transverse, with a long horn projecting as far as the scutellum; segment 3 longest, rather longer than wide, but no longer than the following united; 1 and 2 striate and finely rugose between the striae, the rest finely and densely reticulate-rugose; horn on basal segment rugose at base, smooth and shining at apex. Length, 1·25 mm.

Described from one female labelled "1100 feet, Kuranda, N. Queensland, May 1913; R. E. Turner."

Type in the British Museum.

The third species of *Ceratobaeoides* Dodd. Of the Australian species of *Ceratobaeus* Ashmead, it runs near *giraulti* Dodd, but possesses a much longer abdomen than that species. I have much pleasure in naming the species after Mr. Turner, whose work on Hymenoptera is so well known.

PROCTOTRUPIDAE.

Proctotrupes turneri, n. sp.

♀. Shining black, the antennae concolorous; coxae black, the legs golden yellow; venation sooty black.

Head with scattered minute punctures and pubescence; transverse; eyes large and bare. Antennae long and filiform, the joints longer than wide. Propleurae smooth, with a few striae in centre; mesopleurae smooth; scutum rather densely pubescent, also the scutellum, the latter depressed at base; median segment divided into two parts, the anterior portion long, finely rugose, with a distinct median carina, the posterior portion shorter and coarsely rugose. Fore-wings long, broad, hyaline; stigma rather longer than wide; the radial cell distinct but narrow; radial vein longer than the stigma. Petiole not visible from above; abdomen slightly convex above from lateral aspect; with a median groove and several short striae at base; smooth; oviduct filiform, no longer than body of abdomen. Length, 5 mm., to apex of oviduct.

♂. Femora dusky; otherwise like the female. Length, 4 mm.

Described from three females, one male, labelled "Mt. Wellington, Tasmania; R. E. Turner."

Type and cotypes in the British Museum.

Proctotrupes nitens, n. sp.

♀. Shining black; legs fuscous, the tarsi and base and apex of femora and tibiae, yellow; antennal scape yellow, the rest black.

Head normal; vertex rather narrow; smooth and shining, and with microscopic punctures; below antennal insertion with distinct silvery pubescence. Antennal scape stout, about as long as funicle 1; pedicel very short; flagellum filiform, the joints slender, 1 about four times as long as wide, the penultimate joint twice as long as wide. Propleurae smooth, with several striae in centre; mesopleurae wholly striate; metapleurae smooth for basal half, the rest finely rugose; scutum smooth and shining, without distinct pubescence, wholly gently convex; scutellum convex, depressed at base; median segment gradually declivous, not divided, finely rugose and with a deep median longitudinal groove. Fore-wings long, broad; hyaline; with a deep smoky patch beneath the stigma; venation fuscous; stigma large, as wide as long, the radial vein almost confluent with its distal margin, the radial cell thus subobsolete; basal, median, and recurrent veins faintly indicated. Petiole not visible; base of abdomen without impressions or striae; abdomen compressed, with a long compressed oviduct, which is somewhat longer than the abdomen itself. Length, 6 mm. to apex of oviduct.

♂. Antennae wholly black, the joints hardly as long as in the female; smoky patch beneath stigma small; base of median segment smooth on either side of median channel.

Described from one pair labelled "Yallingup, S.W. Australia, Nov. 1913; R. E. Turner."

Type and cotype in the British Museum.

Proctotrupes janthinae Dodd, 1915.

One female, one male, labelled "Mt. Wellington, Tasmania, March 1913; R. E. Turner." Originally described from Victoria. In this species the median segment is not plainly divided, there being no distinct posterior declivous portion, the carinae not distinct, the short anterior areas smooth; scutellum deeply depressed at base. Male antennae wholly black; pubescent; joints 6–10 of funicle acute on one side apically. In these Tasmanian specimens the radial vein is practically confluent with the stigma, the radial cell thus subobsolete.

Proctotrupes gravidator Linné, var. **partipes,** n. var.

♂. Head, thorax (including the tegulae), petiole, and extreme base of abdomen, black; abdomen blood-red, dusky at apex; antennae wholly black; coxae black, also anterior femora, and posterior tibiae and tarsi; intermediate legs (except the coxae), anterior tibiae and tarsi, and posterior femora, red.

Head transverse, with fine short dense pubescence. First funicle joint about five times as long as wide. Scutum and scutellum densely pubescent; parapsidal furrows wholly absent; scutum raised at meson; median segment long, the posterior portion declivous but not abruptly so, wholly densely reticulately rugose, with a long median carina, the anterior portion separated from the posterior portion by a faint transverse carina; propleurae densely pubescent and with fine dense reticulate rugosity, also the mesopleurae except for posterior half of dorsal portion which is smooth; metapleurae rugose. Fore-wings long, broad, faintly tinted; venation fuscous; stigma somewhat longer than its greatest width; radial cell narrow; the radial vein curved, no longer than the stigma, continued as a brown straight line proximad; other veins, except the submarginal, present as yellowish lines. Tarsal claws simple; large spur on hind tibiae one-fourth as long as basal tarsal joint. Petiole somewhat longer than wide, rugose; base of abdomen strongly striate; abdomen at apex with a long bidentate genital process. Length, 7·50 mm.

Described from one male labelled, "5000 feet, Kashmir, N.W. India, April 1901; C. G. Nurse."

Type in the British Museum.

With only the one sex, I have preferred to class this as a variety of the common European species, *gravidator*; the colour of the legs distinguishes it from other varieties of the species.

Exallonyx orientalis, n. sp.

♀. Black; coxae black, the legs deep reddish-brown; basal three antennal joints red, the others fuscous; tegulae red.

Head transverse, smooth and shining, pubescent. Antennae 13-jointed; scape stout; pedicel very short, almost hidden by the scape; funicle 1 two and a half times as long as its greatest width, the others gradually shortening, the penultimate joint longer than wide. Pronotum very short, transversely striate; scutum and scutellum with fine short dense pubescence, without sculpture; parapsidal furrows not indicated; scutellum not at all depressed; posterior half of median segment abruptly declivous, the whole with a strong median carina, the anterior half subglabrous with subobsolete transverse rugosity and distinct lateral carinae, the posterior half rugose; propleurae smooth; mesopleurae smooth for dorsal half, the lower half pubescent; metapleurae coarsely rugose. Forewings long, broad, slightly tinted; venation fuscous; stigma semicircular, longer than its greatest width; radial cell very narrow; radial vein longer than the stigma, continued as a brown line toward centre of wing; other veins, except the submarginal, marked by brown lines. Anterior and intermediate tarsal claws bidentate; large spur on posterior femora nearly half as long as basal tarsal joint. Petiole short, transversely striate; abdomen, including oviduct, hardly longer than the thorax; oviduct straight, not half as long as rest of abdomen; base of abdomen not striate, with a long median groove. Length, 7 mm.

Described from one female labelled "5000 feet, Shillong, Assam, Sept. 1903; R. E. Turner."

Type in the British Museum.

Family CERAPHRONIDAE.

Megaspilus mandibularis, n. sp.

♀. Golden-yellow or ochreous; eyes and ocelli black; legs wholly yellow; antennae fuscous, the scape yellow.

Head rather wider than thorax; vertex rather broad; viewed from in front no wider than deep; densely rather finely reticulate-punctate; ocelli very close together; eyes rather small, densely pubescent; mandibles very large and conspicuous, bidentate, the outer tooth long and acute. Antennae 11-jointed; scape as long as next four joints combined; pedicel cupuliform, barely one-half longer than its greatest width; funicle 1 cupuliform, a little longer than its greatest width, 2–8 twice as wide as long. Thorax somewhat longer than wide; scutum truncate anteriorly; scutum and axillae sculptured like the head; parapsidal and median furrows distinct; scutellum finely granulate and with moderately dense punctures; postscutellum with a stout tooth. Fore-wings reaching a little beyond apex of abdomen; broad; somewhat fumated; venation fuscous; marginal vein thickened for apical half; stigma semicircular; stigmal vein almost twice as long as the stigma. Abdomen slightly longer than thorax, not twice as long as its greatest width; almost flat above, convex beneath; basal segment occupying a little more than half of surface, striate for its basal half, smooth for the rest; remaining segments finely pubescent.

Posterior femora much swollen. Length, 2 mm.

Described from two females labelled "Bundaberg, Queensland, 1904; R. C. L. Perkins."

Type and cotype in the British Museum.

Closely allied with another Queensland species, *scabriceps* Dodd, but the sculpture of the thorax is different.

Conostigmus brunneipes, n. sp.

♀. Dull brown, the antennae and legs concolorous, the tarsi yellow.

Head normal, a little wider than thorax; densely finely coriaceous; eyes large, with short pubescence; ocelli small, close together. Antennae 11-jointed; scape long and slender; pedicel over twice as long as its greatest width; flagellum hardly clavate; joint 1 as long as pedicel, 2 shorter, 3–8 subequal and somewhat longer than wide, the apical joint twice as long as the penultimate. Thorax a little longer than its greatest width; with scattered setae; scutum and scutellum sculptured like the head, the former almost truncate anteriorly; median and parapsidal furrows distinct and complete; scutellum a little longer than its greatest width; median segment short, granulate. Wings rudimentary, mere flaps that reach to base of abdomen. Abdomen wider than thorax; about twice as long as its greatest width; pointed at apex; striate at base; basal segment occupying rather more than one-half of surface; smooth and shining, and with subobsolete fine impressed reticulation. Length, 1·75 mm.

♂. Like the female, the wings rudimentary also. Pedicel short, no longer than wide; flagellar joints filiform, joint 1 three times as long as wide, 2–8 gradually shortening, 8 one-half longer than wide. Length, 1·50 mm.

Described from one pair labelled "Madeira; Wollaston."

Type and cotype in the British Museum.

Conostigmus wollastoni, n. sp.

♀. Black; coxae black, femora and tibiae piceous, tarsi fulvous; antennal scape fulvous.

Head a little wider than thorax; very finely and densely rugose or granulate; vertex twice as wide as long; eyes large, bare; ocelli large, rather close together, the lateral pair nearer the anterior ocellus than to the eye margins. Antennae 11-jointed; scape slender; pedicel distinctly shorter than following joint; flagellum non-clavate, joint 1 twice as long as wide, 2–8 subequal and a little longer than wide. Thorax stout; pronotum not visible from above;

scutum, scutellum, and axillae wholly densely finely coriaceous; anterior angles of scutum subacute; median and parapsidal furrows distinct and complete; axillae meeting at base of scutellum; scutellum large; median segment declivous. Fore-wings long and broad; hyaline, with an oblong sooty patch beneath whole of stigmal vein; venation piceous; stigma semicircular; stigmal vein one-half longer than stigma, hardly curved. Abdomen hardly longer than its greatest width; almost flat above, convex beneath; smooth and shining, striate at base; basal segment longer than the rest united. Length, 2·50 mm.

Described from two females labelled "St. Helena; Wollaston."

Type and cotype in the British Museum.

Conostigmus rufinotum Dodd.

One female from Bundaberg, Queensland, 1904 (*R. C. L. Perkins*).

Conostigmus terrestris, n. sp.

♀. Ochreous, the legs concolorous; antennal scape yellow, the antennae otherwise piceous; eyes and ocelli black.

Head hardly wider than the thorax; with fine punctures, each giving off a fine seta; eyes not large, faintly pubescent; ocelli very close together, with a shallow groove running from median ocellus to occipital margin. Antennae 11-jointed; scape slender, as long as next five joints combined; pedicel one-half longer than its greatest width; flagellum thickened toward apex, without a distinct club; joint 1 a little shorter than pedicel, 2–8 wider than long, the apical joint longer than the two preceding united. Scutum with fine punctures giving off fine setae; parapsidal and median furrows deep and distinct; scutellum and axillae with a few pubescent punctures. Wings wholly wanting. Abdomen distinctly wider than thorax; hardly longer than its greatest width; somewhat convex beneath; striate at base; with sparse pubescence; basal segment three times as long as the rest united. All femora a little thickened; posterior tarsi no longer than their tibiae, their basal joint fully as long as the rest united. Length, 1·1 mm.

Described from one female labelled "Victoria; C. French."

Type in the British Museum.

The first wingless species of the genus from Australia.

Family BELYTIDAE.

Paraclista antipoda, n. sp.

♀. Black; scutum and scutellum deep red; legs wholly red; scape and pedicel reddish-yellow, the remaining joints dusky to fuscous.

Head viewed from the side as long as high; viewed from above, the antennal insertion very prominent; with rather dense pubescence; eyes small, with a few setae; mandibles small. Antennae 15-jointed; scape thickened, as long as next four joints combined; pedicel one-half longer than its greatest width; flagellum not incrassate, joint 1 as long as pedicel, 2–12 plainly wider than long. Thorax smooth, with some long pubescence; somewhat flattened, wider than its greatest height; parapsidal furrows distinct and complete; scutellum with a large fovea at base; median segment with a plain median carina. Fore-wings long; broad; subhyaline; marginal vein long, fully as long as the closed radial cell, the stigmal vein short; recurrent vein short and straight; basal vein distinct, the median and discoidal faint. Petiole over twice as long as wide, rugose; abdomen depressed at base and with a median groove; with scattered setae; segment 2 twice as long as the following united, 3–8 very short and transverse. Legs stout, the posterior femora much thickened. Length, 3·25 mm.

Described from one female labelled "Mt. Wellington, Tasmania, March 1913; R. E. Turner."

Type in the British Museum.

Differs from *aureipes* in the colour of the thorax, and the rugose petiole.

Paraclista aureipes Dodd.

Meuselia aureipes Dodd, Trans. Royal Soc. S. Australia, 1915, p. 393.

I place this and the following species here on account of the flattened thorax; the thick posterior femora may be a sufficient character to form a new genus.

Xenotoma albohirta, n. sp.

♀. Shining black; anterior and intermediate legs, including the coxae, yellow; posterior coxae, tibiae and tarsi fuscous, the posterior femora yellowish; antennae black, the scape yellow.

Head normal; smooth and shining; with fine pubescence; antennal prominence distinct; mandibles long and crossed, one bidentate, the other tridentate, the outer tooth long and curved. Antennae 15-jointed; scape long and slender; pedicel hardly longer than wide; flagellum filiform, joint 1 one-half as long as the scape, 2–12 gradually shortening, 12 somewhat longer than wide. Thorax smooth and shining, with fine white pubescence; parapsidal furrows complete and distinct; scutellum with a circular fovea at base; median segment with a plain median carina. Fore-wings reaching beyond apex of abdomen; broad; hyaline; venation black; marginal vein long, the stigmal short, the radial cell closed and somewhat longer than the marginal vein; recurrent vein long and curved, and directed toward the discoidal. Petiole slender, nearly four times as long as wide, carinate; body of abdomen twice as long as petiole; smooth and shining; depressed at base and with a long median groove; apical segments very short and transverse. Posterior tarsi rather longer than their tibiae. Length, 3 mm.

♂. Antennae 14-jointed, the flagellar joints shortening less than in the female.

Described from four females, four males, labelled "5000–7000 feet, Tjibodas, Java, Aug. 1913; Dr. Konigsberger." Type and cotypes in the British Museum.

Pantoclis javensis, n. sp.

♀. Head piceous; thorax rich chestnut; abdomen chestnut, somewhat dusky; legs yellow, a little dusky; first three joints of antennae reddish yellow, the remainder piceous.

Head smooth, shining; cheeks with a few fine setae; eyes large, with a few setae; mandibles normal. Antennae 15-jointed; scape long and slender; pedicel a little longer than wide; flagellum hardly clavate, joint 1 twice as long as pedicel, 2 distinctly shorter than 1, 3 subequal to pedicel, 4–12 subquadrate, 13 not much longer than 12, somewhat longer than its greatest width. Thorax normal, smooth and shining, with scattered long fine setae; parapsidal furrows distinct and complete; scutellum with a deep circular fovea at base; postscutellum short, unarmed; median segment long, unarmed, with a distinct median and lateral carinae. Fore-wings long, reaching a little beyond apex of abdomen; broad; subhyaline; venation fuscous; submarginal vein joining costa at fully one-half wing length; marginal vein not as long as the stigmal which is oblique; radial cell closed, several times as long as the marginal vein; recurrent vein short, the basal distinct, the median and discoidal faintly indicated. Hind-wings with one closed cell.

Abdomen composed of eight segments including the petiole; petiole nearly twice as long as wide, with several carinae; body of abdomen conic-ovate, narrow and pointed at apex; smooth and shining, with a few setae on apical segments; striate at extreme base; basal segment fully twice as long as the remainder united. Length, 2·5 mm.

Described from four females labelled "5000–7000 feet, Tjibodas, Java, Aug., 1913; Dr. Konigsberger."
Type and cotypes in the British Museum.

♂. Colour varying to dull brownish-red. Antennae 14-jointed; wholly fuscous; pedicel no longer than wide; flagellar joints long and filiform, slightly decreasing in length, 1 slightly excised on one side at half its length.

Four males labelled as the females.

Procinetus apicalis, n. sp.

♀. Dull brown, apex of abdomen and the petiole lighter; head piceous; legs brown; antennal scape reddish, the three apical joints pale yellow, the rest fuscous.

Head normal; eyes bare; head without setae, also the scutum and scutellum. Antennae 15-jointed; scape slender; pedicel somewhat longer than wide; flagellum gradually thickening toward apex, the basal joints long and slender, 1 hardly longer than 2, many times longer than wide, 11 and 12 quadrate, the apical joint twice as long as its greatest width. Thorax normal, unarmed; parapsidal furrows deep and distinct, nearly parallel; scutellum with a deep circular fovea at base; postscutellum short; median segment long and smooth, with a median carina. Fore-wings long and broad, reaching a little beyond apex of abdomen; subhyaline; venation fuscous; marginal vein long, the stigmal short, the radial cell no longer than the marginal vein; recurrent vein short, the basal distinct, the median and basal faint. Petiole twice as long as wide, carinate; body of abdomen slender, conic-ovate; smooth and shining; basal segment more than twice as long as the following united; oviduct distinctly exserted. Length, 2 mm.

Described from one female labelled "5000–7000 feet, Tjibodas, Java, Aug. 1913; Dr. Konigsberger."
Type in the British Museum, also cotypes.

♂. Antennae 14-jointed; flagellar joints long, with long hairs which are three times as long as width of the joints, joints gradually shortening. Apical abdominal segments short and transverse. Flagellum wholly black.

Two males with the female.

The only other species in the genus is from New Guinea.

Pantolytoidea nigricans Dodd, 1916.

Three females, two males labelled "Tasmania; A. M. Lea," and "Mt. Wellington, Tasmania, April 1913; R. E. Turner." These agree very well with the description of *nigricans* which is from New South Wales.

Oxylabis wollastoni, n. sp.

♀. Chestnut-brown, the prothorax and mesothorax ochreous; legs brownish-yellow; antennae reddish-yellow, the apical half dusky.

Head with numerous minute punctures and rather long fine yellowish pubescence; eyes moderate, hairy; ocelli small. Antennae inserted on a frontal prominence; 15-jointed; scape long and slender; pedicel almost twice as long as its greatest width; funicle 1 distinctly longer than pedicel, 2 one-half as long as 1 and a little longer than wide; the last eight or nine joints form a slender ill-defined club, the joints as wide as long. Thorax about twice as long as its greatest width; pronotum a little visible from above; scutum and scutellum with yellowish pubescence like the head; parapsidal furrows deep and complete; scutellum with a deep transverse fovea at base; postscutellum with a short spine or tooth; median segment smooth and shining, pubescent laterally, with a distinct median and lateral carinae. Wings rudimentary, extending to one-third length of abdomen; very narrow; hyaline; submarginal vein distant from the costa, the marginal and stigmal veins short; basal vein present, perpendicular; no other veins. Petiole one-half longer than its greatest width; body of abdomen ovate, pointed at apex, wider than the thorax, striate at base, its second third pubescent; basal segment three times as long as the following united, 3–6 transverse, 7 longer than its greatest width and as long as the preceding three united. Legs slender. Length, 2–3 mm.

Described from four females labelled "Madeira; Wollaston."

Type and cotypes in the British Museum.

Family DIAPRIIDAE.

Hoplopria Ashmead.

Syn. *Hoplopriella* Dodd, 1915, Trans. Royal Soc. of S. Aust., p. 416.

Hoplopria simulans Dodd, 1915.

One female labelled "Kuranda, N. Qld., May 1913; R. E. Turner." This is the type locality.

Hoplopria fuscitegula Dodd, 1915.

Five females labelled "Mt. Wellington, Tasmania, March 1913; R. E. Turner." This is the type locality.

Hoplopria aterrima, n. sp.

♀. Black; legs black, hardly suffused with red, the tarsi fulvous; antennae black.

Head subquadrate; a carina runs from the occipital margin through the median ocellus terminating in an acute short projection above the antennal prominence; interior eye margins carinate, these carinae terminating subacutely in a line with the termination of the median carina, so that from dorsal aspect the frons has three acute short teeth; cheeks with large punctures, also a row of punctures along occipital margin, two rows along inner eye margins, and a few punctures between these rows and the ocelli; no punctures on frons below anterior ocellus, this area finely alutaceous. Antennae 13-jointed; scape covering base of pedicel and bispinose; pedicel one-half longer than its greatest width; funicle 1 rather longer than the pedicel, the others gradually shortening; last five joints forming a club, each wider than long. Pronotum short, striate; scutum and scutellum smooth and shining, with a few small punctures; parapsidal furrows deep and complete; lateral lobes of scutum feebly depressed, with a foveate groove against the tegulae; scutellum at base with two circular foveae close together, a long shallow fovea along each lateral margin, a small fovea against each tegula, its posterior margin foveate; median segment with a stout curved spine at base. Fore-wings reaching apex of abdomen; broad; fuscous; venation blackish; marginal vein almost punctiform, thickened, the stigmal vein oblique; basal and median veins faint. Petiole over one-half as long as rest of abdomen, four times as long as wide, carinate; body of abdomen smooth and shining, conic-ovate, raised from the petiole, without striae or impressions at base; basal segment four times as long as the rest united. Length, 2·50 mm.

♂. Like the female. Antennae 13-jointed, a little longer than the body; pedicel short; funicle joints cylindrical, subequal, not excised.

Described from one pair from Kuching, Borneo (*J. Hewitt*), and labelled "*Brachyaulax striaticollis* Cameron."

Type and cotype in the British Museum.

The genus *Hoplopria* Ashmead has not formerly been known from Asia; however, Kieffer has described four species of *Odontopria* Kieffer from Java and Sumatra, but for that genus he does not mention the scape being produced, and I do not understand what his character of the "scutum with four grooves" represents.

Hoplopria wallacei, n. sp.

♀. Black; tegulae and legs deep-red; antennae wholly black.

Head normal, smooth and shining; ocelli on a prominence. Antennae inserted on a frontal prominence; 13-jointed; scape long and slender, produced at apex and covering base of pedicel; pedicel cupiliform, one-half longer than its greatest width; flagellum without a distinct club, the apical joints a little thickened, joint 1 distinctly longer than pedicel, about three times as long as wide, 2 distinctly shorter than 1, 3–10 gradually shortening, 8–10 quadrate, the apical joint twice as long as the penultimate. Thorax normal; scutum and scutellum smooth and shining; parapsidal furrows complete and distinct; median lobe of scutum with two shallow depressions anteriorly, the lateral lobes distinctly depressed; scutellum with two longer than wide foveae at base separated only by a line, an elongate fovea at either anterior angle, a long fovea along either side, and the posterior margin foveate; median segment covered with short pubescence, with a raised carina at base. Forewings reaching apex of abdomen; subuniformly lightly yellowish; venation terminating in a triangular margin vein at one-half wing length; basal vein distinct. Petiole fully twice as long as wide, smooth and shining, with indications of carinae; body of abdomen ovate, no more than twice as long as its greatest width, the basal segment several times as long as the rest united; smooth and shining; the anterior margin straight. Length, 4·50 mm.

Described from one female in the Wallace collection from Buru, East Indies.

Type in the Hope Collection, Oxford.

Hoplopria obsoleta, n. sp.

♀. Black; tegulae and the legs wholly reddish.

Head normal, smooth and shining, without punctures; eyes normal, bare; ocelli on a prominence, between this and the eye margins are two very obtuse carinae. Antennae 13-jointed; scape as long as next three joints combined, prolonged at apex; pedicel hardly as long as funicle 1; flagellum with the apical six or seven joints forming a club; funicle 1 twice as long as wide, 2 as long as 1, the others gradually shortening, the club joints wider than long, the apical joint no longer than its greatest width. Scutum and scutellum smooth, without punctures; parapsidal furrows wholly wanting; scutum with a large shallow depression on either side, and two elongate shallow depressions at meson for anterior half; scutellum sub-carinate at meson, the basal foveae very large, circular, well separated, the lateral foveae small and inconspicuous; median segment with a raised triangular scale at base. Fore-wings reaching somewhat beyond apex of abdomen; broad; subhyaline, somewhat dusky in centre but not conspicuously blotched or banded; venation fuscous, terminating at half-wing length; marginal vein short. Petiole of abdomen over twice as long as wide, strongly carinate; body of abdomen conic-ovate; pointed at apex; over twice as long as petiole; its anterior margin straight; its base without striae or sulci; smooth and shining; basal segment several times as long as the rest united. Length, 3 mm.

Described from one female labelled "Omilteme, Guerrero, Mexico, 8000 feet; H. H. Smith."

Type in the British Museum.

Distinguished from all other American species by the non-patterned wings and absence of parapsidal furrows.

Hoplopria affinis, n. sp.

♀. Black; legs wholly red, also the tegulae and basal seven antennal joints.

Closely allied to *obsoleta,* but distinctly smaller; thorax somewhat flattened; lateral depressions of scutum feeble, the medial pair only present against anterior margin; foveae at base of scutellum not so large; petiole barely twice as long as wide; funicle joints shorter, 2 distinctly shorter than 1, 3 only slightly longer than wide. Length, 2 mm.

Described from two females labelled "Teapa, Tabasco, Mexico; H. H. Smith."

Type and cotype in the British Museum.

Hoplopria caniculata Cameron.

Paramesius caniculatus, Cameron, Biol. Cent. America, 1888, p. 439.

Three females labelled "Teapa, Tabasco, Mexico; H. H. Smith."

Neurogalesus carinatus Kieffer.

In the British Museum besides the type, are two females labelled "Mackay, Qld., R. E. Turner," and one female labelled "Sydney." The species is closely allied with *dissimilis* Dodd and *rubripes* Dodd, differing from both in having a sulcus or depression on either side of the median groove at base of abdomen. The pedicel is shorter than the first funicle joint; the legs are deep red, the femora dusky; the antennae except the black club are also deep red.

Spilomicrus Westwood.

Bothriopria Dodd, Trans. Royal Soc. S. Australia, 1915, p. 406.

The Australian species of *Bothriopria* should fall here, the obscure foveae along margins of scutellum not being a distinctive character.

Spilomicrus unicolor Dodd.

Bothriopria unicolor Dodd, Trans. Royal Soc. S. Australia, 1915, p. 407.

Two males, two females from Bundaberg, Queensland (*R. C. L. Perkins*).

Hemilexis gracilis Dodd.

Spilomicrus gracilis Dodd, Trans. Royal Soc. S. Australia, 1915, p. 402.

This species should fall here; the abdomen is subtruncate at apex; the stigmal vein is quite distinct. I have seen a female taken at Bundaberg, Queensland, 1904 (*R. C. L. Perkins*).

Hemilexis truncata Dodd, 1915.

One female labelled "Mt. Wellington, Tasmania; R. E. Turner." This is the type locality.

Hemilexis paucisetis, n. sp.

♀. Black, the antennae concolorous; coxae, femora, and tibiae, dusky brown, the tarsi yellow.

Head subquadrate, a little wider than long; smooth and shining, with scattered long slender setae. Antennae 13-jointed, the joints with rather long setae; scape slender; pedicel twice as long as its greatest width; funicle 1 twice as long as its greatest width, 6 as long as wide; club 5-jointed, 1–4 plainly wider than long. Thorax smooth and shining; scutum with a few long setae; parapsidal furrows deep and complete; scutellum with two circular foveae at base; median segment with an acute raised scale or tooth at base. Fore-wings reaching well beyond apex of abdomen; broad; a little dusky; venation fuscous, terminating in a short triangular marginal vein at almost one-half wing length; basal vein distinct. Petiole about three times as long as wide; carinate; body of abdomen short, not much longer than its greatest width, its base raised from the petiole, its apex abruptly truncate from lateral aspect; smooth and shining; without impressions or striae at base.

Described from one female labelled "Mt. Wellington, Tasmania, March 1913; R. E. Turner."

Type in the British Museum.

This is very distinct from the other Australian species.

Bakeria rugosa, n. sp.

♀. Black; scutellum deep red; body of abdomen fuscous; legs wholly reddish-yellow; first six antennal joints yellow, the next two dusky, the others black.

Head normal, smooth and shining, without sculpture, the occiput pilose; eyes with a very few setae; ocelli close together, on a small prominence. Antennae 13-jointed; scape slender, not produced at apex; pedicel twice as long as its greatest width; flagellum with the last six joints feebly and gradually thickened; funicle 1 distinctly longer than pedicel, 2 shorter than 1; club joints no wider than long, the apical joint nearly twice as long as the penultimate. Thorax plainly convex above; scutum and scutellum densely and coarsely rugose-punctate; parapsidal furrows complete; scutellum convex, without foveae, but depressed at its base; median segment as long as scutellum, without a median scale or tooth, coarsely rugose. Fore-wings reaching apex of abdomen; broad; hyaline along its margins except distad, for the rest a little brownish, but not distinctly banded or blotched; venation reddish, terminating a little beyond half-wing length; marginal vein long, several times as long as the short stigmal; basal vein very distinct, the median vein present distad of basal vein and not reaching the posterior wing margin, no longer than the basal. Petiole very long, many times as long as wide, as long as body of abdomen, carinate, its basal half coarsely rugose; body of abdomen conic-ovate; smooth and shining; with a median sulcus or depression for basal half; basal segment three times as long as the following united. Length, 3 mm.

Described from one female labelled "8000 feet, Omilteme, Guerrero, Mexico; H. H. Smith."

Type in the British Museum.

Bakeria Kieffer formerly contained one species from Central America; *rugosa* is a very distinct and peculiar species, and should possibly form a new genus.

Paramesius longior, n. sp.

♀. Black; legs wholly deep red; apex of abdomen reddish; antennae red, the apical joints fuscous.

Head normal; smooth and shining, with a very few long setae; frons straight from anterior ocellus to antennal insertion; eyes moderately large, with a very few setae. Antennae 13-jointed; long; scape very long, nearly as long as next four joints combined, non-spinose at apex; pedicel almost twice as long as its greatest width; flagellum very gently incrassate, without a distinct club, joint 1 fully twice as long as its greatest width, 2–10 gradually shortening, 10 somewhat longer than wide, the apical joint twice as long as the penultimate. Thorax smooth and shining, with a few long setae; pronotum visible from above and truncate anteriorly; scutum narrowed anteriorly; parapsidal furrows delicate, failing anteriorly; scutellum with one large circular fovea at base, a narrow fovea along each lateral margin; median segment with a plain median carina. Fore-wings reaching apex of abdomen; broad; stained yellowish; venation fuscous, terminating in a long slender marginal vein; basal vein not indicated. Petiole about four times as long as wide, carinate; body of abdomen not raised from petiole no wider at base than the petiole, gradually widening for more than half its length, then rather abruptly narrowing; segment 2 three times as long as the following united, 3–4 very short, apical segment long and narrowly pointed. Length, 4 mm.

♂. Abdomen rounded at apex, without a narrow cone. Antennae 13-jointed, very long, twice as long as the body; black, faintly red at base; scape moderately long; pedicel as wide as long; flagellar joint 1 a little longer than wide, 2 about six times as long as 1, 2–11 about subequal.

Described from one pair from Kuching, Borneo (*J. Hewitt*), and labelled "*Brachyaulax rufipes* Cameron."

Type and cotype in the British Museum.

Pentapria chiriquensis Cameron.

Paramesius chiriquensis Cameron, Biol. Centr. America, 1888, p. 439.

I have examined the type; the scutellum has three foveae at base.

Neopria tinctipennis Cameron.

Spilomicrus tinctipennis Cameron, Biol. Cent. America, 1888, p. 440.

Belongs to *Neopria* Dodd, agreeing with all the characteristics of that genus, which was formerly known only from Australia.

Neopria pallida Ashmead.

Idiotypa pallida Ashm., Jour. Linn. Soc. London, 1894, p. 243.

There are three foveae at base of scutellum.

Tropidopsis clavatus Ashmead.

I have one female labelled "Teapa, Tabasco, Mexico; H. H. Smith." The type is from St. Vincent.

Mantara, n. gen.

♂. ♀. Head normal, subquadrate; eyes small, situated far forward; ocelli absent; mandibles small. Antennae inserted low down on the face, on a small antennal prominence; in the female 12-jointed, with a 4-jointed non-abrupt club, the scape normal, not produced at apex; in the male 14-jointed, the flagellum gently clavate, the basal joints slender, the apical joints as wide as long. Thorax narrowed; neck of pronotum distinct; pronotum proper truncate anteriorly, and covered with dense pubescence; scutum with parapsidal furrows; scutellum small, without foveae, a little depressed; postscutellum not evident; median segment long, with two large spines or furcae springing from its base, these somewhat curved and horizontal, reaching the posterior margin of the thorax. Wings wholly absent in both sexes. Petiole rather longer than wide covered with dense pubescence; body of abdomen ovate, its anterior margin straight, without impressions or striae at base, the basal segment occupying almost all of the surface, the remaining segments minute. Legs normal, the tibiae and tarsi clavate.

Type, the following species :—

Mantara bifurcata, n. sp.

♀. Dull black; legs and basal six antennal joints clear testaceous. Smooth and shining. Head, thorax, and abdomen with scattered fine setae; head distinctly wider than the thorax; abdomen wider than the thorax, fully twice as long as its greatest width. Scape long and slender; pedicel fully twice as long as its greatest width; funicle 1 a little shorter than the pedicel, 6 as wide as long; club joints 1–3 as wide as long, the apical joint fully twice as long as the preceding. Length, 1·75 mm.

♂. Similar to the female. Pedicel twice as long as its greatest width; funicle 1 a little shorter than the pedicel; apical six or seven joints a little widened, as wide as long. Length, 2 mm.

Described from two females, one male, labelled " Madeira; Wollaston."

Type and cotypes in the British Museum.

The peculiar structure of the median segment easily distinguishes this genus; the absence of wings in both sexes is peculiar; seeing the male alone one would certainly take it for a female on account of the non-filiform antennae.

Trichopria acuminata Dodd, 1915.

One female labelled " Kuranda, N. Qld., May 1913; R. E. Turner." The type locality.

Xyalopria spinosiceps Kieffer.

Two males, three females, of what I take to be this species labelled " Teapa, Tabasco " and " Atoyac, Vera Cruz, Mexico; H. H. Smith."

Acidopria spinosiceps, n. sp.

♀. Dull black; legs deep red suffused with black, the tarsi fulvous; antennae reddish, suffused with black, paler toward apex. Head normal, smooth and shining, with two well separated sharp short spines behind the ocelli. Antennae 12-jointed, without a well-defined club, the apical joints somewhat thickened; scape long and slender; pedicel a little longer than its greatest width; funicle 1 as long as pedicel, 2–8 gradually shortening, 8 wider than long, 9 distinctly larger than 8, quadrate, the apical joint one-half longer than the penultimate. Thorax normal; scutum and scutellum smooth and shining; parapsidal furrows wanting; scutellum with a more or less distinct median carina, at base with a large circular fovea; median segment with a raised triangular scale at base. Fore-wings reaching a little beyond apex of abdomen; broad; faintly infuscate; venation reddish, terminating in a triangular marginal vein at one-third wing length; basal vein wanting. Petiole over twice as long as wide, carinate; body of abdomen smooth and shining, one-half longer than the petiole, the basal segment three times as long as the following united. Length, 1·75 mm.

Described from two females from Kuching, Borneo (*J. Hewitt*), and labelled respectively "*Brachyaulax picicornis* Cameron, type," and "*Brachyaulax erythrocerus* Cameron, type."

Type and cotype in the British Museum.

Acidopria Kieffer is represented by four Philippine and one Australian species; *spinosiceps* is distinct on account of the spines being on the vertex, not on the frons.

Galesus muscidorum, n. sp.

♀. Black; antennae wholly black; legs bright red, the coxae dusky.

Head hardly as long as its greatest width; produced between and before the eyes for some distance, this projection viewed from above with its anterior margin straight, its anterior angles acute, its lateral margins carinate; ocelli situated far forward; against the anterior ocelli are two short blunt projections and a smaller one a little lower down; vertex smooth and shining, somewhat roughened anteriorly; occipital margin finely foveate; eyes moderate, with a few long setae, their margins carinate; cheeks pubescent; mouth against thorax and directed backwards. Antennal insertion hidden by frontal projection; 12-jointed; scape long, rather stout, sulcate, apically on outer edge produced and covering base of pedicel, its inner angle acute; funicle 1 twice as long as its greatest width, 2–4 moniliform and as wide as long; club 6-jointed, joints 1–5 somewhat wider than long. Thorax normal; smooth and shining; parapsidal furrows widening posteriorly where they are separated by less than their own width; lateral lobes of scutum feebly depressed; tegulae large; scutellum with two large foveae at base, a smaller one on either side, and its posterior margin foveate. Fore-wings reaching well beyond apex of abdomen; stained yellowish; split mid-longitudinally from base to apex; without venation. Petiole distinctly longer than wide, pubescent laterally, its dorsum shining and tricarinate; body of abdomen ovate, about twice as long as its greatest width, with a median groove for one-third its length; smooth and shining; with scattered small punctures except at base, apically with a few long setae; basal segment twice as long as the following united. Length, 3 mm.

Described from one female bred from Muscid puparium in breeding-ground of *Glossina palpalis* R. D., Uganda, Aug. 1910 (*G. D. H. Carpenter*).

Type in the British Museum.

Differs from female of *silvestrii* Kieffer in the shorter head and wholly black antennae.

Aneurhynchus indicus, n. sp.

♀. Shining-black; tegulae red; legs deep red, the coxae dusky; antennae black, the funicle suffused with red.

Head transverse; smooth and shining, with a few fine setae; eyes rather small, with a few setae; antennal prominence feeble. Antennae 12-jointed; scape moderately stout; pedicel somewhat longer than its greatest width; funicle 1 nearly twice as long as its greatest width, 2 shorter, 3 as wide as long, 5 rather wider than long; club 5-jointed, joints 1–4 somewhat wider than long, the apical joint one-half longer than wide. Thorax smooth and shining, with a few minute setigerous punctures; parapsidal furrows profound, widening posteriorly; scutellum with two circular foveae at base; median segment with a plain median carina. Fore-wings reaching well beyond apex of abdomen; broad; subhyaline; venation terminating at half-wing length; submarginal vein plainly not reaching the costa; stigmal vein distinct and oblique; a long false radial vein; basal vein hardly indicated. Petiole a little longer than wide, carinate, between the carinae finely rugose; body of abdomen about twice as long as its greatest width, smooth and shining, with a few long setae, at base with a short median groove and a few striae; basal segment four times as long as the following united. Length, 2·5 mm.

Described from one female labelled "4500 feet, Kangra Valley, N.W. India, April 1899; G. C. Dudgeon."

Type in the British Museum.

The first Asiatic species of the genus.

IX. *The Scent-scale of* Pinacopteryx liliana *Gr. Smith.*

By F. A. Dixey, M.A., M.D., F.R.S., Subwarden of Wadham College, Oxford.

[Read June 4th, 1919.]

Plate XVI.

In a recent communication on the *charina* group of *Pinacopteryx*,* mention was made of the remarkable scent-scale of *P. liliana* Gr. Smith, ♂. It is now proposed to give a fuller account of this structure, so far as its details can be made out in the absence of fresh material.

As has been elsewhere recorded,† the outline of the lamina of this scale, when seen on the flat, resembles that of the thin glass flasks used in chemical laboratories (Pl. XVI, fig. 1). At the junction of the neck with the body of the flask there is a round or oval granular area (*a*), which under moderate powers of the microscope appears dark by transmitted light, and usually shows a comparatively transparent, highly refracting, roughly circular patch in the middle. The proximal part of the lamina is marked by a fine longitudinal ribbing, which loses distinctness as the central granular area is reached. Examined with a $\frac{1}{12}$-inch immersion lens, each rib in the proximal dilated portion of the lamina has a varicose appearance, as if consisting of a row of very fine granules; these rows can be traced with some difficulty through the central area. Beyond the central area, and throughout the distal portion or neck of the lamina, the ribs are still visible, now parallel with each other and closer together; in this situation the ribs are finer and the varicose appearance is less marked. In the region of the central area, numerous additional granules come into view; these are somewhat larger than the rib-granules and are irregularly disposed. Their presence tends to obscure the regular ribbing of the scale; this, however, probably persists throughout the central area, being continuous in fact from base to apex

* Trans. Ent. Soc. Lond., 1918, p. 191.

† Proc. Ent. Soc. Lond., 1912, p. cx, Pl. E, fig. 10.

of the lamina. If the scale be stained with a solution of coal-tar "light green" in alcohol and examined dry, the varicose ribs are shown with greater distinctness, and the central area is seen to contain a homogeneous body staining deeply with the reagent; this body, hereinafter referred to as the "central substance," corresponds with the highly-refracting patch visible in the unstained scale. The granules of the central area appear to be unstained; but the presence of the granules, and especially the deep coloration of the central substance, interferes with the tracing of the ribs in their course through the central area. If the stained scale be mounted in Canada balsam, it becomes so transparent that over the greater part of the lamina the ribbing can only be made out with difficulty. The central substance, however, is very clearly defined; and in its neighbourhood the ribbing and granules are fairly distinct.

Further light upon the relation of the central substance to the general structure of the scale is afforded by some sections prepared with great skill by my friend Dr. H. Eltringham. Sections taken longitudinally through the fore-wing in a male specimen of *P. liliana*, stained with light green and safranin and mounted in Canada balsam, show the wing-membrane stained a deep pink, with sockets on both upper and lower surface for the reception of the footstalks of the scales (Pl. XVI, fig. 2). Sockets of the ordinary character occur on both surfaces; but on the upper surface, in addition to these, there are visible the special sockets for the reception of the basal portion of the scent-scales; further reference to these special sockets and the articulating structure of the scale will be made later.* Many of the scent-scales are shown in section; sometimes the whole length of the scale is visible, from the portion engaged in the socket to the tuft of fimbriae at the distal extremity (Pl. XVI, fig. 3). In these cases the scale itself exhibits a pink staining, generally paler than that of the wing-membrane; while the central substance (*c*) is distinctly defined and stained blue, this colour being apparently the result of the combined action of the two staining reagents. The lamina of the scale (*d*) is for the most part extremely thin, but in the region of the central substance the upper and lower layers (*a* and *b*) separate

* See p. 387, *infra*.

from each other, giving rise to a cavity in which the central substance is seen in section as an oval or fusiform body in contact with the upper layer, a clear space being left between the central substance and the lower layer of the scale. The body itself tapers off distally and proximally, and frequently shows clefts in its substance which have no visible relation with any structural feature. In the neighbourhood of each of its thinned or pointed extremities there is an appearance as of a small accumulation of granules which seem not to share in the blue staining. These no doubt are the "granules" which were noted as visible in the scale mounted in balsam and observed on the flat, but it may be doubted whether they are due to anything more than irregularities of the surface of the lamina.

Transverse sections under similar treatment show corresponding appearances. In those sections that have passed transversely through the central substance, the clear interval between this substance and the lower layer of the scale is readily seen; the substance itself is fusiform in outline, and a similar or more marked appearance of unstained "granules" occurs at each extremity. A faint beading on the upper layer in the region of the central substance indicates the delicate ribs seen when the scale is examined on the flat. Both beading and "granules" are probably the ridges or ribs of the upper surface of the scale in cross section. In a few cases the under surface of the cavity containing the central substance appears in transverse section to be slightly beaded. The nature of the central substance is uncertain, but the appearance it presents both in the stained and unstained condition is consonant with Dr. Eltringham's suggestion that it represents an accumulation of dried secretion.

In scales that have been doubly stained in light green and safranin and mounted in Canada balsam, the footstalk and accessory disc are coloured pink, whereas the central body, as before noted, is stained blue or greenish blue. The latter colour is also generally to be found at the central region of the base of the lamina, this being the part which marks the insertion of the footstalk.

When the scale is examined on the flat, with the lower surface uppermost, the accessory disc is usually seen to be superposed upon the lamina, the footstalk being so curved as to bring it into this position. If the upper surface is above, the condition is of course reversed, and the accessory disc is seen through the superposed lamina. In either case, the termination of the footstalk in the disc is quite abrupt, and is in apparent connection with a peculiar area of the disc, oval in outline and surrounded by a chitinous ring which seems to be beaded. This, as will be seen later, is probably an aperture. The distal end of the footstalk, at its junction with the lamina, is laterally expanded, becoming trumpet-shaped in outline. A longitudinal section shows that the lamina, footstalk and disc form an S-shaped curve; the footstalk being directed upwards from its origin in the disc, bending sharply over the upper margin of the disc, and then turning downwards to reach the point where it passes into the lamina (Pl. XVI, fig. 1, *c*; fig. 4, *e*, *a*, *b*). Here again there is a sharp bend (fig. 4, *b*), the lamina itself being parallel with this distal portion of the footstalk.

Some of the appearances presented by lamina, footstalk and disc are not easily interpreted; I think, however, that there is little doubt that the footstalk really arises from that surface of the disc which lies next to the wing membrane; that surface, consequently, which in the normal position of the parts is furthest from the lamina. What the relation may be between the origin of the footstalk and the chitinous oval ring mentioned above is doubtful; I am strongly inclined, however, to think that while the footstalk arises from what may be called the ventral surface of the disc, *i. e.* the surface which lies next to the wing-membrane, the chitinous ring bounds an aperture belonging to the other, or dorsal surface. In *Ganoris rapae* Linn., the footstalk has a marginal origin from the disc; and a notch or aperture is visible, indenting the margin at a point opposite to the origin of the footstalk.* If the disc of *P. liliana* really possesses an aperture homologous with the aperture or notch in *G. rapae*, we must suppose that the disc in the former case is flattened at right angles to the plane of the disc in the latter. With respect to the interpretation of these appearances, it may further be noted that in many Pierine genera, e. g. *Nepheronia*, *Pieris* and *Appias*, the accessory disc can frequently be seen to carry an indentation similar to that in *G. rapae*, and like that feature, suggesting a proximal aperture.

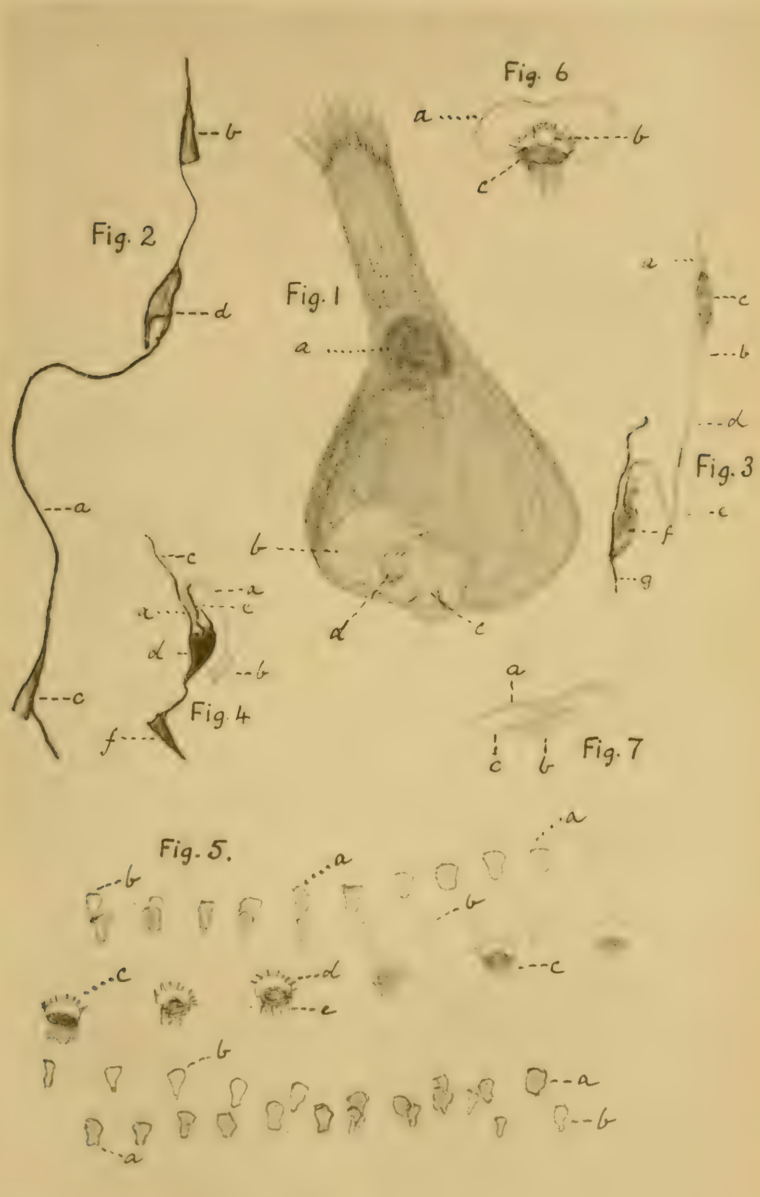
* See Proc. Ent. Soc. Lond., 1909, Pl. D, fig. 4.

When the wing-membrane of *P. liliana* has been denuded of scales, three kinds of socket for the reception of the footstalks of the scales come into view. Those for the ordinary scales are simple funnel-shaped structures, arranged for the most part in parallel rows nearly at right angles with the axis of the wing, and differing in aspect according to whether they belong to the upper or lower surface; those of the former being more amply surrounded by chitinous folds of the membrane, and so presenting a darker appearance. In addition to the ordinary sockets on the upper surface may also be seen the sockets of the scent-scales. These likewise run in parallel rows, between the rows of ordinary sockets. They are fewer in number than the latter structures, and easily to be distinguished from them; being larger in size, broader in shape and darker in aspect (Pl. XVI, fig. 5, *a*, *b*, *c*). Each terminates distally in a transparent crescentic chitinous lip, which is fringed with a row of spiny projections radiating from its convex margin. Proximally to the fringed lip the socket shows a dark opaque area, roughly oval or circular, which shades off into the general surface of the wing-membrane by a number of striations, parallel with the long axis of the socket, and apparently constituted by chitinous folds. In longitudinal sections of the wing-membrane, the funnel-shaped contour of the ordinary sockets of both upper and lower surface is clearly seen; it can also be recognised that the former are set at a somewhat steeper angle to the membrane than the latter, which are more nearly in the plane of the wing (Pl. XVI, fig. 2, *b*, *c*). The sockets of the scent-scales are again easily distinguishable by their larger size and the projecting lip, which is now seen in profile (fig. 2, *d*). A similar lip is visible on the side of the socket which abuts on the wing-membrane; the latter, however, projects from the main body of the socket to a much smaller extent than the former; it also appears to be devoid of the marginal row of spines. These lips may be called "upper" and "lower" respectively; together they form a rim which appears to be continuous round the mouth of the socket.

In a partially denuded wing examined on the flat, the accessory disc of each scent-scale is seen to be engaged in its appropriate socket (Pl. XVI, fig. 6). The disc is much larger than its receptacle, and the only part that is actually included within that structure is a semicircular or segmental area occupying the middle of the proximal edge of the disc. When seen in longitudinal section, the disc appears to fit into a groove between the upper and lower lip of the socket; its proximal margin being curled over towards the lower lip, in contact with the main substance of the socket. In a fortunate section the footstalk may be seen to wind over the distal edge of the disc, and to lie in close juxtaposition with its lower surface (Pl. XVI, fig. 4). Before reaching the curled-over part of the disc it disappears, having apparently become fused with the disc about midway between the proximal and distal edges. I have never succeeded in identifying any appearance in these longitudinal sections as due to the aperture. In transverse sections, the ordinary sockets appear simply as chitinous rings, each enclosing a circular or oval lumen. The sockets of the scent-scales, besides being much larger, are distinguishable by the fact that they show a central body oval in outline and staining readily, in place of the orifice visible in the ordinary sockets. This central body is surrounded by a less deeply stained zone, also oval in outline, and somewhat irregular if the section has happened to pass through the socket near its insertion in the wing-membrane. In many of the sections the disc is seen as a beaded line crossing the socket in the direction of the long axis of the latter, and projecting for a considerable distance at each end (Pl. XVI, fig. 7). I have never been able to satisfy myself that the footstalk is recognisable in these transverse sections.

It is probable that the examination of material properly treated while fresh would clear up many points which are obscure in the dry condition. I am hoping that it may be possible to obtain in course of time some specimens of *P. liliana* which have been put at once into preservative reagents. Meanwhile the facts at present observed seem to be sufficiently interesting to be placed on record in this brief communication.

I am greatly indebted to my friend Dr. H. Eltringham for the care and skill which he has employed in making the sections described and figured in the present paper.



F. A. D. del.

SCENT-SCALE OF PINACOPTERYX LILIANA.

Explanation of Plate XVI.

Fig. 1. The scent-scale of *Pinacopteryx liliana* Grose-Smith, viewed on the flat, × 500.

a. Central granular area.
b. Accessory disc, superposed upon the lamina, the scale being viewed from beneath.
c. Trumpet-shaped distal expansion of the footstalk at its junction with the lamina.
d. Aperture of the disc, surrounded by its chitinous ring.

Fig. 2. Longitudinal section of fore-wing, × 500.

a. Wing-membrane.
b. Socket of ordinary scale of under-surface.
c. " " " upper-surface.
d. Socket of scent-scale, showing upper and under lip.

Fig. 3. Longitudinal section of scent-scale and socket, × 500.

a. Lower layer of scale.
b. Upper layer of scale.
c. Central substance, situated in the dorsal portion of the cavity enclosed between the upper and lower layers of the scale.
d. Lamina of the scale.
e. Junction of lamina with footstalk.
f. Socket of scent-scale enclosing accessory disc.
g. Wing-membrane.

Fig. 4. Longitudinal section of scent-scale socket and footstalk, × 500.

a. Footstalk, arising from about the centre of the ventral surface of the disc, and curling dorsally over the upper margin of the disc.
b. Base of lamina close to the insertion of the footstalk.
c. Wing-membrane.
d. Socket, showing upper and lower lip.
e. Accessory disc.
f. Socket of ordinary scale of lower surface.

Fig. 5. Portion of denuded wing-membrane seen on the flat, × 310.

a, a. Sockets of ordinary scales of upper surface.
b, b. ,, ,, ,, lower surface.
c, c. Sockets of scent-scales.
d. Upper lip with chitinous spines.
e. Dark opaque area of socket.

Fig. 6. Socket of scent-scale with engaged accessory disc, seen on the flat, × 500.

a. Accessory disc in outline.
b. Aperture of accessory disc.
c. Socket, showing upper lip with chitinous spines.

Fig. 7. Transverse section of socket of scent-scale with accessory disc in place, × 500.

a. Wing-membrane.
b. Socket.
c. Accessory disc lodged in socket.

X. *A new* Hydroptila. By Martin E. Mosely, F.E.S.

[Read October 15th, 1919.]

Plate XVII.

Hydroptila simulans n. sp.

A year or two ago, when collecting Hydroptilidae in the neighbourhood of the river Test, Hampshire, I found, one autumn, amongst a large number of *Hydroptila sparsa* Curt., seven male examples which, though similar in general appearance to this species, showed considerable difference in the shape of the inferior appendages and a modification in the shape of the dorsal plate. Since then, some forty or fifty examples have turned up from the Test district, and one from the River Dove near Ashbourne.

The species appears to be plentiful on the River Colne, in the neighbourhood of Uxbridge, Middlesex.

In the accompanying notes on scent-organs in *Hydroptila* it will be seen that in *H. simulans* the form of this organ would alone warrant its separation from *H. sparsa*.

The specimens were collected in fluid and then mounted in Canada balsam: I am consequently precluded from describing the living insect.

The drawings were made from the preparations, the dorsal, ventral and lateral figures being from three different specimens.

Description of the ♂.

Expanse, $5\frac{1}{2}$–$6\frac{1}{2}$ mm.; abdomen, green or brown.

Antennae about 31-jointed in the male, the head furnished with two large bivalvular lobes.

The scent-organs, which are everted from beneath the lobes, take the form of two tubular filaments clothed with yellow hairs. When partly everted the hairs are gathered together into a dense golden pencil or brush.

The dorsal plate is rather deeply excised and somewhat similar in form to that of *H. sparsa*, but the excision begins at the extreme angle of the plate, whereas in *H. sparsa* the hind margin is really produced from the hind angle and then abruptly excised. Towards the base of the plate are two slight projections. Two processes with the outer margins sinuate arise from the edges of the ninth segment, parallel with and on each side of the base of the dorsal plate. From a lateral aspect these side pieces appear to be triangular. The penis towards its apex is bent sharply round at right angles to the main stem, resembling in this respect several other species in the genus. The inferior appendages are large, and, viewed laterally, the extremities are seen to be considerably broadened and furnished with two dark warts, or blunt spines, which, from a dorsal or ventral aspect, appear, one at the extreme apex, and the other a short distance below it. From the side one wart appears on the upper angle, and the other a short distance from the lower angle along the lower margin. The upper margin is armed throughout its length with five or six widely separated spines or strong hairs. There is a lightly chitinised ventral plate, somewhat excised towards the middle.

I have not been able to distinguish the ♀ from that of *H. sparsa*.

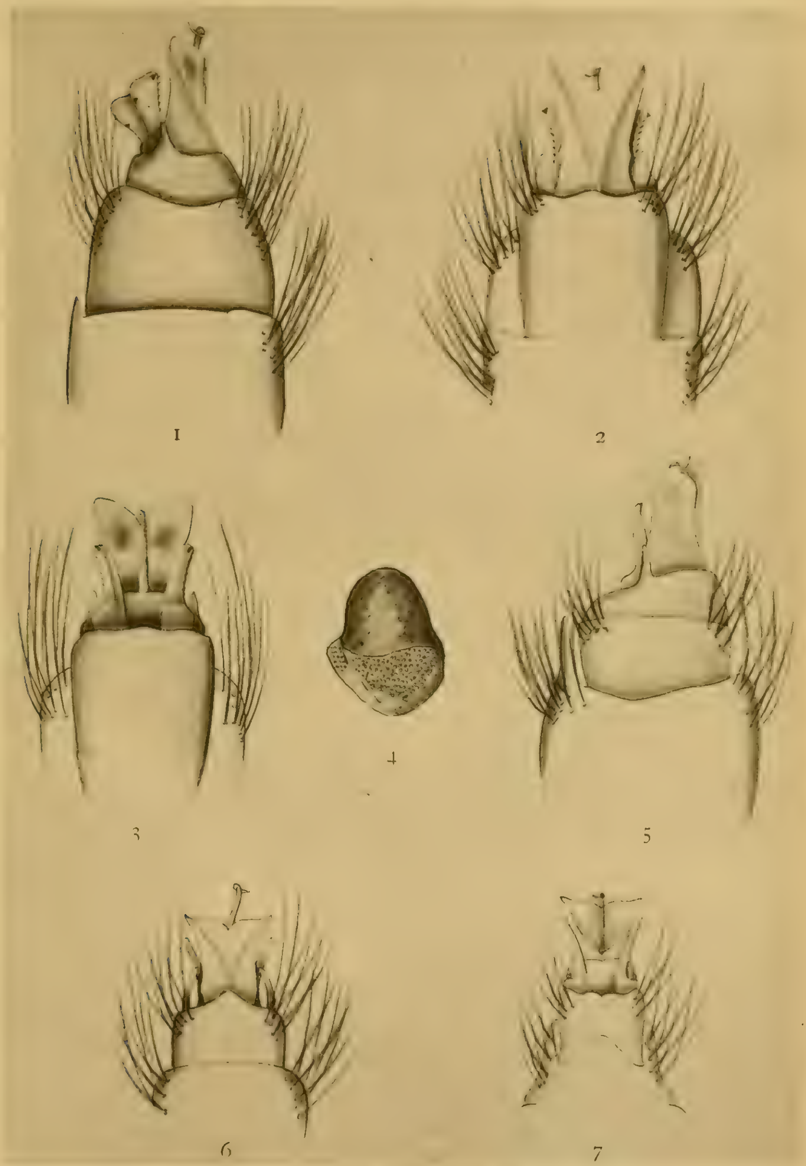
For purposes of comparison, figures of the genitalia of both *H. sparsa* and *H. simulans* are given.

I have in my collection two other British forms, slightly differing from *H. sparsa* in the shape of the dorsal plate and inferior appendages. Although I have four examples of each form, in none of them are the scent-organs everted. I am therefore deferring their description until more material comes to hand.

I am indebted to Dr. H. Eltringham, who kindly made the drawings for the accompanying plate.

Explanation of Plate XVII.

Fig. 1. *Hydroptila simulans*, ♂. Genitalia from the side.
2. " " " " above.
3. " " " " beneath.
4. " " Lobe of the head.
5. " *sparsa*. Genitalia from the side.
6. " " " " above.
7. " " " " beneath.



H. Eltringham, del.

GENITALIA OF *H. SIMULANS* AND *H. SPARSA.*

XI. *Scent-organs in the genus* Hydroptila (Trichoptera).

By Martin E. Mosely, F.E.S.

[Read October 15th, 1919.]

Plates XVIII and XIX.

Scent-organs in the Trichoptera have so far attracted but little attention, and there are few references to them in the writings of entomologists.

Packard in his "Textbook of Entomology," p. 198, refers to the presence of scent-scales on the wing of *Mystacides punctata*. Scales, or thickened hairs, are found abundantly in the male sex on the maxillary palpi and in certain areas of the wings in some genera of the Sericostomatidae, notably *Lepidostoma*, *Silo*, and *Goëra*, and they are also to be found on the wings of certain species of *Setodes*, *Beræa*, *Glossosoma* and others.

In *Sericostoma* the inner surfaces of the maxillary palpi of the ♂ are densely clothed with masses of yellowish hairs or "fluff." It is suggested that these hairs form part of a system for the distribution of scent. A full description of the palpi is given by Bruce F. Cummings in the Proceedings of the Zoological Society of London, 1914, pp. 459–474, and reference made to them by W. Müller, "Archiv. f. Naturgesch." 1887, pp. 95–97. I have failed to find further references to scent-organs in the Trichoptera.

In *Hydroptila* the patterns of scent-organ are varied. In some species there are two eversible, tubular filaments, clothed with golden yellow or else black scent-hairs (Pl. XVIII, figs. 5 and 6; Pl. XIX, fig. 9); in another species there are four, without any hairs at all (Pl. XVIII, figs. 1, 2, and 3). The tubular filaments are probably everted by the action of fluid pressure. In some species scent-scales are present; in others, they have not as yet been made out. The scent-organ may consist of a membrane at the back of the lobes, which form so distinctive a feature of the genus. The membrane is capable of considerable dilatation and carries a few battledore scent-scales on its surface (Pl. XVIII, fig. 4, and Pl. XIX, figs. 7 and 8). Accompanying this form of scent-organ are to be found two tufts of scent-hairs, similar in character to those clothing the eversible, tubular filament in the other pattern. The tufts originate in blunt, membraneous projections, apparently not eversible, situated towards the inner bases of the lobes, and developing out of a membrane which, in all species examined, stretches across the back of the head between the lobes.

Whether all these varying characters should rightly be described as scent-organs, *i. e.* distributors of scent, is a speculation into which the writer is not prepared to enter, but it appears just a little curious that in one comparatively small order such as the Trichoptera so many diverse patterns of scent-organ should be found, varying even in the same genus according to the species, and all supposed to fulfil the same function.

In this memoir it is proposed to give a brief description of the scent-organs of some of the species of *Hydroptila*, and it will be seen that the organs furnish reliable characters by which the closely resembling species of the *sparsa* form may be separated. In all species so far examined the head is furnished with two lobes varying in size and shape, in some species bivalvular. These lobes are erectile, are sometimes lined with scent-scales (Pl. XIX, fig. 10), and the scent-organs are all situated beneath them, or on their inner surfaces. When a tubular filament is withdrawn it is turned outside in, like the finger of a glove, *i. e.* the apex is returned within the walls of the filament, so that when partly withdrawn or everted there is formed a re-entering cup at the extremity (Pl. XVIII, fig. 2). When a filament clothed with hairs is partially extended or retracted, the hairs are gathered together and protrude from the hollowed extremity in a dense yellow or black brush, according to the species (Pl. XVIII, fig. 5, and Pl. XIX, figs. 9, 10, and 11).

In *H. femoralis* this brush in its normal position rests in contact with the scent-scales lining the lobe, and no doubt, on being everted, distributes the scent collected on the hairs to the surrounding atmosphere. Possibly this arrangement may be found to exist in other species as well.

The scent-organs occur in the male sex only.

Description of Scent-organs.

Hydroptila sparsa Curt. (Pl. XVIII, figs. 1, 2, and 3).

The scent-organ consists of four eversible, tubular filaments arising from a membrane extending across the back of the head, between the lobes. Although an examination has been made of a large number of individuals, I have as yet found no clear trace of scent-hairs. Two small groups of battledore scales are attached to the membrane towards the bases of the filaments. These scales differ in shape from those of the other species, having greatly elongated foot-stalks.

The lobes appear to be merely bi-valvular caps, covering the membrane when the filaments are withdrawn.

Hydroptila simulans Mosely (Pl. XVIII, figs. 5 and 6).

There are two eversible, tubular filaments clothed with golden-yellow hairs. I have not been able to satisfy myself as to the presence or absence of scales on the inner surfaces of the lobes, which have somewhat the appearance of longitudinally bisected acorns with roughened inner surfaces.

Hydroptila forcipata Eaton (Pl. XIX, figs. 7 and 8).

The lobes are very narrow, and each is lined with a membrane capable of considerable dilatation. There is a ring of rather narrow striated battledore scales towards the junction of this membrane with the margin of the lobe. A membrane extends across the back of the head connecting the two lobes. Towards the base of each lobe there is a slight swelling in this membrane, from which arises a bunch of scent-hairs, but there does not appear to be any eversible filament.

Hydroptila maclachlani Klap (Pl. XVIII, fig. 4).

In this species the scent-organ seems similar in construction to that of *H. forcipata*. The scales on the membrane may perhaps be fewer in number, and the scent-hairs are inserted in funnel-shaped sockets. The lobes are even more narrow than in *H. forcipata*, and when in their normal position are pressed flat against the back of the head, inclining towards each other and nearly invisible without the aid of a powerful lens.

Hydroptila femoralis Eaton (Pl. XIX, figs. 9 and 10).

The scent-organ consists of two eversible, tubular filaments clothed with black hairs; there are battledore scales very plentifully lining the cup-shaped lobes (Pl. XIX, fig. 10). When the filaments are retracted the hairs are collected together in a dense brush with their extremities resting against the scales of the lobes. The ends of the hairs are slightly broadened, and probably, as mentioned above, collect the scent matter and distribute it to the surrounding atmosphere when the filament is exserted.

H. pulchricornis Pict.

I have seen only two examples of this species, and they are both mounted in positions which do not permit of a high-power examination of the scent-organs. There are two eversible, tubular filaments clothed with black hairs as in *H. femoralis*, but I have been unable to ascertain whether there are any scent-scales present.

Hydroptila occulta Eaton (Pl. XIX, figs. 11 and 12).

In *Hydroptila occulta* the scent-organ is rather complex. There are two eversible, tubular filaments clothed with golden-yellow hairs. The lobes, which are rather narrow and blunt, are each lined with a membrane, and, towards the apex, this membrane can be slightly everted to form a secondary tubular filament. Towards its extremity this filament is clothed with elongated striated scales, but hairs, similar to those on the main filaments, are absent.

Another cluster of these scales is found towards the base of the lobe, and a row of them occurs along the membrane which extends across the back of the head. At the apex of each lobe there is, in addition, a small group of striated battledore scales similar in shape to those of *H. femoralis* (Pl. XIX, fig. 12).

There are, in addition, two described British species of *Hydroptila*—*tigurina* Ris., and *sylvestris* Morton—which I have never seen. There are also two undescribed British forms in my own collection which unfortunately do not display scent-organs sufficiently clearly for description here. One species certainly possesses a brush form of tubular filament, but a full description must be deferred until more material comes to hand.

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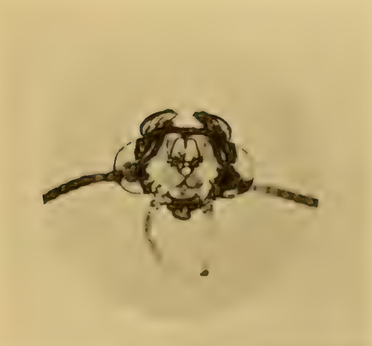

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M. E. Mosely, photo.

SCENT-ORGANS IN *HYDROPTILA*

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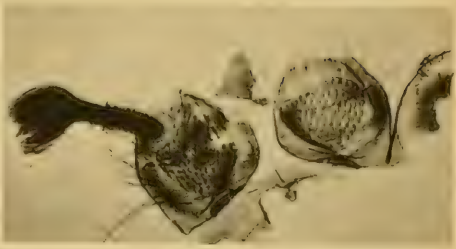

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M. E. Mosely, photo.

SCENT-ORGANS IN *HYDROPTILA.*

I have been fortunate in enlisting the interest of Dr. H. Eltringham, M.A., D.Sc., F.Z.S., in these scent-organs. His admirable paper on a similar formation in the Danaine butterflies, with his splendid drawings, appeared in the Transactions of this Society in 1913, pp. 399–406, and in 1915, pp. 152–176. I should like to express my thanks to him for the enthusiastic manner in which he has given his valuable time to the study of my preparations, and he has conferred a further obligation on me by promising a supplementary paper on the subject, elucidating the histological details of the structures. I have seen the rough outline of his notes, together with some beautiful drawings, and am grateful to him for thus filling in the gaps and omissions which, I fear, are all too plentiful in the above descriptions.

Explanation of Plate XVIII.

Scent-organs of *Hydroptila* spp.

Fig. 1. *Hydroptila sparsa.* Tubular filaments fully everted × 30.
2. ,, ,, ,, ,, partly withdrawn × 36.
3. ,, ,, ,, ,, fully withdrawn × 25.
4. ,, *maclachlani.* From a dissection × 65.
5. ,, *simulans.* Filaments partly everted × 30.
6. ,, ,, ,, fully everted × 25.

Explanation of Plate XIX

Scent-organs of *Hydroptila* spp.

Fig. 7. *Hydroptila forcipata* × 25.
8. ,, ,, From a dissection × 105.
9. ,, *femoralis* × 22.
10. ,, ,, From a dissection (one filament removed to show scales) × 60.
11. ,, *occulta.* Filaments slightly retracted × 25.
12. ,, ,, Lobe, showing the secondary filament everted and the arrangement of the scent-scales × 116.

XII. *The Male Abdominal Segments and Aedeagus of* Habrocerus capillaricornis *Grav.* [Coleoptera, Staphylinidae]. By F. Muir.

[Read October 15th, 1919.]

Plate XX.

In 1911 Dr. L. Weber,* in an interesting paper, described and figured the male genitalia of a number of species of Staphylinidae, *Habrocerus capillaricornis* Grav., being among them. The figures and description of this species show that it departs so greatly from the normal Staphylinid type that the homologies of the terminal abdominal segments and the aedeagus are not easily recognised. While Dr. Weber is correct in the main points, there are certain others which we consider of importance, such as the recognition of the membranous condition of the aedeagus, which he does not mention, and some of his interpretations we do not agree with. For these reasons, and for the interest attaching to the departure of a species from the normal type of a very large group of which it forms part, the following notes are published.

In all the male Staphylinidae which we have examined with this one exception there are nine abdominal segments and an aedeagus. The first tergite is in intimate relation with the metanotum, the lateral portion being longer than the middle and including the first abdominal spiracle, which is sometimes very large; the second tergite, which is often short, and the following seven are well defined. The first two sternites are mostly membranous and modified to accommodate the hind coxae (as is the rule in the Coleoptera); the following seven are well defined. The hind margin of the eighth sternite is emarginate in some species. Each of the first eight abdominal segments bears a spiracle. The eighth segment, in many species, is attached to the seventh by a large membrane, which allows of the former being drawn within the latter. The ninth segment is modified and differs considerably in different genera; it is attached to the eighth by a considerable membrane, which allows of great mobility.

* "Fests. Ver. Nat.," Cassel, 1911, pp. 284–313.

In *Tachyporus solutus* Erich., the ninth segment (figs. 1, 2, 3) consists of four pieces, a large ovate sternite (IX), a pair of large subtriangular pleural plates (*pp*) meeting together on the dorsal aspect and overlapping the basal portion of the tergite (9) and connected by a slender strip on the ventral aspect, and a large dorsal plate whose basal area is overlapped by the pleural plates. In *Leistotrophus* we find a similar arrangement of segments, but the ninth differs considerably (figs. 4, 5). The pleural plates (*pp*) are small and each bears a large style (*s*), on the ventral aspect they are connected by a narrow strip and on the dorsal aspect they are widely separated by the large tergite; a pair of large glands open on the connecting membrane (*a*) between the eighth and ninth tergites.

What is here considered as the ninth tergite is considered by some writers as the tenth tergite, but we can see no morphological reason for considering it so, and we have no information as to its ontogeny. The anus opens beneath the ninth tergite on a membrane which connects the aedeagus with the ninth segment (*im* 1).

Without entering into a comparative study of the ninth abdominal segment we can consider the two mentioned as typical of the Staphylinidae.

In *Habrocerus capillaricornis* Grav., the first tergite is well defined, between it and the second there is a fairly large membrane, the second and five following tergites are well defined. The first two sternites are small and membranous, the following five are well defined. The seventh segment is connected by a large membrane to the sixth some distance from its posterior edge, which gives the seventh great mobility and allows of it being completely withdrawn into the sixth.

The eighth segment (VIII in figs. 6, 7, 8, 9) is highly modified and consists of four pieces. A large pair of pleural plates (*pp*), on which the eighth spiracles (fig. 6, *sp*) are situated, embrace the lateral area, and from the apex of each a large, spine-like style arises; the dorsal aspect consists of a very short tergite (8), and the sternite (VIII) consists of a large plate more heavily chitinised round the edges, the posterior portion is external and visible and has a small emargination in the middle, the rest of the sternite is internal. The lateral portion of the eighth tergite articulates with the lateral edges of the sternite and also articulates in a depression at the base of the pleural plates. The eighth segment is attached to the seventh by a large membrane (*b*) and can be completely withdrawn into it. The ninth segment is highly modified and shaped like an oat (fig. 11). The distal and visible portion consists of a pair of pointed and slightly curved lobes connected in a V-shaped piece on the dorsal aspect; the basal and internal portion consists of a membranous plate (*f*) chitinised along the edges (*g*). On the ventral aspect at the meeting of the lobes there is a small trident body (figs.6 and 10, and 11 *t*) attached to a rod (*d*) which lies free within the segment. The segment is attached to the preceding by a membrane (*c*), which allows of considerable play between the pleural plates of the eighth segment. The anus (*an*) opens on a membrane between the lobes; the rectum can be protruded. In figure 9 it is shown retracted and in figures 7 and 11 protruded.

For the sake of those who may not be acquainted with the male genitalia of the Staphylinidae it may be stated that in the more generalised forms, e.g. *Gyrophaena pulchella*, the median lobe is long, cylindrical, with the median foramen at the basal extremity and the median orifice at the other, the internal sac is small and undifferentiated and the tegminal lobes large. The line of specialisation is for the basal portion of the median lobe to become large and the distal portion shorter, the median foramen to move along the medio-ventral line towards the median orifice till they are separated by only a very narrow area and for the tegminal lobes to be greatly reduced; a good example of this specialisation is found in *Xantholinus glabratus*. The internal sac in these more specialised forms is large, complex and often bears a highly developed armature. In these forms the median lobe is a beautifully adapted bulb for the evagination of the internal sac by blood pressure. The ventral aspect is highly chitinised, also the dorsal aspect, but not so strongly; a band of membrane connects the two; muscles attach the dorsal surface to the ventral portion, and by their contraction the dorsal surface is depressed and the pressure exerted on the fluids within the bulb ejects the sac. In freshly dissected specimens this can be accomplished artificially by slight pressure on the dorsal surface of the bulb.* In all species in which the internal sac is specialised (and they include the largest

* For fuller details of this subject the reader is referred to Trans. Ent. Soc. Lond. 1912, pp. 477 *et seq.*

portion of the Coleoptera), it is the chief functional organ, the tegmen and median lobe serving for its protection, guidance and protrusion.

In *Leistotrophus* the basal portion of the median lobe forms but a small bulb, and the distal portion is comparatively large; in *Tachyporus* the bulb is much larger and the distal portion smaller. The connection with the inner surface of the ninth segment is by a membrane arising around the edge of the median foramen; the anus opens on the dorsal portion of this membrane (fig. 3, *im 1*; in this figure the aedeagus is shown drawn out of this membrane in a diagrammatic manner impossible to do in nature).

In *Habrocerus capillaricornis* there is nothing to correspond to the highly developed median lobe of *Leistotrophus* and *Tachyporus*, but the internal sac is well developed and specialised (*is*). In the place of the median lobe we find a membranous tube opening in the dorsal aspect of the small trilobe process (figs. 10 and 11, *t*), on the same membrane as the anus is situated. This tube enlarges coneshape and is inflexed (*h*) for a short distance and then reflexed (*i*), this reflexion continuing as the internal sac; the inflexed membrane (*tg*) is in close contact with the outer membrane (*im 1*), and there is a small, semichitinised, triangular plate (*e*) at the point of inflexion. The outer membrane (*m 1*) is homologous in position to the connecting membrane (*im 1*) of *Tachyporus* and *Leistotrophus* and the inner, inflexed membrane (*tg*) with the aedeagus.

The internal sac (fig. 12, *is*) is large and covered with small spines pointing basad; along one side there is a row of nine spines fixed to the sac by large bases; the apical three are smaller than the others; along the opposite aspect there is a row of small semitriangular plates, one overlapping the other.

The membranous cone (fig. 10, *im 1*, *tg*) varies somewhat in size in different specimens, the one figured is very distinct, but others are smaller and not so plain. In the absence of fresh or spirit specimens certain important points relating to the musculature have to be left unexplained, but there is a large group of muscles attached to the margin of the cone (fig. 10, *h*) enveloping the internal sac. This evidently acts as a muscular bulb in a somewhat similar manner to the muscular bulb in certain Lamellicornia (i.e. *Melolontha vulgaris*). There are several points in the structure of the membranous aedeagus which require further investigation, but as the opportunity for carrying on the work will not occur for an indefinite period we consider it advisable to publish the results as they now stand.

That this species presents profound modifications on what is generally recognised as the normal Staphylinid morphology must be admitted by all students of this group, but unfortunately we have very slight knowledge of the morphology of this large group, and so we can only blindly speculate as to the line of evolution it travelled to reach its present condition.

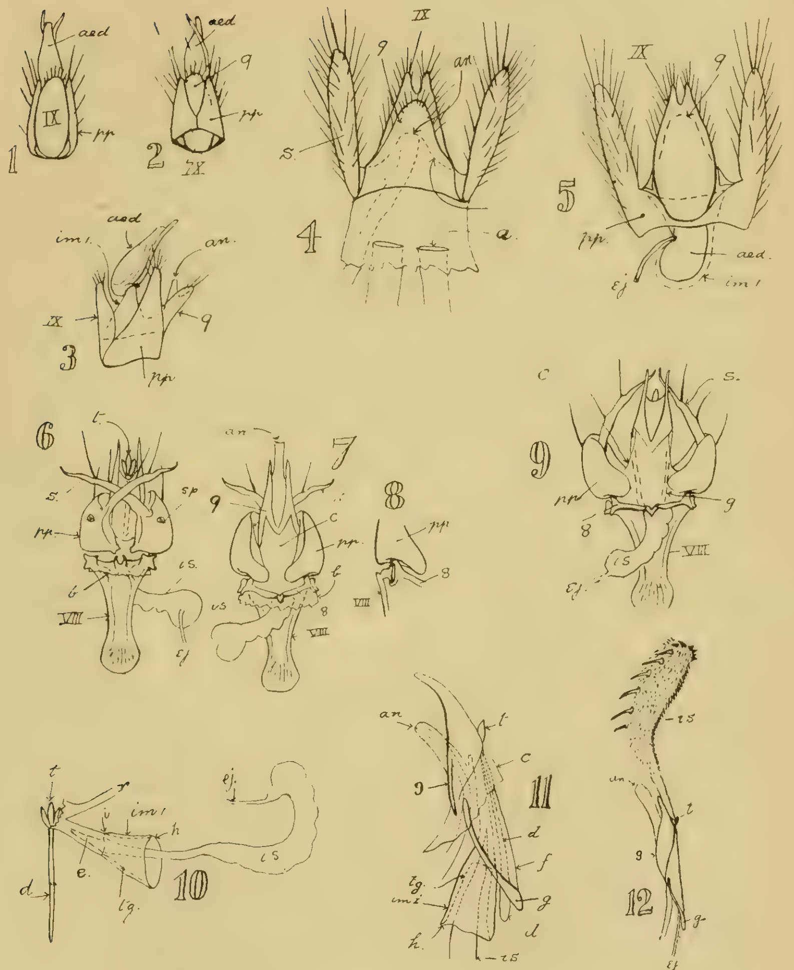
The theory that nine well-developed abdominal segments and a well-defined aedeagus is the older type is founded upon good morphological reasons, but forms having once arrived at a certain stage of specialisation, such as exists in all presently known species, are not likely to undergo a profound modification. It is therefore early in the phylogeny of the group that *Habrocerus* must have started on its line of specialisation. It is possible that further research will reveal forms that will show us some of the stages of this evolution, but until then it will be safest to consider that the genus is very distinct from all the other Staphylinidae which we know and must have been so from a very remote period in the evolution of the family.

Figure 12 is from a drawing by my wife, who everted this sac and mounted it when working with Dr. David Sharp.

Explanation of Plate XX.

Fig. 1. Ventral view of ninth abdominal segment and aedeagus of *Tachyporus solutus* Erich.

2. Dorsal view of the same.
3. Lateral view of right side of the same.
4. Dorsal view of the ninth abdominal segment of *Leistotrophus* sp.
5. Ventral view of the same.
6. Ventral view of eighth and ninth abdominal segments of *Habrocerus capillaricornis* Grav.
7. Dorsal view of the same.
8. Articulation of eighth tergite and eighth sternite and the pleural plate.



MALE GENITALIA. STAPHYLINIDAE.

9. Dorsal view of the eighth and ninth abdominal segments showing the connecting membrane between them.
10. Trident body and rod with membranous "aedeagus."
11. Lateral view, left side, of ninth abdominal segment.
12. The same with internal sac partially everted.

a, duct of anal gland; *aed*, aedeagus; *an*, anus; *b*, membrane connecting seventh and eighth segments; *c*, membrane between eighth and ninth segments; *d*, rod of trident process; *e*, slight chitinisation on aedeagus; *ej*, ejaculatory duct; *f*, membrane at base of ninth segment; *g*, chitinisation along the edge of *f*; *h*, base of tegmen; *i*, point where tube is reflexed; *im 1*, membrane between aedeagus and body wall; *is*, internal sac; *pp*, pleural plates; *r*, rectum; *s*, styles; *sp*, spiracle; *t*, trident; *tg*, membranous cone; 8, 9, eighth and ninth tergites; VIII, IX, eighth and ninth sternites.

XIII. *On the Mechanism of the Male Genital Tube in* Coleoptera. By Frederick Muir.

[Read October 15th, 1919.]

Plate XXI.

Although we have considerable knowledge of the skeleton of the male genital tube of a number of species of Coleoptera, but little is known as to the mechanism and muscles of this organ. Some of the most detailed work on this subject, such as Straus-Durckheim on *Melolontha vulgaris*, was done by workers who did not recognise the importance of the internal sac and the predominant rôle it plays in copulation. For these reasons the following remarks on some of the types and their manner of functioning, with a few details relating to muscles in a couple of "ring" types, may be of interest, notwithstanding their desultory character.

Orientation.

For the sake of clearness it is necessary to define the terms of orientation employed. For this purpose I accept for orientation the point between the abdomen and thorax, as defined by Dr. Sharp,* as basal. The portion of any segment or appendage nearest to that point being the base, and the portion most distant being the apex. In measuring the respective distances a continuous line on the body wall must be followed, a dorsal, pleural or ventral line for their respective areas. Thus the tarsus of a front leg lying against the basal point would still be the apex of the leg, and the coxa the base. This orientation applies equally to invaginations, struts or glands, and evaginations, tegminal lobes, etc. Thus the base of a tegminal lobe is that part nearest the body of the tegmen, and the apex is the free end; and the base of the tegminal strut is where it joins the tegmen, and the apex is the free end; the apex of the median lobe is the free end, and the base of the internal sac is where it joins the median lobe. The terms anterior or cephalic and posterior or caudal are relative to the head and tail, hence the anterior margin of a thoracic segment

* "Cambridge Natural History," V, "Insects," I, p. 112, fig. 62.

is the apical margin, and the anterior margin of an abdominal segment the basal margin. It is, however, not a good principle to use the terms anterior or posterior when discussing parts of an appendage.

The term invagination is applied to any withdrawal of the ectodermal surface into the body lumen, whether it be long and narrow, as is the case with the median struts in many beetles, or broad and short, as is the case with a large portion of the basal piece in many beetles.

Relation of Structure and Function.

A study of the skeleton, that is, of the membrane and the external and internal chitinisations of the male genital tube of Coleoptera, shows that there are several distinct types which it is reasonable to expect function in different ways, though little is known as to the method by which the sperm is conveyed from the testes to the spermatheca. One of the most interesting and instructive works on this subject is by Blunck on *Dytiscus marginalis*.* He shows the formation of a spermatophore within the median lobe and the subsequent transference of the sperm to the female through a hole in the wall of the spermatophore. The median lobe of the Dytiscidae is funnel-shape, and there is no specialised internal sac; the Haliplidae and Pelobiidae are built on a similar plan, and there is good reason to believe that they form spermatophores in a similar manner to *Dytiscus*. The median lobe of the Gyrinidae is not funnel-shape, and it is highly probable that they do not form spermatophores, or if they do they are of a different shape to that of *Dytiscus*. These three families belong to the minor section of the Coleoptera, which has no specialised sac, whereas the major section has a large, more or less highly specialised sac, which is the chief organ of copulation. The shape of the sac and the armature upon it is often highly complex, especially the armature, called the transfer apparatus, round the functional orifice, where the ejaculatory duct opens on the internal sac. In some species this transfer apparatus takes the shape of a fine, long tube or flagellum. This is the case with the little Cucujid *Cryptomorpha desjardinsi*, which has a long sac and a long, slender flagellum; during copulation the long sac is entirely everted and enters the long membranous vagina, and the

* Zs. wiss. Zool. Leipzig, Bd. cii, Heft 2, pp. 169–248 (1912); also Carl Demandt, t.c. Bd. ciii, pp. 171–299 (1912) for the muscles.

long flagellum enters the long, spiral duct of the spermatheca. In this manner a complete tube is formed from the testes to the spermatheca. In *Anomala orientalis* the sac is large and the functional orifice is large and without any transfer apparatus; it is not brought against the opening of the duct of the spermatheca but to the opening of the bursa copulatrix, into which the sperm is discharged. By what means it is conveyed to the spermatheca it is impossible to say at present.

The coadaptation of the organs of the two sexes in a number of forms examined by Dr. Sharp and the writer is quite remarkable. A good case of this is in *Neolamprima adolphinae*, where the median lobe is small and produced into a very slender and long flagellum *; in the female the base of the duct leading to the spermatheca is widened and shaped like the median lobe; the more distal portion of the duct is very slender and spiral.

The fact that some Coleoptera are known to make spermatophores and the probability that others do not, suggests the possible division of the order into two groups. Whether this classification would separate certain families, or whether it would cut across several families separately it is impossible to say with our present knowledge. It is highly probable that when no specialised sac is present, especially if the median orifice be large, spermatophores are formed; when a sac is present and no specialised transfer apparatus exists it is possible, or even probable, that spermatophores are formed; but when a highly specialised transfer apparatus, especially if it be a flagellum, exists it is highly probable that no spermatophores are formed.

In the vast majority of Coleoptera the internal sac is the chief organ of copulation, the tegmen and median lobe acting as protectors and guides. In the following section the muscles explain the protrusion and retraction of the median lobe and tegmen and the retraction of the sac, but they do not explain the evagination of the sac. This is always brought about by blood pressure, and it is highly probable that the different types have followed certain lines of evolution to accommodate the different development of the sacs, and allow for their functional mechanism.

* This is not shown in Sharp and Muir, Trans. Ent. Soc. Lond., 1912, Pl. XLIV, figs. 10, 10*a*, as the authors failed to detect it at that time. As it is permanently everted it is easily broken during dissection.

It is among the trilobe forms of aedeagus that the sac is least developed; in many cases it cannot be distinguished from the ejaculatory duct, and in others it is only differentiated by a slight increase in size. In these cases it lies entirely within the median lobe. With the enlargement of the sac modifications have taken place in the median lobe and tegmen. These modifications have been mainly along three lines. The development of the median lobe into a bulb with the reduction of the tegmen (the Staphylinid type): the development of the median lobe into a long tube (the Phytophagoidea type): and the development of the tegmen into a more or less tubular organ (the Melolonthid type).

Something like the beginning of the Staphylinid type can be seen among the trilobe forms in *Syndesus cornutus*,* but it is among the Staphylinidae that this type reaches its most complete development. In that family such forms as *Gyrophaena pulchella* and *Zirophorus bicornis* have the median lobe cylindrical and the internal sac small, but in the latter the basal portion is slightly swollen and the dorsal surface but slightly chitinised, and it can be pressed down against the ventral portion; the median foramen is also very small. The line of development is for the apical portion of the median lobe to shorten and the basal portion to become enlarged and rounded, the ventral and dorsal areas to become chitinised, especially the former, with a band of membrane separating them. The dorsal surface can be brought towards the ventral surface by muscular contraction. Thus a complete automatous bulb is formed, which reaches a high state of perfection in such a form as *Xantholinus glabratus*. In many Staphylinidae if the aedeagus be dissected out of a freshly killed specimen and slight pressure be placed upon the bulb the sac will instantly be evaginated. The invagination of the sac is done by the contraction of muscles between certain areas on the sac and others on the median lobe. But there are innumerable stages between these forms among the Staphylinidae. This line of evolution has been followed in other groups such as Pselaphidae and some Malacoderms (i. e. *Telephorus limbatus* and *Balanophorus mastersi*).

* For figures and descriptions of the forms mentioned the reader is referred to Trans. Ent. Soc. Lond., 1912, pp. 477–642 and Plates XLII–LXXVIII.

The second line of development, the elongation of the tubular median lobe (the Phytophagoidea type), necessitates a greater or lesser amount of play between the median lobe and the tegmen. The limit to the length of a stiff, chitinous median lobe is soon reached on account of its want of flexibility, but this is overcome by a portion becoming membranous and thus capable of folding up. When the sac is shorter, or but little longer, than the median lobe the retractor muscles can ply between the sac and the median lobe, but when the sac becomes much longer than the median lobe this method of invagination would lead to a great crumpling up of the sac. This problem is met by one or two areas on the median lobe, to which the retractor muscles actuating the sac are attached, becoming invaginated, lengthened and chitinised. In this method the median struts arise which reach a wonderful state of perfection and slenderness in some of the Rhynchophora; in the Longicorns the struts are long, wide and flat (a state also found in the Brenthidae). In this type the tegmen is reduced to a more or less slender ring and a strut, or even to a Y; the tegminal lobes are found in every condition from large (Longicorns, Brenthids) to total absence.

The third type (the Melolonthid) is not so uniform as the other two, but equally worthy of notice. In this type the median lobe is greatly reduced and the tegmen is formed into a more or less complete tube. It is found in the Scarabaeidae and in certain Tenebrionidae. Every degree in size of the sac is found among these forms.

In the Staphylinid type, as we have already stated, there is an automatous bulb with a small foramen, which by contraction can exert blood pressure upon the sac. In the Phytophagoidea and Melolonthid types there is no such development of the median lobe, and the median orifice is large. The blood pressure must therefore be brought about by some other mechanism. In the Phytophagoidea type, and in many of the Melolonthids, this is most likely effected by the reduction of the abdominal cavity, either by the contraction of the abdominal walls or by the distention of the air sacs in the abdomen, or by a combination of the two.

In *Melolontha vulgaris* Straus-Durckheim describes and figures some large muscles, which he styles "les deux chefs du constricteur du canal ejaculatoire." In an *Anomala* which I have examined these form a large bulb of circular muscles at the base of the median lobe, the basal edge being connected to the base of the median lobe. These muscles do not touch the ejaculatory duct or the sac except where the former passes through from the body cavity. When retracted the apex of the sac and a length of slack ejaculatory duct lie loose within this muscular bulb. That these muscles do not act as constrictors of the duct or sac is perfectly evident, and it is very highly probable that they act as a bulb for the evagination of the sac. The retractors of the sac are shown in Straus-Durckheim's work arising from different parts of the sac and proceeding to a point apparently on the wall of the muscular bulb. It would at first appear as if these retractor muscles had no connection with the median lobe, but this is not the case, for the dorsal strut of the median lobe proceeds as a membrane to this point and the muscles are attached to its apex. *Geotrupes sylvaticus* has a very small unspecialised sac, a very small median strut and no muscular bulb, and is a very much simpler structure.

Dr. Sharp called my attention to some peculiarities of the sac of *Anoplognathus*. Upon examination I find that there are three ducts opening on the sac at three distinct spots. Two of these are of a similar nature and the third apparently of a glandular nature; there is also a short diverticulum which also appears to be of a glandular nature. Whether the two similar ducts proceed separately to the testes I am unable to say from examining only dried specimens. There is also a strange arrangement of the female uterus.

Musculature.

As two representatives of the Phytophagoidea type I have selected *Rhynchophorus ferrugineus* and *Strangalia armata*. The *Sphenophori* differ from the other Rhynchophora in possessing a pseudotegmen formed by the chitinisation of part of the membrane connecting the tegmen with the body wall, and by the eighth abdominal segment being invaginated within the seventh, the pygidium being formed by the seventh tergite. In *Strangalia armata* not only are the eighth tergite and sternite well developed, but there is a well-developed ninth segment, a condition not found in any of the Rhynchophora. I do not know if this distinction holds throughout the Longicornia, but should it do so it will be of great importance.

Figure 1 represents in a semidiagrammatic manner the skeleton of the male genitalia of *Rhynchophorus ferrugineus*. The seventh tergite is large and forms the pygidium, its apical margin meets the apical margin of the seventh sternite and closes the outer cloaca. The eighth tergite is much smaller and fits into the convexity of the ventral side of the seventh tergite, to which it is connected by a large membrane allowing of considerable play. The basal margin of the eighth tergite is produced into two large, flat processes or struts to which the protractor muscles are attached and allow of greater play. The eighth sternite is small and together with the eighth tergite closes the inner cloaca. The apical margins of the eighth segment is connected to the base of the tegmen by a large membrane (*im 1* and *ptg*), the median portion of which is chitinised and forms the pseudotegmen. At the base where it joins the eighth segment this membrane forms a narrow tube (shown too large in the figure), which allows of the median lobe moving through it but does not admit of any lateral motion. The anus (*an*) opens on the membrane beneath the eighth tergite. The tegmen consists of a strong chitinous ring (*tr*), incomplete on the dorsal area where the chitin curves slightly apically but does not meet, and a large, strong strut (*tgs*) which varies somewhat in shape and size in different specimens, the one figured (1 *a*) being large and broad at the apex; a strong keel runs down the dorsal surface of the strut. The median layer or median tube consists of the median lobe and the membrane connecting it to the tegmen. The median lobe is a tube incompletely chitinised, the ventral plate being nearly divided into three pieces by two deep, narrow membranous areas; the basal corners of the ventral plate are continued as two narrow struts (*ms*); the dorsal plate is produced basad farther than the ventral plate. The median struts (*ms*) at first form chitinisations on the surface of the median lobe and later join the invaginations which form the free struts. The internal sac (*is*) lies within the median lobe.

The chief muscles which control the movements of this skeleton are (fig. 2) :—

(*a*) Retractor and protractor muscles from the pseudotegmen to the eighth segment, by which the pseudotegmen is held firmly in its place and moved through a limited distance.

(*b*) A large series of muscles from the apex of the pseudotegmen to the large apical portion of the tegminal strut (*tgs*). This holds the ring of the tegmen into the base of the pseudotegmen, where it fits quite tightly, the membrane connecting the pseudotegmen and the tegmen forming a fold between them.

(*c*) The retractor of the median lobe connects the base of the median lobe and the base of the median struts with the inner surface of the apex and the ridge of the tegminal strut.

(*d*) The protractor of the median lobe connects the ring of the tegmen (*tr*) with the outer surface of the apex of the median struts.

(*e*) The retractors of the internal sac connect certain points (e^1, e^2, e^3, figs. 3, 4) on the sac with the inner surface of the apex of the median struts. At the point on the sac where the largest of these muscles (e^3) is attached there is a large Y-shaped sclerite. A few small muscles connect the basal portion of the sac (*g*) with the median lobe near its apex. When it is remembered that the median struts are invaginations or prolonged folds of the median lobe it will be seen that all the muscles of the internal sac are in fact attached to the median lobe.

Figure 5 represents in a semidiagrammatic manner the skeleton of *Strangalia armata* with the internal sac partly evaginated. In this species of Longicorn the eighth tergite is well developed and forms the last visible segment; the eighth sternite (fig. 7, VIII) is small and membranous with two small triangular chitin plates and a short strut or spiculum. The ninth tergite (fig. 6, 9) is distinct and forms a small arc, each corner of which is produced into a small spiculum (*lsp*); the ninth sternite (IX) is well developed and produced into a large spiculum (*sp*). The membrane (*im 1*) connects the ninth segment with the tegmen. The tegmen consists of a " ring " with a pair of large, dorsal-tegminal lobes (fig. 5, *tgl*), the ventral portion being produced into a large strut (*tgs*), the chitinisation not meeting till the apex. The median lobe is tubular with a gusset of membrane along each lateral area, the ventral chitinisation extending further distad than the dorsal and is pointed and hooked at the apex, the base is produced into two wide struts (*ms*). The base of the struts and the base of the body of the lobe is indicated by the attachment of the membrane (*im 2*) which connects the tegmen with the median lobe. The internal sac is very long, simple, cylindrical, bent about half-way and again near the apex, with two small subcrescent-shaped sclerites near the base and a semichitinised patch near the apex; there is no complex transfer apparatus.

Muscles connect the spiculum of the eighth sternite with the seventh sternite (fig. 7), and a larger series of muscles connect the plates of the eighth sternite with the large spiculum of the ninth sternite. These muscles hold the ninth sternite and its spiculum in place and take off the strain of the protractors and retractors of the tegmen (*g* and *b*). A few bundles of muscle connect the small spiculum of the ninth segment to the connecting membrane, and others connect it with the walls of the rectum (fig. 6, *m*, *k*, *l*).

The retractor of the tegmen (figs. 7, 8 *b*) consists of a large series of muscles attached to the membrane (*im 1*), mainly on its right side and near its junction with the tegmen, and to the apex of the spiculum (*sp*).

The protractor of the tegmen (*g*) consists of a large bundle of muscles from the inner surface of the base of the spiculum of the ninth sternite to the apex of the tegminal strut.

The retractor of the median lobe consists of a long muscle from the inner surface of the apical half of the median lobe to the apex of the tegminal strut (fig. 8 *c*).

The protractor of the median lobe (fig. 8 *d*) proceeds from the ring of the tegmen to the apical portion of the median struts.

Retractors of the internal sac (fig. 8 *e*) are very long and fine muscles from the apex of the median struts to areas on the internal sac, a few to the crescent-shaped sclerite near the base of the sac, and others to the semichitinous area near the apex. There are other small bundles from the sac to the inner surface of the median lobe.

Another muscle (fig. 8 *n*) connects the apex of the tegminal strut with the apex of the median struts. This would help to co-ordinate the movements.

To those who are interested in the mechanism of insect-structure these few notes may be of interest, and may lead them to work on the details of various forms. The task is huge, and the information desired is harder to procure than that relating to the external morphology, but no final "natural classification" can be attained without studying the male genitalia, and the mechanism and function are an important part of that study.

My thanks are due to Dr. David Sharp, who has been at work on these structures for several years and has accumulated a mass of material and information, both of which have been freely placed at my disposal. The material used for *Rhynchophorus* was supplied to him by Prof. Bainbrigge Fletcher of Pusa.

Explanation of Plate XXI.

Figures 1–4 are of Rhynchophora; 5–8 of *Strangalia* (Longicornia).

Fig. 1. Lateral view of skeleton of the male genitalia of *Rhynchophorus ferrugineus*.

1*a*. Tegminal strut.

2. Lateral view of pseudotegmen and muscles of aedeagus.

3. Apex of internal sac showing the attachment of muscles.

4. Internal sac evaginated.

5. Lateral view of skeleton of the aedeagus of *Strangalia armata*, with internal sac partly evaginated.

6. Ventral view of ninth abdominal segment of *S. armata*.

7. Eighth and ninth sternites of *S. armata*, with muscles attached.

8. As fig. 5, but with the muscles.

an. Anus.
ej. Ejaculatory duct.
fo. Functional orifice.
im 1. Membrane between tegmen and body wall.
im 2. Membrane between tegmen and median lobe.
lsp. Lesser spiculum.
ml. Median lobe.
mo. Median orifice.
ms. Struts of median lobe.
ptg. Pseudotegmen.
sp. Spiculum.
tgs. Tegminal strut.
tr. Tegminal ring.
8. Eighth tergite.
9. Ninth tergite.
VIII. Eighth sternite.
IX. Ninth sternite.
a. Retractor and protractor muscles of pseudotegmen.

b. Muscles between the apical edge of pseudotegmen and apex of the tegminal strut (fig. 2). Retractor of tegmen (figs. 7, 8).

c. Retractor of the median lobe.

d. Protractor of the median lobe.

e. Retractor of the internal sac.

e^1, e^2, e^3. Areas to which retractor muscles of internal sac are attached.

f. Apical edge of pseudotegmen.

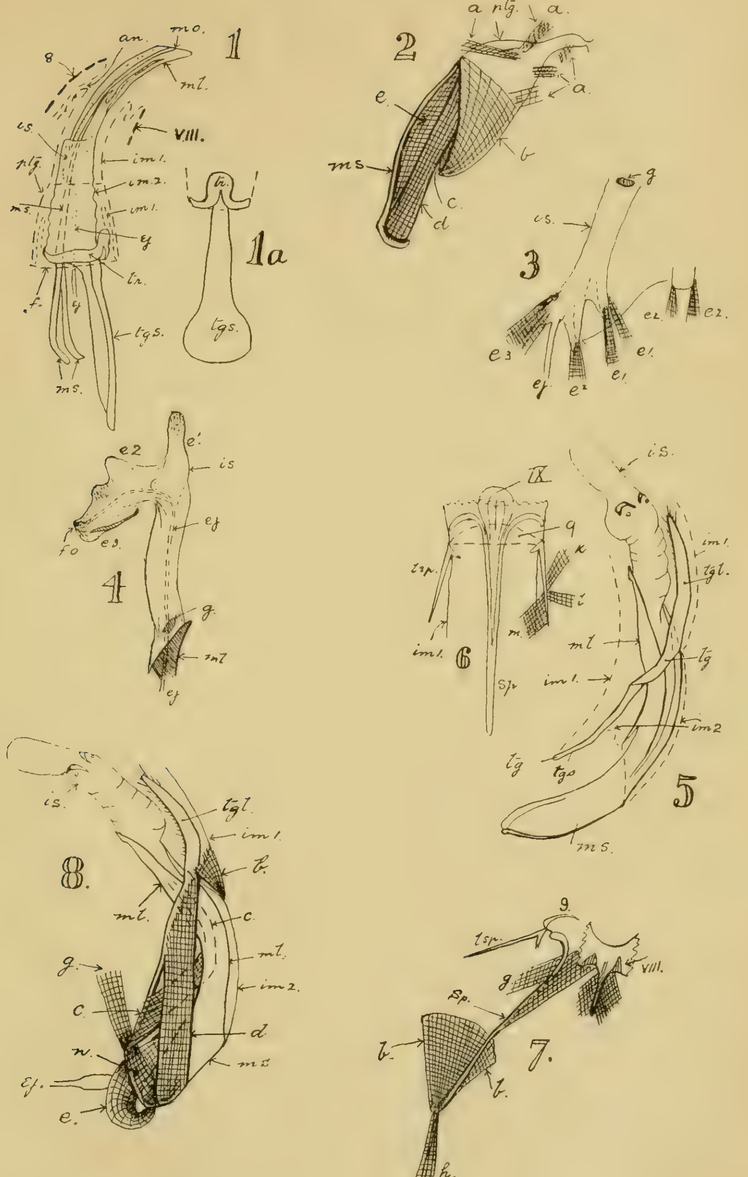
g. Sclerite at base of the internal sac (fig. 4). Protractor of tegmen (figs. 7, 8).

k. Muscles from the lesser spiculum to the walls of rectum.

l. Muscles from lesser spiculum to the walls of rectum.

m. Muscles from lesser spiculum to connecting membrane *im 1*.

n. Muscles from apex of tegminal strut to apex of median struts.



MALE GENITALIA. COLEOPTERA.

XIV. *A New Family of* Lepidoptera, *the* Anthelidae. By A. Jefferis Turner, M.D., F.E.S.

[Read October 15th, 1919.]

The Australian moths belonging to the genus *Anthela* and its allies have given some trouble to systematists. Usually, I think, they are regarded as a part of the family *Liparidae* (*Lymantriidae*), and they have been so arranged by Sir George Hampson in the collection of the British Museum. Until recently I concurred in this opinion, but, recognising that they showed certain peculiarities, I treated them as a separate subfamily, the *Anthelinae* (Trans. Ent. Soc., 1904, p. 469). For this view there appeared to be sufficient justification, for they agree with the rest of the *Liparidae* (as generally known) in the absence of a proboscis, in the neuration of the hind-wings, in the fore-wings having vein 5 arising from near the lower angle of the cell, and in the presence of an areole. The areole is present in the more primitive genera of the *Liparidae*, though many have lost it. In the *Anthelidae*, however, the areole is always present, and shows important structural peculiarities.

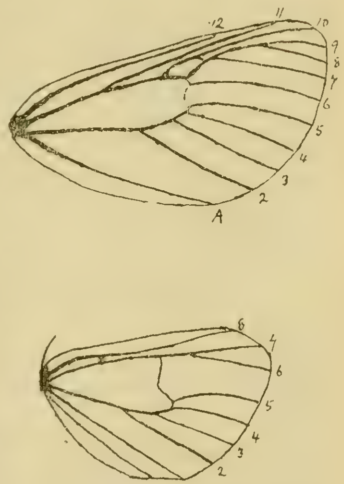


Fig. 1.—*Laelia obsoleta* Fab.

The accompanying figure shows the neuration of one of the more primitive genera of the *Liparidae*. It will be noted that it shows the presence of an areole typically formed, from which arise vein 10 by a separate stalk, and 7, 8, 9 by a common stalk. This structure occurs also in other families, such as the *Arctiadae*, *Noctuidae*, *Notodon-*

tidae, and *Geometridae*. Compare with this the neuration of *Anthela ferruginosa* Wlk. (fig. 2). The peculiarities of

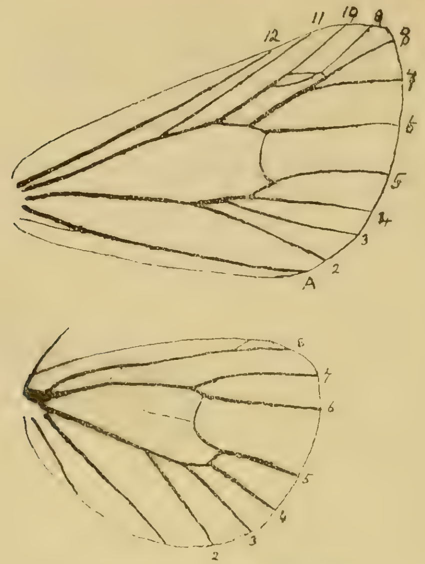


Fig. 2.—*Anthela ferruginosa* Wlk.

the areole are at once apparent. This is very elongate, all the veins 7, 8, 9, 10 arise from it separately, and a triangular

Fig. 3.—Areole, *Anthela ferruginosa*.

portion at the apex appears to be cut off by a cross-vein (fig. 3). This triangular portion is not always evident. In fig. 4 are parts of the fore-wing of two individuals of *Anthela acuta* Wlk. In one the triangle is very minute, in the other absent, having evidently been lost by the coalescence of the cross-vein with the wall of the areole.

How can this peculiar structure be explained? Some light is thrown on it by the fore-wing of *Chelepteryx collesi* Gray. In this very large moth—it expands 140 to 170 mm. —it is evident that veins 10 and 9 are normally stalked, while 9 soon after its origin is connected by a short cross-bar with 8, so forming the areole. An oblique cross-vein formed by a strong chitinous ridge arises very near 11, runs across 10 and 9 after their bifurcation, and ends on the cross-bar, which connects 9 and 8. The use of such a structure in this large unwieldy insect is evidently to strengthen the

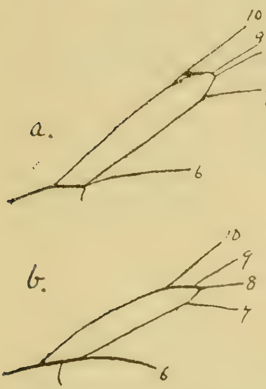


Fig. 4.—Areole, *Anthela acuta* Wlk.

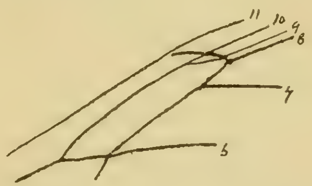


Fig. 5.—Areole, *Chelepteryx collesi* Gray.

apical part of the fore-wing. It is an adventitious development, and forms no part of the true areole.

In an archaic genus from Queensland hitherto unnamed, which I name *Gephyroneura*,* there is a similar bar running from 11 across vein 10, but here the original structure has been obscured by the partial loss of the areole, by the coalescence of 10 with the chorda, so that 7, 8, 9, and 10 are long-stalked from the upper angle of the cell. The distal extremity of the areole is, however, preserved as a small triangle from which the veins 7, 8, 9, and 10 arise separately. Extremely similar to *Gephyroneura* in appearance and closely allied to it is *Munychryta* Wlk. Here the areole is preserved, but the oblique cross-bar from 11 has fused with

* γεφυρονευρος, with bridged veins.

its apical wall. *Munychryta* is remarkable for the development of a strong spiral proboscis, which is completely absent in all the preceding genera. Both *Gephyroneura* and *Munychryta* are of comparatively small size (25 to 35 mm.), and possess a strong basal costal expansion of the hind-wing, similar to that found in the *Lasiocampidae*, but with a strong frenulum present in the ♂. In the only ♀ (*Munychryta* sp.) that I possess the frenulum appears to be absent.

The *Anthelidae* are an Australian family. So far as known no species occurs outside the Australian region. A few species of *Anthela* are known from New Guinea.

I interpret these facts as follows. In the primitive Lepidoptera Heteroneura all the veins from the areole arose separately, the areole being completed by a short cross-vein running from 9 to 8, as occurs in the more primitive

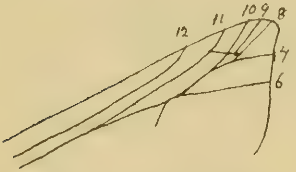


Fig. 6.—Apex of fore-wing, *Gephyroneura* sp.

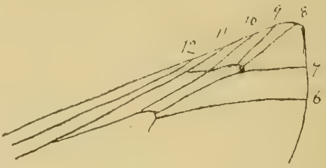


Fig. 7.—Apex of fore-wing, *Munychryta senicula* Wlk.

Cossidae. With more active habits of flight in large-winged moths a necessity arose for strengthening the scaffolding of the apex of the fore-wing. This was attempted in two ways, by a lengthening of the areole, and by an approximation of the veins running from the areole towards the apex, with a coalescence of their stalks. Both changes may be observed in the neuration of the *Cossidae* (Trans. Ent. Soc., 1918, p. 155). In the more specialised families one of these lines of evolution was followed to the exclusion of the other. In most as in the *Liparidae* there was stalking of the radial veins, the areole remaining short, and tending to dwindle and disappear. In the *Anthelidae*—and this is the justification for regarding them as a distinct family—the veins remained separate though approximated as the areole grew longer. The ancestral *Anthelidae* I imagine to have been moths of large size, like *Chelepteryx* or larger, and in them this mechanism was not sufficient to give the necessary strength. As a consequence a strong oblique chitinous bar was developed near the apex, forming a cross-vein running obliquely from 11 across 10 to 9. With diminution of size, or more sluggish habits, or both, this cross-vein has tended to disappear, but in two archaic genera *Gephyroneura* and *Munychryta* it has been preserved in spite of great reduction in size.

So far as I know, the only other family possessing a similar areole, which, however, may not be an homologous development, is the *Cymatophoridae*, and with these the *Anthelidae* cannot be allied, the differences between the two families being very great in other respects.

Note.—In the hind-wing of *Anthela ferruginosa* (fig. 2) the subcostal vein is forked. This is an individual peculiarity of the specimen figured, but important, as it goes to prove, what I have previously suspected, that the subcostal is a composite vein. The first radial runs into the subcostal in the hind-wing in many genera of many families, but this is the first instance I have observed, in which it separates again.

XV. *On the Histology of the Scent-organs in the Genus* Hydroptila, *Dal.* By H. Eltringham, M.A., D.Sc., F.Z.S.

[Read November 5th, 1919.]

Plate XXII.

My friend Mr. Martin E. Mosely has made a discovery of the first importance, which should prove of the greatest interest to entomologists. In a paper read before this Society on October 15th (p. 393), he described the external features of certain organs in the heads of various species of the Trichopterid genus *Hydroptila*.

Mistrusting his own skill as a microtomist with a lack of faith which, judging from some of his excellent preparations, I regard as unfounded, he has done me the honour to hand over to me a supply of material for the investigation of the minute structure of these organs. Just as Science generally is indebted to him for his discovery, I am personally under an obligation to him for enabling me to carry out an examination of unusual interest and fascination.

Some time ago I described and illustrated the scent-organs in certain male Danaine butterflies (Trans. Ent. Soc., 1913, p. 399; 1914, p. 152).

It will be remembered that these included certain eversible brushes located in the extremity of the abdomen. These brushes were formed of hairs of varying structure set on the inner surface of an eversible membranous bag, so that when the latter was everted, doubtless by fluid pressure, the hairs projected from its now outer surface. In some cases the scent material was obtained from glands in the wings, whilst in others the brushes themselves exhibited a glandular structure.

We know from the work of Dr. F. A. Dixey and others that certain special scales on the wings of butterflies act as scent-organs. In all these cases the scent-scales, brushes, glands, etc., are of comparatively considerable size, and occur on insects which, even in the case of Lycaenids, are large compared with *Hydroptila*. These little creatures are themselves no larger than the brush of a Danaine butterfly, yet, as Mr. Mosely has shown, they possess eversible brushes, scent-scales, expanding membranes and tubercles, of a high degree of complication. Moreover, the organs in question are not located in the abdominal extremity, but in the back of the head.

It is a most interesting case of what may be termed the independent development of practically homologous structures in insects of different orders, since, however nearly related the Lepidoptera and Trichoptera may be, it cannot be urged that these scent-organs in the two orders had a common origin.

On Descriptive Terms.

Before describing the organs it may be well to define the terms applied to some of the structural details.

It has been suggested to me on more than one occasion that the term *hair* should be confined to mammalian hairs, and that insect hairs should be known by some other word. I referred to this matter in a note to my paper on the Danaine scent-organs (*l.c.*), and I am still unable to see the necessity for any alteration in terms.

The Oxford Dictionary defines a hair as "One of the cylindrical filaments that grow from the skin or integument of *animals*, especially of most mammals . . . ; applied also to similar looking filamentous outgrowths from the bodies of insects and other invertebrates, *although* these are generally of different structure."

Similarly, we speak of the *scales* on the wings of Lepidoptera and on other insects, without in any way implying that they are of the same nature as the homonymous structures in fish.

There is a greater difficulty which would not be removed by the invention of another word for insect hairs, namely, that of deciding the precise point at which an insect hair becomes an insect scale. Under a low power a Trichopterous insect such as *Hydroptila* may be regarded as covered with hairs on wings and body, but on examination with a higher magnification it is seen that the structures in question would be better described as elongated scales. Furthermore, we have in insects certain growths known as scent-scales or *androconia*. It is an unsatisfactory term, but as its signification is generally understood we may retain it for the present. Is this term to be applied to any modification of insect scales or hairs characteristic of the male insect, or is it to be confined to those structures that have a direct connection with glandular tissue of a sexual character? If the former, the word becomes almost too vague to be useful, if the latter, then the brush hairs in *Hestia* are androconia, whilst those in *D. chrysippus* are not, and so before we can use the term at all, we must have a knowledge of the histology and perhaps even of the embryology of the structures to which we refer.

It would seem, then, that if we aim at greater precision in terms we merely arrive at the position of a person who cannot describe a landscape because he has not measured the elevations to see whether they are hills or mountains, and fears to mention a wood till he has identified the species of trees it contains.

In describing the organs in these small Trichoptera I propose, then, to use the word hairs when referring to the long, fine bristles which form brushes similar in form to the brushes described in the *Danainae*. In several species there are structures which, though of varying form, resemble more or less closely the scent-scales already known to occur in many Lepidoptera. Though the word is unsatisfactory I shall refer to them as androconia, for the reason already stated.

Finally, there are the elongated scales or hairs found so plentifully on the wings and body. As the order is known as "hairy winged" as distinguished from "scale winged" we will call them the cuticle hairs.

The organs to be described are, of course, only found in the male sex.

Descriptive.

Hydroptila sparsa Curtis.

Four eversible tubercles arise from a membrane lying across the back of the head, such tissue forming the lightest possible protection for the brain situated immediately beneath it. Towards the upper and anterior edge of this membrane there is on its underside a layer of moderately large cells which may be merely hypodermal, but probably also have a glandular function. Arising from this membrane on its upper portion and on either side of the centre line is found a small tuft of very remarkable androconia

(Plate XXII, figs. 1 and 2). They are pyriform with long delicate stalks, and the outer expanded portion is clothed with filaments apparently similar to those in the scent-scales of certain Pierine butterflies. Apart from their shape and position they possess a feature which I have been unable to find in any other species examined. Each has beneath its socket a large, granular, heavily nucleated cell, distinguishable by its size and structure from the other cells of the layer in which it lies. There are some twelve of these androconia on each side of the centre line. There is no trace of hairs or brushes. Structures somewhat resembling the " brush bags " in other species are present, but without hairs. These are the four eversible tubercles already referred to. There are two of these on each side, and when fully expanded they extend to a considerable length, as may be seen on reference to Mr. Mosely's photographs. The material of these tubercles is an extremely delicate chitin, not of the same nature throughout its entire length, since the proximal portion takes a different stain from that of the remainder.

A section through the partly everted tubercle (fig. 3) shows a few scattered cells on the inner side. These are probably hypodermal cells which have been displaced in the process of preparation. The whole tissue of the tubercle when not fully extended is thrown into a multiplicity of interlocking folds. When retracted it is inverted and not merely collapsed, and this remark applies to those eversible tubercles in other species, which are lined with hairs and form brush bags. A similar inversion takes place in the brush bags of the Danaine butterflies, but it can there be accounted for by the presence of a muscle attached to the apex of the bag, and acting as a retractor when the fluid pressure is released. It is a remarkable fact that no such muscle can be found in any of the species of *Hydroptila.* This is not due to any fault of the preparation. Muscle tissue is amongst the easiest of all to recognise in insect sections, and in my preparations other tiny muscles inside the head are easily observable.

So far I am unable to account for the inversion of the retracted tubercle, unless it is to be explained by some complicated condition of a variable coefficient of elasticity in different parts of the membrane. The fact of its differential staining already alluded to does not help us, as this occurs only in the present species.

The lobes which cover the eversible tubercles when retracted are somewhat of the shape and appearance of half an almond shell, but much thickened towards the base. Owing to the peculiar angle of view in fig. 1 their shape is not well shown. On the outer surface of the lobes the chitin is perforated by a multiplicity of openings, and in ordinary preserved material some of these perforations emit cuticle hairs of considerable length, whose stalks are deeply embedded in the hypodermal epithelium within. This epithelium may possibly be glandular, since it presents an active appearance (fig. 5). Mr. Mosely informs me that the lobes in this and some other species are densely covered with these cuticle hairs when the specimen is in fresh condition, but that they become detached with great facility, so that the lobes, even in life, are often found practically naked. We may therefore assume that in fresh examples each perforation carries a cuticle hair. We may further venture to speculate as to whether when detached they may not conceivably act in a manner analogous to that of the "dust particles" which are so marked a feature in some of the butterflies already referred to, and of which the use has, since their discovery, been actually observed and recorded by Carpenter (Proc. Ent. Soc., 1914, p. cxi).

Plate XXII, fig. 1 shows the head of this species with the lobes turned back and the tubercles in a condition of partial eversion. Fig. 2 shows two of the androconia with their special cells. Fig. 3 a highly magnified view of one of the tubercles partly everted. Fig. 4 a section through one of the lobes. Fig. 5 part of the same more highly magnified to show the cells lining the outer cuticle. Fig. 6 a vertical longitudinal section through the head and one of the tubercles incompletely everted.

H. simulans Mosely.

Each lobe in this species may be said to resemble externally half an acorn. The basal portion is thick and well rounded, and shows the same perforate structure as in *H. sparsa*. The upper part is smooth and rounded and of a somewhat darker colour, whilst the apical part is thin, flat, and subtriangular. On its inner surface each lobe has a deep oval concavity forming a receptacle for the retracted brush. No sign of androconia has been detected in this species, but the surface of the concavity of the lobe has a peculiar structure as though formed of minute chitinous plates, giving it somewhat the appearance of a tessellated pavement. The thicker basal portion of the lobe shows in section a lining of hypodermal cells probably of a glandular nature. Beneath the lobes and directed upwards and centrally are two brushes formed of a mass of golden yellow hairs arising from small sockets in the lining of a brush bag, the whole presenting an arrangement and appearance closely resembling that in many Danaine butterflies. A section through the head in the plane of the long axes of the two brushes is shown at fig. 8. From this it will be seen that the hairs arise over nearly the whole length of the bag, and hence when the latter is everted the appearance is somewhat that of a test-tube brush or pipe cleaner. The hairs are slightly thickened towards their distal extremities. In the substance of the bag are two distinct layers, the inner one being thin chitin thrown into a multiplicity of folds and bearing the sockets of the hairs. These sockets are of peculiar formation; and resemble the structures known to botanists as bracts. Outside this membranous layer is a glandular epithelium consisting of granulated and heavily nucleated cells shown in fig. 10.

The hairs themselves are not smooth, but have an elaborate structure which I have endeavoured to represent in fig. 9. There are whorls of laminate projections having irregularly curved distal margins. Also the projections are not continuous round the hair, but the rings are intercepted at irregular intervals by more or less vertical fissures. The elaborate structure of the minute brush hairs in this and other species is one of the most notable features of the scent-organs.

The general arrangement in *H. simulans* seems to be analogous to that in the butterflies *Trepsichrois mulciber* and *Hestia lynceus*, in which the brush hairs themselves are the direct vehicles of a secretion produced by glands at the bases of their sockets. Fig. 7 is a view of the head with the lobes closed.

H. forcipata Eaton.

In this species the lobes are very small as is the whole area of the scent-organs. Fig. 15 is a view of the posterior surface of the head with the lobes turned back. Here we find a new modification in the fact that the lobes are provided on their inner surface with a membrane which can be distended, probably by fluid pressure. On this membrane are a few androconia of not quite circular section, having long stalks and a very deeply ribbed surface. The androconia are probably porous or very absorbent, as they stain rapidly and intensely. The outer surface of the lobe is covered with extremely minute black setae having widened bases, like rose thorns. A section through the lobe, fig. 19, shows that the extensible membrane contains at its base a mass of granular, heavily nucleated cells which doubtless furnish a volatile secretion. The androconia are not provided in this species with special cells at the bases of their sockets. Indeed, this is a condition I have found only in those of *H. sparsa*. Fig. 16 shows a highly magnified view of the inner face of one of the lobes. The lobe itself is seen to the left, whilst the membrane extends all over it and some distance to the right. The androconia lie on, and arise from, the membrane in an irregular fashion. The small bunch of hairs here shown does not in reality arise from the membrane of the lobe, but from that on the back of the head between and beneath the lobes, though in this dissection they have come away with the lobe itself. They take the form of a mere tuft of bristles, and though the membrane from which they arise may be slightly extensible there is no eversible bag. The hairs are of the complicated structure shown in fig. 17 and in transverse section at fig. 18. There is a very slight development of glandular epithelium at the origin of these hairs. They have a very thin cuticle, and in section show a very large lumen.

H. maclachlani Klap.

The structure in this species bears a close general resemblance to that in *H. forcipata*. The lobes are smaller and very inconspicuous, but their extensible membranes seem to be more highly developed. Fig. 23 shows a section through one of the lobes and the neighbouring structures. The membrane has a dense mass of glandular tissue at its base, and bears a number of androconia, one of which is represented at fig. 20. These are very deeply ribbed and circular in section. On one lobe I have mounted there are twenty-one, and on another eighteen. The little pencil of hairs is as in *H. forcipata*, but the hairs themselves appear to be longitudinally striated and without the dentate structure found in that species.

H. femoralis Eaton.

In this species the lobes, while distinctive in shape, resemble somewhat those of *H. simulans*, their perforate portion thickly clothed with cuticle hairs and containing a layer of epithelial cells into which the stalks of these cuticle hairs project. Attached to the inner face of the lobe there are numerous heavily ribbed androconia, the stalks of which pass through the chitin and communicate with an epithelial layer beneath. These androconia stain very deeply, have an oval section, and a small central lumen. The lobes cover two large eversible brushes provided with black hairs, the latter being considerably expanded at their distal extremities.

The brush bag appears to have much less glandular development than in *H. simulans*. The hairs are quite characteristic in structure, being very thick walled and covered on the outer surface with whorls of regularly arranged projections. Figs. 22 and 24. In many of the transverse sections of these hairs there is a slight staining of the central lumen indicating the presence of some structureless material in that position, probably a coagulated secretion.

Fig. 25 shows a section through the entire head of this species. At the lower side of the figure may be seen the lobes with part of the cellular material they contain, and their perforate external surface. Within the inner boundary are a few of the androconia cut across and portions of the brushes cut obliquely. Fig. 21 is a view of the entire head with brushes partly everted.

H. occulta Eaton.

The organs in this species are more remarkable than in any of the others examined. The lobes are narrow and somewhat conical. They bear on the inner surface a membrane, which towards the upper extremity contains a deep tubular pocket lined with long androconia. This pocket forms in fact a miniature eversible brush bag and can be extended so as to form a small secondary brush, the androconia then radiating from its surface. Besides this structure there are a few small androconia near the apex of the inner surface of the lobe, and arising from a point near the base is a third mass of androconia still more elongated than those already referred to. Sections of the lobe show that this second mass of androconia also lies in a small pocket and can presumably be everted. Both androconia pencils are surrounded by glandular tissue. Text fig. 2 shows a section through part of a lobe. At this plane the section shows chitin on the inner surface of the lobe. Apparently the eversible membrane as a whole only covers a part of the surface.

Lying beneath the lobes and arising from a membrane on

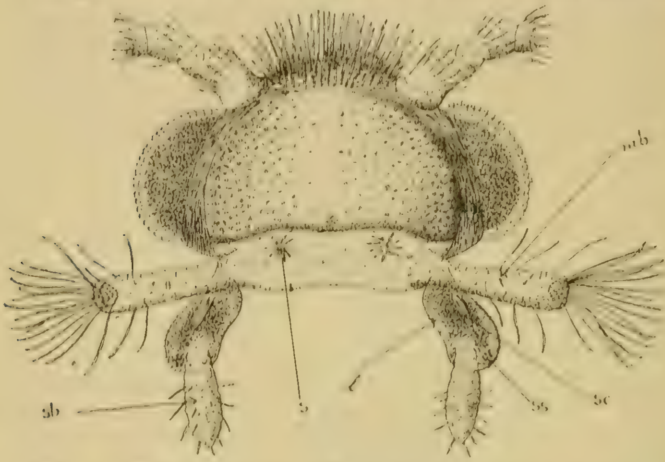


Fig. 1.—*Hydroptila occulta.* Head with scent-organs everted. *sb.* Secondary brush. *s.* Androconia. *l.* Lobe. *sc.* Patch of elongated androconia. *mb.* Main brush. *ss.* Small androconia. (Width across eyes ·64 mm.)

the back of the head are two small eversible brushes with yellow hairs resembling those in *H. simulans*, but their sockets are more concentrated towards the bottom of the bag. The hairs themselves appear to have a structure somewhat similar to that in *H. forcipata.* There are also two small tufts of androconia arising from the membrane between the main brushes and on either side of the centre line. The general arrangement of the head with expanded organs is shown in text fig. 1, herewith. Fig. 11 shows one of the brushes dissected out. Fig. 13 a view of the lobe, the secondary brush being in a retracted condition. Fig. 14 represents one of the androconia from the secondary brush.

It is hoped that in the course of time other species than those so far examined will be available. Mr. Mosely has in his collection two examples of *H. pulchricornis* Pict., but beyond the fact that this species has black brushes resembling those in *H. femoralis* he has not been able to examine them more critically. There are other British species and several not so far found in Britain, and doubtless many new forms still undiscovered. But few collectors are interested in these small and inconspicuous insects. Now that Mr. Mosely's discovery has revealed their curious

Fig. 2.—*Hydroptila occulta.* Section of lobe.

sc$_2$. Androconia of second tuft. *m*$_2$. Membrane of ditto. *rl.* Reticulated tissue. *sc.* Androconia of secondary brush. *m.* Membrane of ditto brush bag. *gs.* Glandular substance. *h.* Hairs of primary brush. (Length of section ·072 mm.)

and interesting features collectors will have a new incentive to secure examples.

In case this paper should be read by any one having facilities for securing further material, it should be noted that dry specimens are useless for observation. They should be dropped alive into a strong solution of bichloride of mercury in distilled water, to which has been added about half its bulk of 96 per cent. alcohol, and about 1 per cent. of acetic acid. After a few hours in this they should be transferred to clean 96 per cent. alcohol.

On the page facing the plate I have given the actual sizes of the various parts figured. A certain combination of objective and eyepiece may give a definite magnification, but when a figure has been drawn therefrom the size of the figure may not really represent the true magnification, but a mere expansion of the view obtained with the objective used. A photograph of a section measuring two inches across may represent a magnification of a hundred diameters, but the same photograph projected on a six-foot screen is not a magnification of three thousand six hundred diameters, but merely an enlarged view of what can be seen in the original photograph.

I have already expressed my thanks to Mr. Mosely for having supplied the material for this investigation, and I would add that he has further assisted by visiting Oxford on several occasions to compare the results with his previous knowledge of the species.

Explanation of Plate XXII.

[*See Explanation facing the* Plate.]

Explanation of Plate XXII.

Fig. 1. *Hydroptila sparsa.* Head viewed from above showing four eversible tubercles partly expanded. Width across eyes ·6 mm.

2. Two of the androconia with their sockets and glands. Length from bottom of socket to apex of scale ·03 mm.
3. Enlarged view of one of the tubercles partly expanded. Width in narrowest part ·015 mm.
4. Section through one of the lobes. Length ·15 mm.
5. Part of ditto (not necessarily the same section) showing epithelium and parts of cuticle hairs. Greatest width ·03 mm.
6. Section through head showing one of the tubercles partly everted. Length of tubercle ·18 mm.
7. *Hydroptila simulans.* Head with lobes closed. Width across eyes ·77 mm.
8. Section through same in plane of brushes. Width across eyes ·6 mm.
9. Part of one of the brush hairs showing structure. Greatest width ·003 mm.
10. Enlarged view of brush bag showing hair sockets and epithelium. Greatest thickness ·015 mm.
11. *Hydroptila occulta.* Part of a brush. Length of hairs ·22 mm.
12. A small androconium from lobe of same. Length ·015 mm.
13. View of inner surface of lobe of same with secondary brush retracted, scent-scales, etc. Greatest length ·15 mm.
14. One of the scales of the secondary brush. Length ·06 mm.
15. *Hydroptila forcipata.* Back view of head with expanded lobe membranes and hair tufts. Width across eyes ·58 mm.
16. One of the lobes viewed from inner side. Length ·176 mm.
17. Part of one of the hairs. Diameter of main stalk ·003 mm.
18. Transverse section of same. Diameter over projections ·005 mm.
19. Section through one of the lobes showing gland cells at base. Length from end of membrane to upper corner of lobe ·09 mm.

Explanation of Plate.

FIG. 20. *Hydroptila maclachlani.* A scent-scale from lobe. Length ·015 mm.

21. *Hydroptila femoralis.* Head with brushes partly expanded. Width across eyes ·473 mm.

22. Part of a brush hair. Width across points ·003 mm.

23. *Hydroptila maclachlani.* Section through lobe, etc., showing glandular base. Length from point of membrane to point of lobe ·105 mm.

24. *Hydroptila femoralis.* Transverse section of hair. Diameter ·0015 mm. to ·0037 mm.

25. Section through head. Width across eyes ·55 mm.

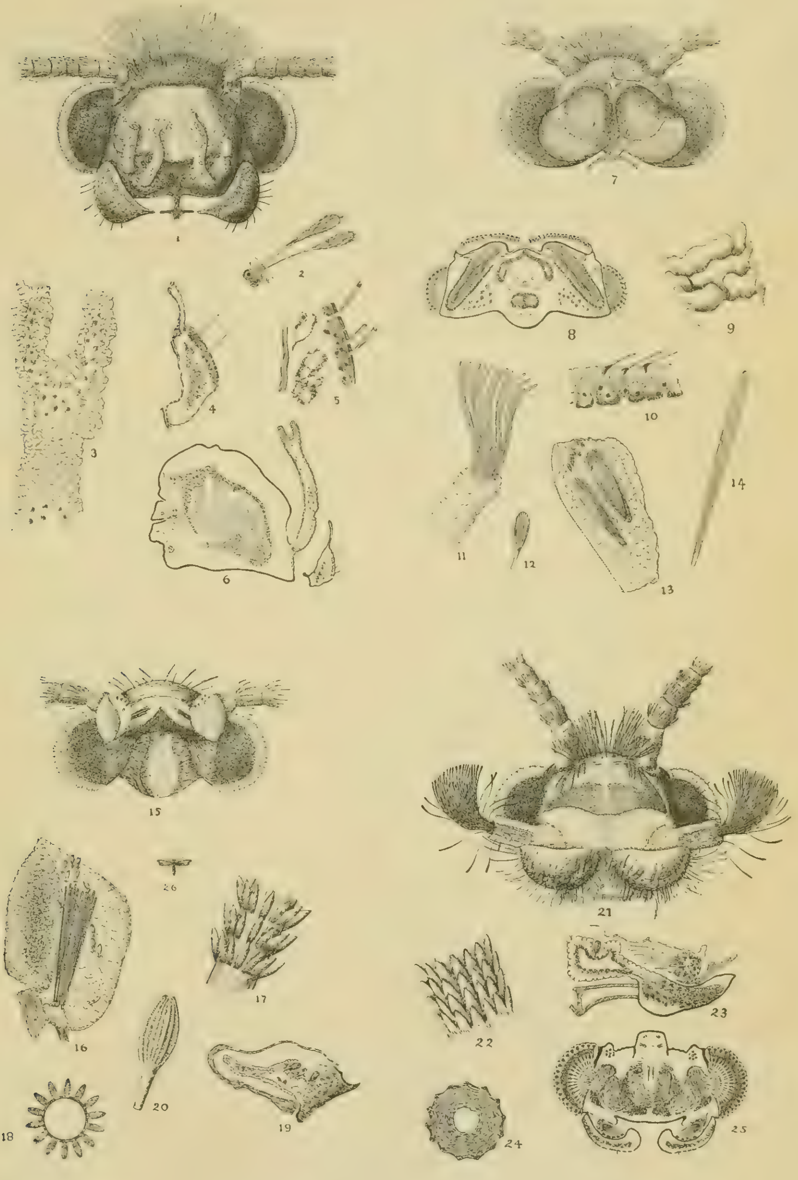
26. Diagrammatic figure representing about the natural size of *H. femoralis.*

Plate XXII of the Transactions (1919) not being satisfactory to the Author, he has had it reprinted, and, by permission of the Council, a copy is enclosed herewith so that Fellows may substitute it for the original impression.

Explanation of Plate.

Fig. 20. *Hydroptila maclachlani.* A scent-scale from lobe. Length ·015 mm.

21. *Hydroptila femoralis.* Head with brushes partly expanded. Width across eyes ·473 mm.
22. Part of a brush hair. Width across points ·003 mm.
23. *Hydroptila maclachlani.* Section through lobe, etc., showing glandular base. Length from point of membrane to point of lobe ·105 mm.
24. *Hydroptila femoralis.* Transverse section of hair. Diameter ·0015 mm. to ·0037 mm.
25. Section through head. Width across eyes ·55 mm.
26. Diagrammatic figure representing about the natural size of *H. femoralis.*



H. Eltringham del.

SCENT ORGANS IN *HYDROPTILA*.

H. Eltringham del. *Half-Tone Eng. Co., Ltd.*

SCENT ORGANS IN *HYDROPTILA.*

XVI. *New Moths collected by Mons. A. Avinoff in W. Turkestan and Kashmir during his journeys in* 1909–1912. By Sir George F. Hampson, Bart. Communicated by J. Hartley Durrant.

[Read November 5th, 1919.]

A short paper giving a list of the moths collected by Mons. Avinoff was sent to the Entomological Society in 1913. It was intended to be supplementary to a paper written by him giving a full itinerary of his journey and an account of the butterflies he collected; the MSS. of this paper was, however, lost in the post. Owing to the outbreak of war he has been unable to supply a copy of the missing MSS. It is therefore desirable to publish descriptions of the few new moths he collected of which the descriptions have not already appeared. The types are in the British Museum, and the numbers before the species refer to my catalogue of moths and papers on the classification of the *Pyralidae*.

NOCTUIDAE.

Agrotinae.

315*a*. **Euxoa dimorpha**, n. sp.

♂. Head and thorax grey faintly tinged with brown and mixed with blackish; tegulae with black medial line; patagia with some black scales near upper edge; tarsi black with pale rings; abdomen grey with an ocherous tinge and irrorated with fuscous. Fore wing grey faintly tinged with brown and irrorated with blackish, the veins with pale streaks; subbasal line double, black, waved, from costa to submedian fold; antemedial line double, black, oblique, waved; claviform moderate, slightly defined by black; orbicular and reniform whitish irrorated with fuscous and defined by black, the former round; an indistinct, sinuous dark medial line; postmedial line blackish defined on outer side by grey, double at costa, bent outwards below costa, then slightly dentate and produced to black and white points on the veins, oblique below vein 4, some whitish points beyond it on costa; subterminal line whitish defined on inner side by fuscous, excurved at vein 7 and angled outwards at veins 4, 3; a somewhat lunulate black terminal line and white line at base of cilia. Hind wing white tinged with reddish brown, the veins and terminal area brown; a slight dark terminal line; cilia white with a dark line through them from apex to vein 2; the underside whiter, the costal area irrorated with fuscous, a slight black discoidal lunule and terminal series of lunules from apex to vein 2.

♀. Thorax purple-red irrorated with white; fore-wing suffused with purple-red.

Hab. Kashmir, Stagmo, 12,000 ft. 2 ♂, 1 ♀ type. *Exp.* 40–44 mill.

624*a*. **Feltia fuscifusa**, n. sp.

♂. Head and thorax pale olive-brown; palpi black except at tips; tegulae with black medial band; patagia edged with black scales above; abdomen brownish white, the terminal half suffused with fuscous; pectus, legs and ventral surface of abdomen suffused with blackish, the tibiae at extremities and tarsi ringed with white. Fore wing olive-grey, thickly irrorated with fuscous; subbasal line represented by dark striae from costa and cell, the former defined on outer side by white; antemedial line blackish defined on inner side by whitish, sinuous, excurved above inner margin; claviform defined by black, long and narrow; orbicular and reniform defined by black except above, the former round, the latter filled in with blackish; postmedial line blackish defined on outer side by whitish, bent outwards below costa, then minutely dentate and produced to points on the veins, excurved to vein 4, then incurved; subterminal line whitish with blackish suffusion before it and beyond it except at apex, angled outwards at veins 7, 4, 3; cilia olive ochreous with two slight blackish lines through them. Hind wing pure white, the costa and veins slightly tinged with brown, the hair on inner margin with an ochreous tinge; a fine brown terminal line from apex to vein 2; the underside with the costal area thinly irrorated with brown, a small discoidal spot.

Hab. Kashmir, Khordong, 16,500 ft. 1 ♂ type. *Exp.* 26 mill.

Hadeninae.

1461*a*. **Trichoclea elaeochroa**, n. sp.

♀. Head and thorax olive-brown mixed with grey; pectus, legs and abdomen grey-brown. Fore wing grey-brown irrorated with white and with some olive-yellow suffusion in the interspaces especially the cell and submedian interspace; an indistinct sinuous blackish subbasal line from costa to submedian fold; antemedial line blackish, waved; traces of a diffused medial line, oblique to vein 2, then erect; orbicular and reniform faintly defined by olive-yellow, the former round, the latter with its lower part filled in with fuscous, a white point at its inner lower extremity and two at outer extremity; postmedial line blackish, bent outwards below costa, then dentate, oblique below vein 4; subterminal line indistinct, olive-yellow, slightly waved, somewhat excurved at vein 7; cilia with a dark line through them. Hind wing fuscous tinged with grey; cilia ochreous white with a dark line through them; the underside with diffused curved postmedial line.

Hab. KASHMIR, Khalsi, 10,000 ft. 1 ♀ type. *Exp.* 44 mill.

ZYGAENIDAE.

ZYGAENINAE.

Zygaena avinoffi, n. sp.

♂. Head, thorax and abdomen black, the tegulae crimson; legs streaked with ochreous yellow. Fore wing black suffused with metallic blue; an elongate orange-yellow subbasal spot on costa and a patch from median nervure to above inner margin; a streak of orange-yellow scales below middle of costa; a rounded orange-yellow spot from below middle of costa to just below the cell where it is almost confluent with a larger round spot below end of cell; an elliptical spot beyond the cell, and a curved subterminal band from above vein 6 to below 3; cilia ochreous suffused with brown. Hind wing crimson, the base, inner margin and termen purple-black; cilia ochreous brown.

Hab. W. TURKESTAN, Pamirs, Koitesck, 13,100 ft. 1 ♂ type. *Exp.* 28 mill.

This species was taken on M. Avinoff's 1909 journey, and is nearest to *Z. coeandica* Ersch.

Procris pamirensis, n. sp.

♂. Head and thorax golden-green with a slight cupreous tinge and some blackish hairs mixed; antennae, with the branches blackish; tibiae and tarsi blackish; abdomen blackish tinged with cupreous purple and green at extremity and with purple on ventral surface. Fore wing uniform golden green, the cilia fuscous brown. Hind wing uniform fuscous brown, rather thinly scaled. Underside uniform fuscous brown without any green.

Hab. W. Turkestan, Pamirs, Alitshur, 12,500 ft. 2 ♂ type. *Exp.* 20 mill.

This species also was taken by M. Avinoff on his 1909 journey; it is closely allied to *P. dolosa* Stand., and has similar antennal characters, but has no green on the underside of the wings.

PYRALIDAE.

Agroterinae.

118*a*. **Pyrausta rubritinetalis**, n. sp.

♀. Head whitish tinged with rufous; thorax black mixed with rufous; abdomen black irrorated with white; pectus, legs and ventral surface of abdomen white. Fore wing rufous irrorated with black; a black fascia above inner margin from base to beyond middle with a white fascia above it in submedian interspace; a black streak on extremity of median nervure with a white fascia above it in the cell; an oblique white band from below costa just before apex to inner margin, defined on each side by black, the black on inner side interrupted at submedian fold; a slight black terminal line. Hind wing fuscous, the cilia whitish with a fuscous line near base. Underside white irrorated with fuscous; fore wing with fuscous subterminal band; both wings with fine black terminal line.

Hab. Kashmir, Nubra Valley, Panomite. 1 ♀ type. *Exp.* 20 mill.

XVII. *Cocoon Softening in some Agrotids* (Noctuae). By T. A. Chapman, M.D., F.R.S.

[Read November 5th, 1919.]

In making some further observations on the resting positions of Lepidoptera immediately after the expansion of the wings and before the resting attitude normal to the species is assumed, I met with a circumstance in connection with the emergence from the pupa of certain Agrotid Noctuae that was new to me, and has not so far as I know been reported as to that group. The species observed all pupate underground, and make a cocoon which usually contains a good deal of silk. What I saw seemed unmistakably to indicate that this silk is softened by a special secretion by the moth during emergence, so as to facilitate its breaking through.

In order to see the moths immediately after the expansion of the wings, the accident of coming across a moth just at that stage, in the breeding cage, is rather uncertain and very disappointing. It is only too often the case that one finds the moth some little time after the critical period one wished to see had passed.

To obviate this difficulty I had the pupae out of their cocoons and laid them on the bottom of the jar. Like most others, these moths emerge at a particular time of day—often, however, spread over several hours. When emergence is imminent, the pupa, which has been darkening for a few days from the brown chitinous colour to nearly black, displays the feature that I have called "Inflation." * Air is secreted into the alimentary canal, distending the abdomen, so that the segments are stretched apart, exposing the intersegmental membrane (between the movable segments) and lengthening the abdomen, making a marked change in the appearance of the pupa.

When this extension is complete, emergence takes place very soon, generally within an hour. By watching for this indication, the emergence can be observed, without unduly prolonged watching, or futile watching when no emergence is due to take place.

Whilst inflation is taking place, the pupa frequently

* Proceedings South London Entomological Society, 1902, p. 22

moves the abdominal segments, in some cases possibly to assist the abdominal contents to accommodate themselves to the expansion that is taking place. In others the pupa is throughout quiescent.

Emergence begins by the rupture of the pupa case, and the gradual emergence of the moth seems to involve strenuous exertion, and the abdomen is obviously making the same vermicular movements that a larva does when walking. When the moth has emerged a certain distance, about 8 mm. in the case of *Triphaena fimbria* and about 5 mm. with *Agrotis comes*, it becomes suddenly absolutely still, in what I may call the triangular or akimbo attitude, because the first two pairs of legs have so far left the pupa case that the femur and tibia with the body of the insect make a triangle, the tibio-femoral articulation being held away from the side of the insect; each of these four legs therefore forms a triangle, with a somewhat grotesque effect. Almost at the same time, a globule of fluid begins to appear at the mouth at the base of the labial palpi, which are completely deflexed. As the proper use of this fluid is impossible under the conditions of the observation, it gradually accumulates till a considerable drop is formed, the pupa lying on its back, so that in almost every case the drop could no longer maintain its position and rolled off, and a second one begins to form; in one or two cases a third and even a fourth drop appeared. It seemed that the surface of the moth could not be wetted by the fluid, which consequently appeared as a spherical drop, a sphere broken only, of course, at the point at which it was being added to by the mouth. Such a drop, of course, easily fell off, later or earlier, according to whether the pupa was exactly on its back or leant a little to one side.

The emergence to the angular position occupies a little over a minute. The angular position is maintained usually for something over a minute; in a specimen of *T. fimbria* it was seventy seconds, in one of *A. comes* it extended to six and a half minutes—these are about the extreme values. During this period, in normal circumstances, no doubt the fluid is soaking into and softening the front of the cocoon. At the end of the period, in my examples, the moths suddenly completed their emergence with a rush and quickly made for a position for expansion; it was obvious that all the effort for getting out of the pupa case had taken place in the first period, though the moth was still three-fourths within it, and that all its efforts were now available for breaking through the cocoon—a labour that my examples had not to undertake. It is to be regretted that I concentrated my attention so much on the mechanical part of the process and neglected to make any chemical examination of the fluid, which must, however, have been very perfunctory. No doubt a considerable amount of the fluid might be collected, if preparations were made for doing so, the material being a good supply of pupae of, say, *T. fimbria* and *Agrotis pronuba*, which can easily be obtained in quantity.

We have long known of the cocoon-softening fluids of Saturniids and Cerurids, and I have reported a similar fluid as used by sawflies (*Trichiosoma tibiale*); there are probably other records, so that no doubt if observations were made it would prove to be a very frequent circumstance. I have not, however, been able to find any observations reported except those on Saturniids and Cerurids, and certain Lasiocampids and Limacodids mentioned by Mr. Latter. I may say that in many specimens of *Eriogaster lanestris* and *Limacodes testudo* I have reared, I have seen no indication of a softening fluid, the lid of the cocoon being broken off by pressure from within at a specially provided brittle line, and started in *Limacodes* by a sharp pupal point.

In 1868 Trouvelot, in the American Naturalist, vol. i, p. 31, recorded that the softening of the cocoon by the secretion of a fluid by the moth about to emerge was, in the case of *Telea polyphemus*, marked by a distinct pause in the movements of the moth between the breaking of the chrysalis and the rupture of the cocoon for emergence, a pause during which the softening fluid has time to act on the adhesive material of the cocoon.

In the case of *Actias luna*, Packard (American Naturalist, vol. xii, p. 379,1879), described the "cocoon-breaker," which, it would appear, was in active use by the moth from the moment of rupturing the pupa case, till the moth broke through the cocoon, no pause occurring.

Kettlewell recorded precisely similar observations in 1907 (Journal Bombay Nat. Hist. Soc., xvii, p. 541) on *Actias selene*, and on *Antheraea roylei* and *Caligula simla*.

In Mr. Latter's papers in our Transactions for 1892 and 1895, on the emergence of *D. vinula* from its cocoon, the only definite reference to this point is in 1895, p. 400, where it appears that the insect is active during the whole process of emergence; there is no resting period, the movements being with two objects, to "compress the contents of the body and expel drops of potassium hydroxide from the mouth" and "constitute the strokes made by the labial prongs against the cocoon wall."

In looking through Mr. Latter's papers and my own on *Hybocampa milhauseri* (Entomologist, 1890, p. 91) and on *Cerura* (Entomologist, 1892, p. 302), I conclude that there really is no resting stage in *Cerura.*

In *Hybocampa* the moth is active all the time in cutting out the lid with its "sardine opener," the cutting being facilitated by the softening fluid that is guided into the track by the opener.

In *Cerura* the moth is active in smearing the fluid over the proper area of the cocoon.

There is one fact in the emergence of *Cerura*, though this is hardly relevant to the present paper, that convinces me that the moth does not produce any effect on the cocoon with the labial prongs that Mr. Latter so carefully describes and figures, and that is that the opening by which *Cerura* emerges from its cocoon is a very irregular fracture, often in several pieces, and not alike in any two instances. Were the prongs in any way cutting or disruptive implements the lid would be of regular form and uniform in all cases, as, in fact, the lid in *Hybocampa* is.

The prongs are, as Mr. Latter recognises, to keep the "shield" in position during the movements of the moth—a function that would be in danger of failing were they also used in tearing the cocoon.

The movements of the moth are, I think, entirely directed to distributing the fluid properly; any assistance they give to the expression of it is, so to speak, accidental. I have reared a good many *Cerura* in the last few years, and my observations on them quite confirm this view of the mechanics of the escape from the cocoon.

So far as I have been able to find any published notes on the subject, the only observation of a rest being taken between breaking the pupa shell and quitting the cocoon is that by Trouvelot on *Telea polyphemus*, but one supposes it must also take place in such cases as in species of *Saturnia* like *S. pyri*, *S. carpini*, etc., that have a specially prepared exit; which, indeed, also exists in such species as *Antheraea pernyi* and *A. yamamai*, although the undisturbed cocoon shows no indication of it.

The interval, then, that occurs in these Noctuids during which the moth lies absolutely inert, is rather unusual than otherwise. The triangular or akimbo attitude has not been noticed in other cases of cocoon softening.

The elbows (or knees) must press against the sides of the cocoon, and so maintain the head of the moth against the end of the cocoon, so that the fluid at once comes in contact with it. On the softening having taken place and the moth resuming its efforts to escape, these angular projections must give effective *points d'appui* for the necessary forward efforts.

I add some notes of the actual observations:

Agrotis comes, June 14, 1919, at 8 p.m. (G.M.T.). Found a pupa lying, as it happened, on its back, with the imago so far emerged that the top of the front piece of the pupa reached only to the base of the femur of the first pair of legs, the femora and tibiae of the first and second pair of legs projecting angularly, the tarsi being still covered within the pupa case, giving, from the tibio-femoral joints standing away from the pupa, a rather unusual aspect. On the face of the moth was a globule of clear fluid. In a few minutes this fell off, then a rather larger globule appeared during a few minutes; this also fell off, and the insect still lay motionless. A trace of fluid again appeared. Then, suddenly, by a few active movements the pupal case was left and a rapid rush was made, but brought to a standstill almost at once, a place suitable for expanding the wings being found; this occurred about 8.15.

A. comes spins a loose cocoon underground; it seems a reasonable hypothesis to suppose, that at the stage of emergence observed the cocoon would make some impediment to further advance, and the fluid was intended to soften the cocoon or the earth in which it laid. The fluid appeared to come from somewhere close to the bases of the labial palpi; certainly it had nothing to do with the proboscis, which still lay, as in the pupa, straight down in front, its extremity still in the pupa case; the labial palpi were also deflexed, so as to be, as in the pupa, straight down in front (*i. e.* along the venter).

Triphaena fimbria, June 15, 1919.

9.10. p.m. (G.M.T.). A pupa that was normal 20 minutes ago has the abdominal segments stretched.

10.3. Emerged to "triangular" position in about 20 seconds, is about 8 mm. out of the pupa case, pupa and moth on dorsum. Fluid at once began to appear.

10.6. Globule of fluid is about 2·5 mm. in diameter, point of origin above bases of labial palpi, which are deflexed, pointing directly backward (towards posterior extremity).

10.7. Having been quite motionless, emergence is almost suddenly completed, taking only a few seconds, the drop of fluid falls off, and the moth rushes, almost wildly at first, to find a resting-place for expansion. Naturally, of course, the fluid would have been absorbed by the cocoon, and the moth would have had a further considerable effort to get through the cocoon and any superincumbent material.

I may abbreviate several other records.

T. fimbria, June 17.

10.5.20 p.m. (G.M.T.). Breaks pupa shell.
10.6.20. Fluid appears.
10.7.0. Reaches angular position, fluid rapidly increasing.
10.8.0. Very large globule of fluid.
10.8.10. Globule falls as moth rushes out.

T. fimbria, June 18.

9.11.0 p.m. (G.M.T.). Begins emergence.
9.12.30. Fluid 1 mm. in diameter.
9.14.0. Fluid 2.5 mm. in diameter.
9.14.15. Moves forward a little and then stops.
9.15.0. Fluid drops.
9.15.30. Completes emergence.

T. fimbria, June 13.

10.28.0 p.m. Has burst pupa and protrudes about 10 mm. The moth lies quiet, with all tarsi still within pupa. A globule of fluid appears on face.
10.31.0. Moth completes emergence.

T. fimbria, June 17.

7.30 (G.M.T.). Found a pupa with abdominal segments extended.
8.12. Began to emerge, and in 80 seconds (1.20)
8.13.20, it reached angular stage and became quite quiescent, fluid exuding from base of labial palpi.
8.16.40. Globule large, moth became active and left pupa case in a few seconds.

Agrotis comes, June 25, 1919.

9.10. p.m. (G.M.T.). A pupa has abdominal segments extended.
9.50. In the course of about 30 seconds, forced itself out of the pupa about 5 mm. with tibio-femoral joints of first and second pairs of legs projecting in triangular manner, and at once a globule of fluid began to exude from mouth, the moth being absolutely quiescent, and was of some size at the end of two minutes.
9.54. The globule is about 4.5 mm. in diameter, in another half-minute, the moth became suddenly active and rapidly completed emergence, the drop falling away at 9.54.30.

A. comes, June 17.

10.20.20. p.m. (G.M.T.). Breaks pupa.
10.21.20. Reaches angular position, and fluid appearing.
10.22. Considerable globule.
10.23.50. Globule falls off.
10.24.40. Small drop of fluid.
10.25.5. Rushes out, palpi adpressed backwards, antennae beneath wings.

A. comes, June 17.

9.46.5. p.m. (G.M.T.). Breaks pupa.
9.47.5. Fluid appears.
9.47.20. Reaches resting position.
9.49.0. Rushes out.

A. comes, June 17.

9.59.50. p.m. (G.M.T.). Begins to move.
10.0.40. In angular attitude with fluid.
10.1.30. Large globule.
10.2.30. Globule falls.
10.2.50. Small globule appears.
10.3.40. Considerable globule.
10.4.20. Large globule.
10.5.10. Rushes out.

A. comes, June 18.

8.21. p.m. (G.M.T.). Pupa breaks.
8.22.10. Angular position attained and fluid begins to appear.
8.23.0. Considerable globule.
8.24.0. Large globule.
8.25.20. Globule falls off when quite 2 mm. in diameter.
8.26.30. Fresh globule forming.
8.28.20. Globule falls off when nearly 2 mm. in diameter.
8.28.50. Small fresh globule (3rd) falls off as the moth makes the usual rush. The wild rush is more impressive after the first slow laborious emergence, and then the prolonged quiescence.

I made some observations also on *Triphaena janthina.*

XVIII. *Notes on* Lycaena alcon *F., as reared in* 1918–1919.

By T. A. Chapman, M.D., F.R.S.

[Read November 5th, 1919.]

Plates XXIII–XXVIII.

My observations on the early stages of *Lycaena alcon* F., in 1917–1918, ending with the emergence of a ♂ imago on Aug. 2, 1918, are reported by Monsieur Oberthür, in the 16th volume of the "Études de Lépidoptèrologie Comparée," and referred to in the Proceedings of the Entomological Society of London, 1918, p. clv.

Monsieur Oberthür sent me larvae of *L. alcon* again in the autumn of 1918, and my observations on these are similar to those of the preceding year, but I have added an item or two. I have especially secured figures by Mr. E. C. Knight of the full-grown larva and pupa (Pl. XXIII). Mr. Knight's figures are remarkably good, though those of the larva do not suggest so strongly, as a close examination of the living larva does, that the fat-bodies are really the basis of the appearance of the larva and lead to the dorsal vessel appearing as a dark line down the back, a line in which really nothing is to be seen but the darkness due to its being overshadowed by the tissues beside it, making it an unoccupied chasm. It varies in width with the regular pulsations, and the figure shows a spot where it is rather wider as the pulsation passes along. I also succeeded in obtaining the larval skins cast on pupation, and one of these, obtained immediately it was cast, is not altogether a failure in mounting; the others were less successful. I was very glad to obtain these, as it enables me to show photographs proving that the head and prothoracic plate of the full-grown larva are identical with those of the small third instar larva that is carried into the ants' nests. However much any one may be willing to accept my word for this most remarkable circumstance in the life-history of a Lepidopteron, it is much more satisfactory to have actual demonstration submitted.

I had six nests of *Myrmica*, four of which were *M.*

scabrinodis and two *M. laevinodis*. Several of these were poor in quantity of brood and in other respects, but all accepted the larvae of *L. alcon* given them in September. On Sept. 13 they are noted as all grown and looking well.

On Oct. 13 No. 1 nest (*M. scabrinodis*) had practically no brood, but four *L. alcon* larvae. One of these was removed to nest 2, a newly taken nest of *M. scabrinodis*, with plenty of brood, this transferred larva soon disappeared, and the nest was used to supply No. 1 with ant brood, and in the result two *L. alcon* in No. 1 reached maturity.

No. 3 nest, *M. laevinodis*, had four *L. alcon*, one was given to nest 4 (also *M. laevinodis*), but disappeared. No. 4 nest was afterwards used to supply No. 3 with ant brood, and one *L. alcon* larva matured in No. 3.

Nos. 5 and 6 were small nests without much brood, each contained *L. alcon* larvae. So late as Dec. 16 No. 5 had one *L. alcon* and No. 6 had four. On Jan. 18, 1919, No. 6 had three *L. alcon* but hardly any brood, and No. 5 had by some oversight been allowed to get too dry and contained neither *L. alcon* nor ant brood, and the ants crowded round water as soon as supplied to them. It was a small nest, both as to the nest itself and the ants contained in it, and probably dried up too easily.

On Feb. 23 a larva in nest 6 was found dead, and later the others disappeared, probably from insufficiency of ant brood, though some was supplied from nest 2.

In the autumn the *L. alcon* larvae appear to suck the juices of the ant larvae, and the collapsed remains are found on the middens. The *L. alcon* increase in size and become several millimetres longer, but during the winter they dwindle again to nearly the size at which they entered the nest, and the larva in nest 3 that finally pupated, but not satisfactorily, was so small at the end of winter that I thought it could not come round.

In the spring the *L. alcon* eat the ant larvae, holding them between the head and the front of the forward abdominal segments, the necessary curvature being in the thoracic segments.

In the spring no collapsed ant larvae are found, nor did I find any frass containing ant remains, but my search was probably defective, as the middens (the glasses on which I gave them honey) were always very wet from deliquescence of honey, and full of remains of flies, earwigs and other food provided, presenting a great difficulty to effective examination, that I failed adequately to face.

May 5.—There survive to-day three *L. alcon* larvae, two in nest 1 (*M. scabrinodis*) and one in nest 3 (*M. laevinodis*). Those in nest 1 are a larva (1) now about 7 mm. long and the other (2) still to all appearance of only wintering size. The one (3) in nest 3 looks rather starveling, but is always picked up and carried off by the ants when daylight is let into the nest.

May 19.—The *L. alcon* have grown. In nest 1 No. 1 is now fully 9 mm. long and stout in proportion, much paler in colour, light rose or flesh colour. No. 2 is only 5 mm., but looks stouter and paler and is to all appearance doing well. No. 3 (in nest 3) is about 6 mm. long and looks thriving, and contrasts with the starveling it was some two or three weeks ago. Since this month came in, it has been possible to get varied food for the ants, flies, small Tipulids, etc., but the increased activity of the ants, their larvae, and the whole nest, is probably seasonal rather than dietetic, though the latter is no doubt essential in view of the spring awakening. The ant larvae grow very markedly, and eggs are more or less plentiful in nests with queens.

May 25.—No. 1 is now very fat, all but 10 mm. long. No. 2 is growing well, about 6·5 mm. long. No. 3 has grown very well, nearly 7 mm. long. There are in nest 1 some worker ant pupae.

May 30.—No. 1 is 10 mm. long and about 2·5 thick. No. 2, 8 mm. and 2 mm. thick. No. 1 is very pale, not whitish, but very whitey pink. No. 2 is darker, about a flesh-colour. No. 1 is therefore about twice the bulk of No. 2. An ant is about 4 mm. long and averages perhaps 0·6 mm. thick. The respective bulks would be: No. 1, 62 c.mm.; No. 2, 32 c.mm.; an ant 1·5 c.mm. Yet the ants manage to move the larvae about. No. 3 is 9 mm. long by about 2·3 across, not of quite so pale a tone as No. 1.

The ant larvae in nest 3 have been dwindling in numbers of late, and yesterday I gave them more from another nest; there can be little doubt that the *L. alcon* larva must actually eat them.

June 9.—No. 1 *L. alcon* very pale, 11 mm. long. No. 2 seen on examining nest to have half a larva (or rather less) held between its head and forward abdominal segments, the head being depressed by bending of thorax. In a few minutes, no doubt owing to disturbance, the larva straightened itself and the small size of the remains of ant larva was evident; the nest contained only full-grown larvae and pupae.

June 12.—No. 3 *L. alcon,* figured × 4 by Mr. Knight (Pl. XXIII). It looked 11 or 12 mm. in nest, but is 14 mm. when out of nest and measure can be put against it. It has a black patch beneath mesothorax, so it is supposed all is not well with it. The nest is now a rather dirty one. Whilst having his portrait taken the larva showed an activity much beyond what one expected from its quiet sedentary attitude in the nest, and whilst out of the nest, must have walked a good many feet.

June 12.—Looking into nest 1 at 6 p.m. (G.M.T.) this evening, larva No. 2 was seen resting on the floor of the nest, with his head and two first segments raised and his head advanced forwards (sphinx attitude), and an ant, also with her front raised, had her mouth and that of the *L. alcon* in contact. Luckily I had a lens in hand and was able to scrutinise them for ten or twelve seconds, when the process ended, the ant going off and the larva dropping his front segments to the floor of the nest. I directed attention specially to the adjacent mouths, and so failed to note precisely the altitude by which the head of the ant was raised. I was looking down on the tops of both the heads, and the movements of the mouth parts touching each other were unquestionably those of food being passed from the ant to the larva, viz. slight to and fro movements from one to the other, with adjuvant movements, or aspects of the same movement, of the maxillae, etc. It is difficult to describe this simply or at all, considering how short a time for observation was allowed, but the heads being in a plane on which one looked down at right angles, and the two heads being just far enough apart to show the mouth parts of both projected between them, their movements as observed could clearly only be those of food passing from one to the other. I feel, however, that the more I try to elaborate the account of what I saw, the less I shall probably convey to any one else the certainty that I immediately felt that the ant was feeding the *L. alcon* larva.

June 15.—*L. alcon* No. 3 shows a slight enlargement of prothorax, whether as first preparation for pupation or in connection with black patch uncertain. *L. alcon* No. 1 shows very markedly about and below spiracular region the "fat-bodies" with their rounded convolutions and sulci between, filled with clear fluid, not at all unlike cerebral convolutions.

June 16.—No. 2 can hardly be called smaller than No. 1. Yet in colour No. 1 is almost yellow, a pale sandy colour, whilst No. 2 is still pink, a warm flesh colour.

Shortly after last entry, on looking into the nests, No. 2 was seen to have the remains of an ant larva in the usual position, the front segments curled ventrally so as to bring them round the small remains of the ant larva, held by this curvature and between the prothorax (and head) and the 3rd and 4th abdominal segments. In no case has the larva gone on eating when exposed to the light.

No. 3 seems to have mesothorax rather swollen.

June 16.—Third note, later, 4.30 p.m. (G.M.T.). No. 3 *L. alcon* is found to be lethargic and motionless, the thoracic segments are enlarged, more in length than thickness, there is a slight waist at 1st abl. The abdominal segments are still thicker than the thoracic. The black marks remain as noted, *i.e.* not extending in any way. The larva is obviously near pupation, so is placed alone in a separate vessel to try to secure cast skin. Whether the black marks will prevent due pupation remains to be seen.

June 18.—No. 3 found this morning to have pupated, the skin is cast, but the black mark seems to have been removed only by some tearing (of 1st leg probably), and some bleeding had occurred, and the pupa looks shrunk, so will probably not mature.

No. 1 was last night away from brood, with a few ants in attendance, and prothorax looked swollen. This morning, lengthening of thorax and appearance of waist shows preparation of pupal moult.

June 19.—No. 1 is laid up for pupation, quite lethargic.

No. 2 is measured to-day, over 14 mm., not quite 15; moving too much to be quite precise; is still pink, though pale, not yellowish like Nos. 1 and 3 when full grown.

June 20.—7 a.m. No. 1 has just pupated. No. 3 pupa apparently alive, but discoloured in places.

No. 2 seems larger and fatter and rather paler; is a little away from brood.

June 22.—No. 2 lies away from brood, lethargic, mesothorax a little enlarged, 1st and 2nd abl. form a slight waist, several ants keep running over it, pale, hardly to be called pink.

June 25.—12.1 p.m. (G.M.T.). No. 2 has just pupated.

July 4.—No. 2 pupa figured by Mr. Knight.

Mr. Powell tells me that he has succeeded in finding three larvae of *L. alcon* in nests of *Myrmica scabrinodis*, but not in the nests of other ants that he explored. One found on June 12 was about 7 mm. long. Two found on June 30 were 13 mm.

These larvae were clearly not so advanced as mine kept indoors, which are, however, three weeks in advance of the previous year—a difference to be attributed to the fact that the clerk of the weather sent us July and August instead of May and June. This, of course, affected the temperature of my room, though probably not that of the ants' nests in the wild, brood and larvae being carried by the ants to shallower or deeper apartments as might be necessary to secure a desired temperature.

July 19.—No. 1 *L. alcon* has quite matured in pupa, and seems to have been ready to emerge for the last two days, certain dark marks on the pupa that appeared shortly after change probably cause some adhesions preventing emergence.

No. 2 has black eyes and thickened wings, but as yet no coloration.

July 21.—9 a.m. (G.M.T.). No. 2, a ♀ *L. alcon* emerged.

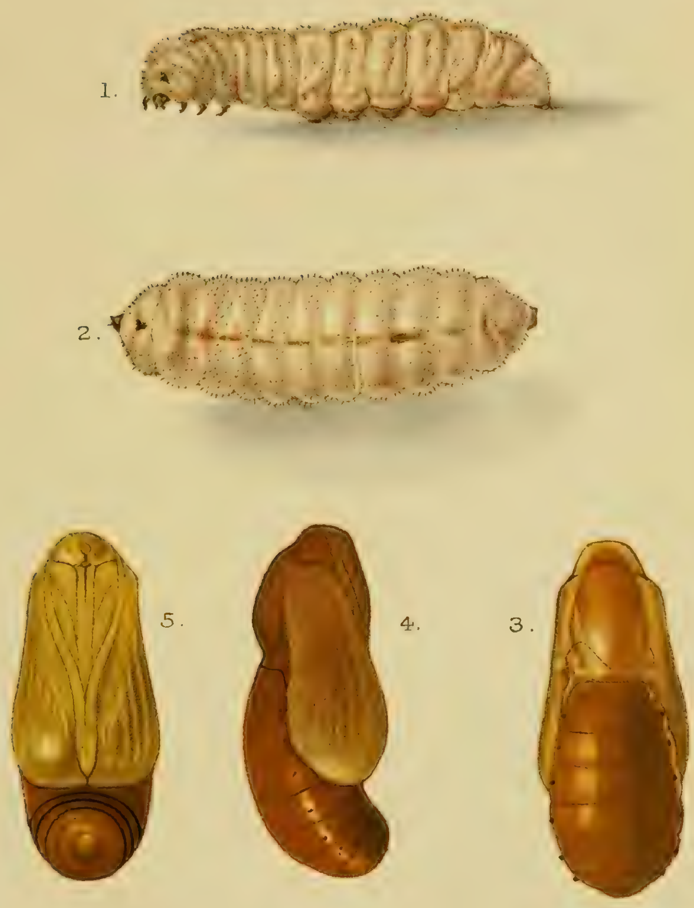
Explanation of Plates XXIII–XXVIII.

Lycaena alcon F.

Plate XXIII, fig. 1. Lateral view of full-grown larva × 4.

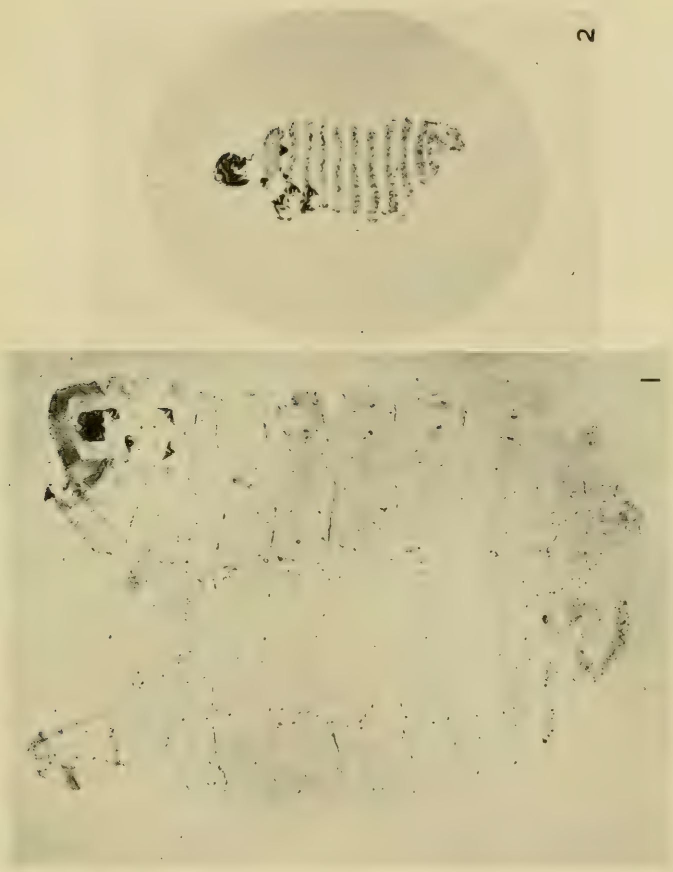
Fig. 2. Dorsal view of full-grown larva × 4.

If these are compared with the figures on Pl. DI of the 16th vol. of the "Études de Lépidoptèrologie Comparée," which show the larva at a much younger stage, practically that at which it leaves the gentian, the great difference in colour due to the extension of the skin, in or immediately beneath which the colour resides, is obvious. In the full-grown larva the skin is so stretched and the colour diluted by covering the larger area, that it retains only a faint pink tinge



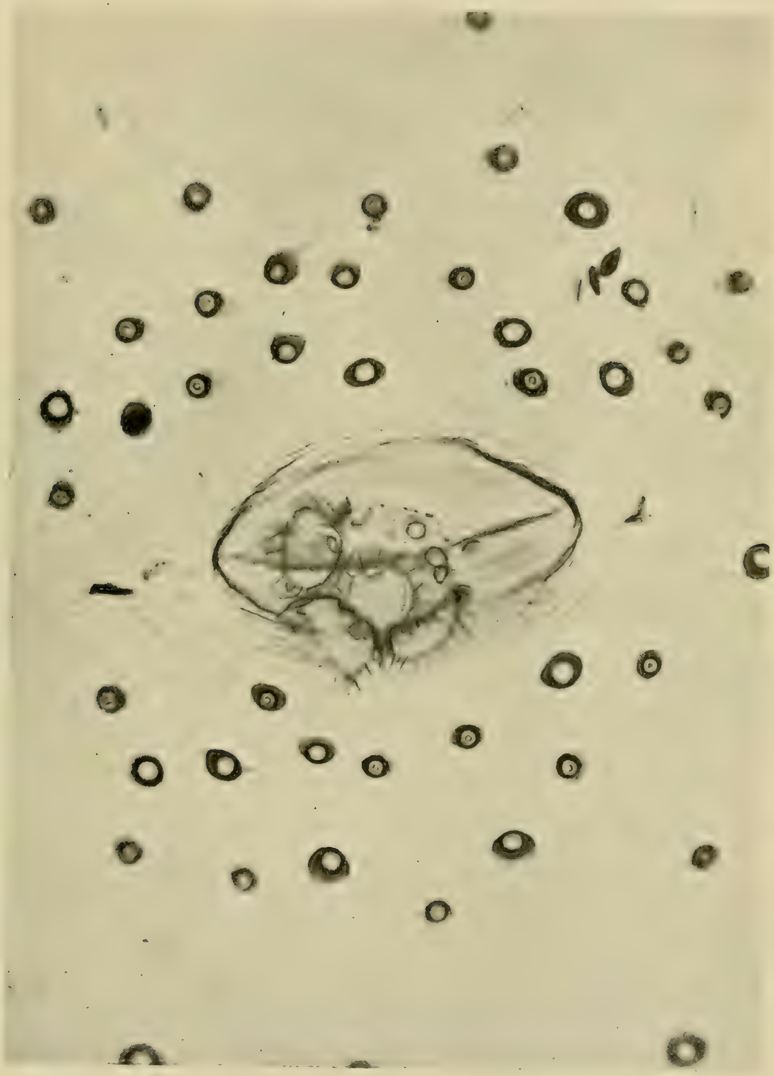
E. C. Knight del. et chromo. Huth, imp.

LARVA AND PUPA OF *LYCAENA ALCON* L.



Half-Tone Eng. Co., Ltd.

THIRD SKINS OF *LYCAENA ALCON* F.



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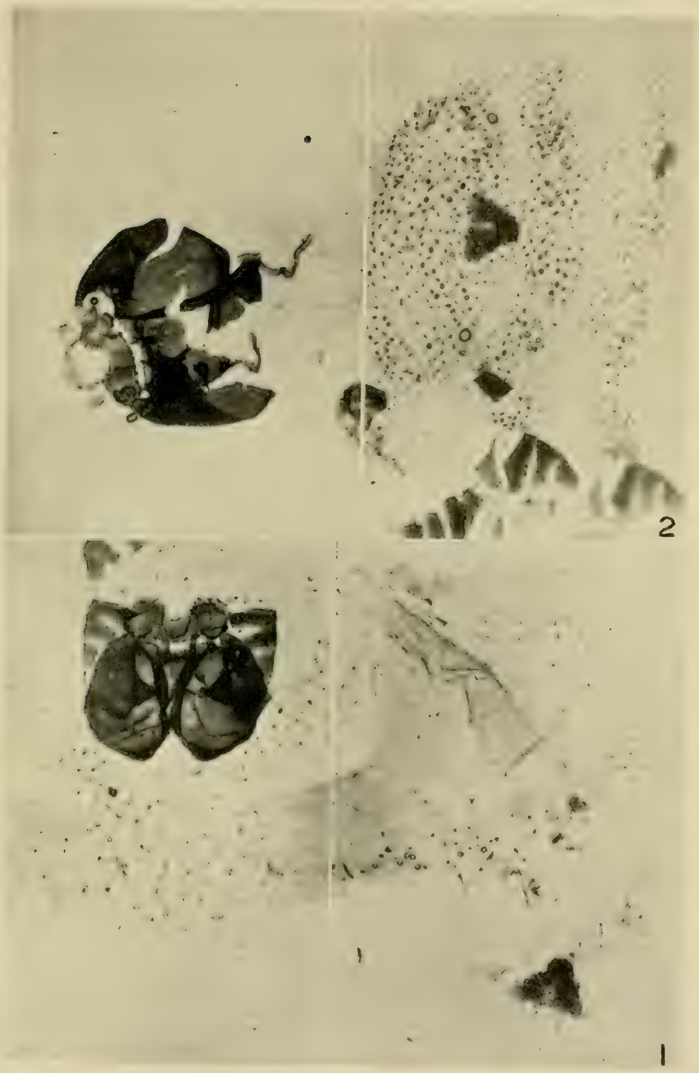
HONEY GLAND OF *LYCAENA ALCON* F.



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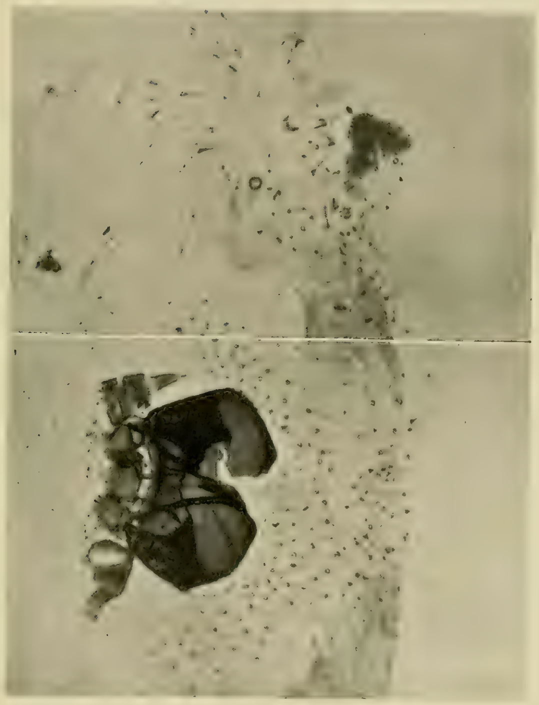
THIRD STAGE OF *LYCAENA ALCON* F.



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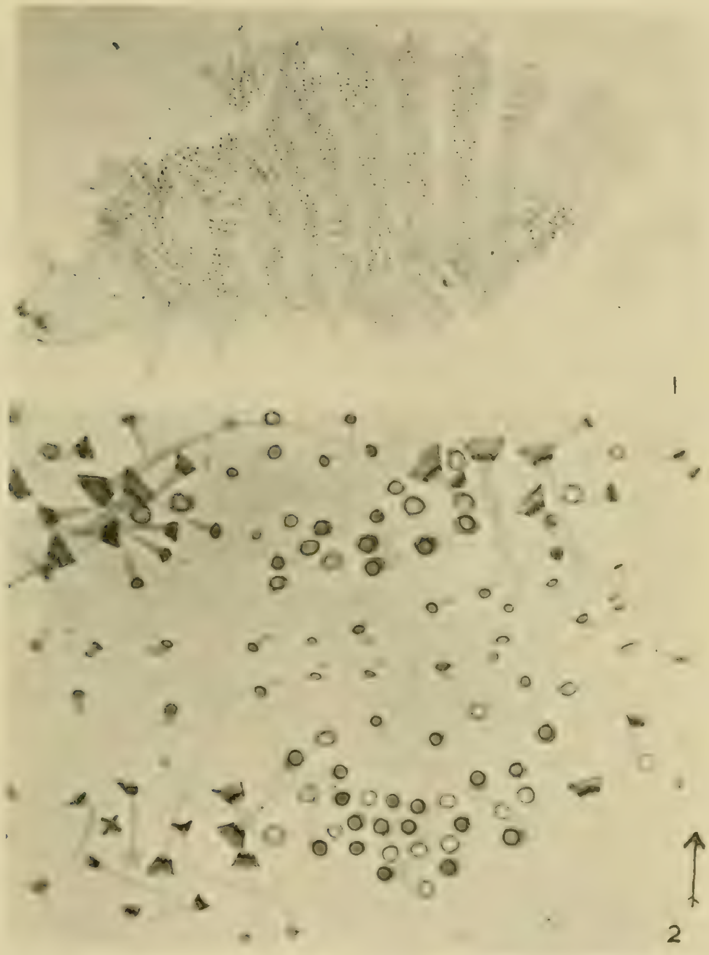
THIRD STAGE OF *LYCAENA ALCON* F.



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ABERRANT FOURTH STAGE OF *LYCAENA ALCON* F.

over the underlying fat-bodies, or the colour may be practically evanescent.

Figs. 3, 4, 5. Lateral, dorsal and ventral views of pupa × 4.

Plate XXIV, fig. 1. Skin cast at pupation (of No. 2 larva) × 6.

Fig. 2. Skin of larva on entry to ants' nests × 6, *i. e.* same magnification as fig. 1.

Plate XXV. Honey-gland in skin shown in Plate XXIV, fig. 1 × 240. The hair-bases and lenticles that crowd round it in fig. 2 are here seen well spread. Various details of the gland itself are well seen; the four circles, seen in all honey-glands of Lycaenids examined, are very evident; whatever their precise function in the gland, they seem to represent the four dorsal hairs of each abdominal segment (1st to 7th), here replaced by the honey-gland. Other smaller circles are also shown.

Plate XXVI, fig. 1. Head and prothoracic plate of skin in Plate XXIV, fig. 1 × 35.

Fig. 2. Head and plate of skin shown on Plate XXIV, fig. 2 × 35.

Plate XXVII. Head and prothoracic plate of another skin cast at pupation.

The object of these photographs is to show that the full-grown larva is in the same instar as the small third instar larva that enters the ants' nest. Though the skin is stretched and the hairs and lenticles are more widely apart they are of the same size in the large and in the small larva, but the demonstration depends more particularly on the head and prothoracic plate being of the same size and structure in the large as in the small larva.

Plate XXVIII, fig. 1. Skin of 4th stage larva figured Plate C, Fasc. XVI, "Études de Lépidoptèrologie Comparée" × 20. This rare and aberrant specimen is referred to in the following paper on *L. euphemus* (p. 455). In order to show the small clubbed hairs there referred to, I remounted the specimen in Canada balsam, not too successfully, but the hairs noted are shown in fig. 2 × 190. The arrow pointing towards head is in middle dorsal line of first abdominal segment, and the cross in centre of spiracle of same segment.

XIX. *Contributions to the Life History of* Lycaena euphemus *Hb.* By T. A. Chapman, M.D., F.R.S.

[Read November 5th, 1919.]

Plates XXIX–XXXVI.

Monsieur Oberthür has continued to pursue the investigation of the Myrmicicole species of *Lycaena* with the ardour and enthusiasm which we all admire, but which in no way surprises us, since they are always forthcoming for any Lepidopterological research. In 1918 the observations on *L. alcon* were followed up, and in 1919, *L. euphemus* has taken the front place in the work in hand. In both species Mr. Powell has been most active and successful, especially this summer in the case of *L. euphemus*; by a combination of hard work, and a genius for understanding and following up the details of the life histories of Lepidoptera, we have a complete view of the economy of *L. euphemus*; though, of course, there is still room for further observations. Mr. Powell began the campaign by finding a newly emerged *L. euphemus* over an ants' nest, and on examining the upper portion of the nest found an empty pupa case. This case is obviously one of a *Lycaena*, and as *L. arion* and *L. alcon* are practically ruled out, it must be the case of *L. euphemus*. For all practical purposes, the proof is almost complete that it is that of the imago found. The ants' nest was that of *Myrmica ruginodis*. Thereafter, in face of various practical difficulties, he obtained eggs and larvae in four different stages. I have to thank M. Oberthür and Mr. Powell most heartily for sending me material by which I have been able to follow up the history of the larva during the period of its pre-ant existence, and further to place larvae in the nests of ants and observe their life therein. I will relate my own observations as though they were original, as simplifying the narrative; but almost everything I observed was at the same time or earlier noted by Mr. Powell. Mr. Powell made one observation, viz. that of the ants carrying in the larva of *L. euphemus* to the nest with the same ceremonial that obtains in the case of *L. arion*. My specimens failed to afford me this pleasure, though I devoted some time to detecting it. Probably it occurs less easily in the case of ants in small artificial nests, and the ants and the larva of *L. euphemus* are certainly much more apathetic towards each other than is the case with either *L. arion* or *L. alcon*, and *L. euphemus* is decidedly more active than either of the others, and not improbably finds its own way into the ants' nest in many cases.

The egg of *L. euphemus* is laid on one of the bracts at the base of the flower in the flower-head of *Sanguisorba officinalis*; the side of the egg is towards the axis of the flower-head, and the vertical axis of the egg is often at right angles to that of the flower-head. Oviposition takes place whilst the flower-buds have still some growing to do, so that the butterfly can push between them into the flower-head to reach the bracts inside. Later, the flower-buds grow, and the egg, and after, the larva, is quite imprisoned until it prepares a way out, for finally leaving the plant.

The egg is almost of the usual *Lycaena* shape, much that of a cheese, but at first glance seems very different. This is due to the top, which in typical Lycaenas is nearly flat and has an elaborate network of adventitious white material, but is, here, without the white material and is raised in a slight arch. The sides have the usual white network, and the top has a network without the adventitious white material. It is 0·6 mm. wide and 0·35 mm. high.

The larva lives inside the solid flower-head in its 1st, 2nd and 3rd instars. In the 3rd instar it completes the eating out of a space, very usually by scooping out one side of the axis of the flower-head rather above the middle, but not unfrequently without invading the central stem and even at various angles to it. In doing this it cuts several flowers (or fruits) free from the stem, so that one at least is easily pushed out when the larva wants to escape. The larva, full-grown in its 3rd instar and pretty well 4·0 mm. long, fills this excavated space, and there undergoes its third moult. This takes place in an extraordinary manner, one to which I know no parallel, either in Lycaenids, or in any other Lepidopteron whose moultings I have observed. Opened at the right moment, the cavity contains the larva of a very curious pallid aspect, and it is seen that the larva has loosened itself from the skin to be cast, and that the tracheae can be seen through it, drawn out for about a third of the width of a segment, and that the pallid appearance is due to air between the effete and the new skin.

When I first saw such a larva, I said this larva tried to moult, but failed and died before it had made much progress. Some twenty-four hours after—and I believe, usually, after a longer period, but the point could not be tested with the amount of material I had, whose destruction I feared to risk—the moult is completed, the larva creeps out, hardly disturbing the seedpod pushed aside to allow of its escape. It is now ready to leave the plant in order to meet with ants. On examining the head that is left, the cavity is seen to be lined with the cast skin, which can, with some care, be removed in the form of a complete skin fully distended; not quite complete, however, as the larva escaped from it by pushing off the head and a portion of the prothorax, which are apt to be lost in looking for the cavity containing the skin.

A good many *Lycaenidae* leave their first cast skins fully distended, and some even a later one, but the process of freeing itself from the skin, and to a slight degree beginning the moult and then resting for a day or two, as *L. euphemus* does, is a puzzling novelty.

Is it a rest in order to await suitable weather for adventuring on a new world? Is it foregone, if conditions are quite suitable when the process is begun? Possibly Mr. Powell may have some details throwing light on the meaning of this most unusual habit.

In the 2nd, 3rd and 4th instars the larva is of red or red-brown colour closely matching the colour of the flower-heads of the *Sanguisorba*. In the 2nd and 3rd instars the armature is of simple hairs with some lenticles. In the 4th stage the hairs are reduced to a series on each side of the dorsum and a lateral series below the spiracles, one or two to a segment; these hairs are 0·6 mm. long, below the lateral flange there are more numerous and shorter hairs. The hairs that were (comparatively) so numerous in the previous instars are replaced by stellate hair-bases set, one might say, as closely together as there is room for; some of these seem to be mere bases, some lenticles, but some carry short thick processes, about as long as they are wide and that are, of course, morphologically, hairs. This larva is, of course, no larger than it was in the 3rd instar; it is about 4·5 mm., though they vary a little in size; they do no eating till in the ants' nest. Seen from above they have a curious square aspect, the eight middle segments form a parallelogram divided into eight segments, and the prothorax in front and the 7th to 10th abdominal segments behind, form two nearly semicircular ends of about equal dimensions.

Once established in the ants' nests they grow rapidly. In a week the 4·5 mm. larva becomes about 7 mm. long, and looks a little more when stretched; but a week or ten days later it is no larger, looks even smaller as though ceasing feeding with a view to hibernation.

I saw a larva eating an ant grub, which it did very rapidly; the larva maintained its stiff, straight attitude; it had the ant grub beneath the thorax, held it, and moved it forward with its true legs, and finished it by pressing it against the glass, through which I was observing it. The head was all the time retracted within the prothorax with the jaws pointing downwards; the hollow in the prothorax was large enough to give the head much freedom of movement, and when the meal was finished it might be said to lick its chops, as it passed its mouth rapidly with licking-like movements over the whole interior surface of the prothoracic hood, as though cleaning off any fluids from the eaten ant grub, and I could not resist the conclusion that that was what it was actually doing. This process of eating was very different from that of *L. alcon*.

I have never seen a larva actually amongst the ant brood, as was so usual with *L. alcon*, nor have I seen an ant take any notice whatever of a larva—they run over them and past them as if they were merely portions of the nests. The larvae are fairly active, may often be seen moving about, but are usually resting on the side of the nest a short way from the ant brood.

I have seen no ant milking a larva, except when I was watching for a larva to be carried into the nest; in this case the larva offered a fluid at the honey-gland, which was taken by a passing ant, who took no further notice. Further fluid was secreted and accepted by other ants three or four times in one case, but the ants made no further overtures.

On Sept. 17 a larva was taken from nest 3 and sent to be figured; it came back on the 21st and looked well; it was returned to the nest. The ants paid a little more attention to it than they usually do to the larvae of *L. euphemus*, which is, indeed, practically none at all. They came up to it, rested a fraction of a second, tapped it with their antennae, a few waited a second or two, but all then passed on satisfied; their questioning may have been as to the arrival being a possible stranger and enemy, but equally looked like a welcome home and inquiry as to well-being. The next morning, 22nd, the four larvae are resting in the sides of the nest away from the brood as usual, and it is impossible to say which was the one returned.

A comparison of the larvae of *L. arion*, *L. alcon* and *L. euphemus* in their several instars up to the time of entering the ants' nests, brings into strong relief the extraordinary peculiarity of *L. alcon* in having only two moults and three larval instars. In the first instars they are very much alike. The most obvious differences are that in *L. euphemus* the spiracles are of very large size, nearly twice the diameter of the others. The lenticles are fewer. The prothoracic plate has, in *L. alcon*, the usual pair of lenticles large, and on the front margin; in *L. arion* they are small and a little way from the front, and in *L. euphemus* it is doubtful whether they can be said to be present.

In the 2nd instar, *L. alcon* has several pairs of lenticles on the prothoracic plate, the others fewer. *L. alcon* also has more lenticles than *L. euphemus*. *L. arion* has a stronger panoply on the general surface, more lenticles, and the "skin-points" are especially large and dark. The size of spiracles in *L. euphemus* is now little different from the others.

In the 3rd instar *L. euphemus* has the least elaborated armature, the skin-points are well developed, but there are very few lenticles, except on the last segments, and no stellate hair-bases; on the abdominal segments are about twenty black, not long, hairs, to be counted between the dorsal line and the spiracle. In *L. arion* there is an abundant armature, far short, of course, of that in the next instar, but with very numerous lenticles and hair-bases, not easily distinguished from each other, and here and there slightly stellate. In *L. alcon* the hairs are about as numerous as in *L. euphemus*, but are longer and there are a great many lenticles (and hair-bases ?), but these carry no abortive hairs, and show no stellation. The armature is, in fact, less simple than in *L. euphemus*, hardly so full and developed as in *L. arion*, very definitely therefore a

3rd instar panoply. This is the last instar in *L. alcon.* The 4th instar is reached by *L. arion* and *L. euphemus*, and they are very much alike at this stage. They have a dense coat of stellate hair-bases; they have on the dorsum a long hair on each side and a long one below the spiracle. *L. euphemus* has a second smaller dorsal hair on 4th, 5th and 6th abdominal, and has the first abdominal segment narrowed and without dorsal hairs. The prothoracic plate in *L. euphemus* has much the form of a boy's kite—a rather broad one. In *L. arion* it is more rounded and shield-shaped. In both, on the margins of the segments the hair-bases carry minute hairs, most obvious on the fronts of the 3rd to the 6th abdominal. These are more usually hairlike in *L. arion*, in *L. euphemus* more frequently thick and clubbed.

In the remarkable solitary instance in which I obtained a 4th instar specimen of *L. alcon*, the hairs and lenticles are much as in the 3rd instar; the lenticles (or hair-bases ?) are circular, none stellate, but there are certain minute clubbed hairs very like those in the fourth stage of *L. euphemus* and *L. arion*, and of which there is no trace in the third stage of *L. alcon*. There is a double row of these in the incision between the metathorax and the first abdominal segment, numbering about forty altogether, perhaps a single row along the border of each segment, a few others may be found on the mesothorax and on the 6th and 7th abdominal segments. The bases of these are smaller than the lenticles, receding from, rather than approaching, the stellate form. There may be other points that escape me, the specimen being a little immature, but these hairs fully indicate that the larva of *L. alcon* retains a memory, weak and indistinct, of a 4th instar, probably with an armature not unlike that of *L. arion* and *L. euphemus*.

It may be noted that the enlarged meso- and metathoracic segments dorsally in *L. euphemus*, together with the smaller and weaker 1st abdominal, present a resemblance to the curious attitude we saw in *L. arion*, and which Mr. Powell has seen in *L. euphemus*, which the larva assumes when being carried in by the ants. There is no corresponding weak 1st abdominal in *L. arion*, but in *L. alcon* this segment is faintly narrower than the following segment and has only about half the number of hairs, about ten instead of twenty, across the dorsum between the spiracles. The primary hairs that are so strong in *L. euphemus* compared with the other species, obviously might interfere with the ant getting a proper hold of the larva by the 1st abdominal segment, which seems to be the correct position at which to grasp it, were they equally strong here as elsewhere. The disappearance of the dorsal hair gets over this difficulty.

The long hairs in *L. euphemus* would be inconvenient if the larva lived amongst the brood, as that of *L. alcon* does; but it always rests on the wall of the nest, its own length and often much more away from the brood; these two facts are no doubt therefore correlated, but precisely how this is brought about is less evident.

There is ground for much speculation, but, so far as my present knowledge goes, for little else, as to how English *Myrmica* of two (and possibly all) species can satisfactorily entertain the larvae of *L. alcon* and of *L. euphemus*.

There is sufficient room for astonishment that these *Myrmica* (*M. scabrinodis* and *M. laevinodis*), natives of Reigate, are excellent hosts for *L. arion*, which their ancestors can only have known a considerable number of generations back, and any crossing with species of *Myrmica* familiar with *L. arion* must have been exceptional and very indirect. Still, one may explain in that way that *L. arion* is not altogether strange to them. But when we come to *L. alcon* and *L. euphemus*, we are dealing with species that Reigate ants cannot have known during some uncounted generations. It is to be observed that we cannot say they know all about *L. arion* and the same instinct serves them with these other species. The habits of the three species of *Lycaena* in the ants' nests differ distinctly in each species, and their treatment by their hosts equally differ in each case. The attitudes of *M. scabrinodis* and of *M. laevinodis* are identical with each *Lycaena*. Each treats *L. arion* with a certain amount of care, but has an extreme solicitude in the case of *L. alcon*, whilst as to *L. euphemus*, they may be said, comparatively, to pay no attention to them.

One definite conclusion seems forced upon us, and that is, that the relations between *Myrmica* and *Lycaena* originated with the ancestors of the two genera, when possibly each was represented by a single species; that as *Myrmica* developed into a number of species, *Lycaena* maintained relations with all (? or most) of them; that as *Lycaena* subdivided into separate species, each form trained all the species of *Myrmica* involved, in its special habits, and that all this took place at so distant a date, and through so long a period, that the necessary instincts are deeply and firmly impressed on the several species of *Myrmica*, so that they remain ready to act on demand, though they may not have been exercised for what in human chronology we might call ages.

I may give a rather fuller description of the egg and 1st instar, but a very detailed description of the three following instars seems unnecessary in view of the figures by Mr. Knight (Pl. XXX) and the photographs of the mounted skins (Pl. XXXI–XXXV), especially as I have mentioned various points concerning them in other connections.

I add also my notes from day to day to illustrate various items in the habits of the larvae. A possible redundancy here and there may be useful, as giving the facts from a slightly different point of view.

July 31.—The egg regarded as of the usual cheese shape of Lycaenid eggs has the top raised as a slight dome, and the bottom is also raised, *i. e.* not quite flat. The egg is green above and below and the side stands out as a white zone, the sides having some of the white material usual on Lycaenid eggs, the top and bottom being without it. The sides are nearly vertical, perhaps slightly narrower above than below. The egg is 0·6 mm. wide, 0·35 high. The lateral zone is 0·23 wide (or high), the difference between 0·23 and 0·35, viz. 0·12, marks the fullness of the upper and lower portions, say 0·08 for the top, 0·04 for the bottom. The cells of the white sculpturing of the sides are shallow, square rather than hexagonal, but of various forms, and about 0·02 in diameter. The top also has a network, tending to be more hexagonal, without any adventitious white material, and towards the margin at least with cells larger than those of the sides, the transition being at a very marked and definite line, as is the lower margin of the lateral zone also. The actual measurement shows these cells to be very slightly larger than those of the zone, but the want of the white coat makes them look larger comparatively.

When hatched the larva is about 1 mm. long, of a light greyish tint, due to its interior structures, the skin seeming to be transparent and colourless. I have not seen it when grown, but suppose it acquires something of the ruddy colour of the later instars. The head is dark, 0·23 mm. across, the jaws brown, with five sharp teeth and a short one on the lower margin. Ocelli, five in a curve and one rather larger at centre of curve. The prothoracic plate is pointed at each side, and produced to a blunt angle posteriorly, but only somewhat curved in front; it is about 0·18 mm. across; it has no lenticles, a pair of short hairs near the front and a slightly longer pair further back and wider apart.

There are several hairs in front of the plate and a pair behind it, and three or four in front of the spiracle and a little group of five almost in a vertical row behind it. On the mesothorax dorsally are, on each side, an anterior and two posterior hairs, the latter close together, the outer the shorter. On the metathorax there are a longer inner and shorter outer hair on each side of the dorsum, a minute hair behind these at posterior margin, and a lateral hair ranging with abdominal supra-spiracular hairs. On the abdominal segments there is a long dorsal hair (about 0·07 mm. long), a shorter one a little outside this, and a minute one at posterior margin. Above the spiracle is a hair about 0·03 mm. long, and a shorter one behind and a little above it. The 9th abdominal segment has no dorsal hairs but an anal plate; the 10th has about ten marginal hairs.

Below the spiracles are the usual three hairs (four in 2nd and 3rd thoracic). There is a lenticle below the first spiracle; there is also one just below the dorsal hairs on the 3rd (sometimes 2nd) to 8th abdominal segments. The spiracles are exceedingly large and the first is at the top of a chitinous tube deeper than the width of the spiracle; the spiracle seems to be level with the cutaneous surface, and not, as the tube suggests at first glance, at the top of an exterior column, *i. e.* the tube is the first portion of the trachea. The true legs are tinted, but much paler than the head. The prolegs have each an anterior and posterior set of hooks, each set consists of a larger and a smaller hook, of which the smaller is sometimes wanting. The claspers in one specimen had one hook in each set on one side, on the other side one set had one, the other two hooks.

In the 2nd instar the larva is about 3 mm. long and has acquired the red (or red-brown) colour, but it is hardly as dark as in the two following instars. The primary setae (dorsal and lateral) that exist in the first and in the last instars, are not here obvious by differentiation from the other hairs. It is, of course, only an assumption, quite reasonable, but also quite open to doubt, that the long hairs of the last stage are primary setae. The hairs over the dorsum (spiracle to spiracle) of an abdominal segment are fourteen to sixteen, but vary in number and disposition from segment to segment, and vary in length from about 0·2 to 0·3 mm.; some on the prothorax are a little longer. The skin-points are conspicuous and somewhat regularly arranged. The head, legs, and prothoracic plate are dark (black till magnified). The lenticles show something of the same irregularity of disposition as the hairs. The prothoracic plate has two pairs, and also a minute pair that seem to represent the special angular hair. In the specimen noted, there are two lenticles in front of the right half of the prothoracic plate, and one near the left angle; there are none on 2nd and 3rd thoracics. The 1st abdominal has a lenticle above spiracle on left side only, none on right, all the other abdominal spiracles have such a lenticle above them, and 4th and 5th abdominal on right side only have a second, just above and in front of the first. The 5th and following segments have a lenticle on each side of dorsum near front margin. On the 7th the spiracular lenticle is a good way above the spiracle; on the 8th it is close to the spiracle and in front of it, and on the right side only another rather behind though above; the two dorsal ones are rather close together and just in front of four rather long hairs placed trapezoidally as does not occur on any other segment. The 9th has the two dorsal lenticles only; the 10th has them also and a pair behind them perhaps representing the anal plate, that is otherwise absent.

The honey-gland is represented by a smooth oval area, about 0·2 mm. from angle to angle, with the skin-points arranged in condensed lines closer together and smaller in size as they approach the smooth area. Very remarkably the centre of this area carries a small hair about 0·1 mm. long.

The spiracles do not differ materially in size from those of *L. alcon* at the same stage. In *L. alcon* the spiracles are each on a low chitinous cone, and its lenticles have a similar appearance; it has no trace of honey-gland, and lenticles are very numerous on the prothoracic plate. On the prolegs in this instar there are to each set (anterior and posterior of each proleg) one long hook and two, and occasionally three, short ones; on their bases are only two or three quite small hairs. In the 3rd instar each set has two large and three small hooks, but with a little variation. The claspers have three hooks; one or two may be large.

In the last instar there is considerable variation in the hooks of the prolegs—a usual formula is two long, two medium, and five short; there may be four long, and it may be difficult as to several hooks to say whether they are long or short; eleven seems a usual total number. The column of the proleg has a covering of very short hairs with conical bases. The marginal group above this has twelve to fifteen similar short hairs, as well as stellate lenticles or bases.

The 4th stage larva has the first six abdominal segments with a dorsal surface, raised a little at each side, but with a deep recess in the middle line at its anterior margin. This recess has stellate hair-bases at the bottom of the hollow, but the sides are nearly free from them. In the 3rd instar there is no trace of this, but at the posterior margin of the segment there is a small shining point as of a chitinous plate; this is almost hidden in the incision; the mounted skin, however, shows no such structure.

In 4th stage the hollows in the dorsal line on the 2nd and 3rd thoracic segments are in the middle of the segment and not at the anterior margin as on the abdominal. On these the saddle behind the depression is lower than on each side, giving a dorsal depressed line, sinking much lower at the depressions and incisions.

The following are some of the detailed notes made from day to day.

July 16.—Mr. Powell found a ♂ *L. euphemus* drying its wings and, searching below, found a pupa case just over a nest of *Myrmica ruginodis*. The pupa case (sent to me) is obviously that of a *Lycaena*.

July 30.—Received from Mr. Powell six heads of *Sanguisorba* with eggs of *L. euphemus*. The egg is inserted almost close to the central stem, between the bracteoles and pedicels; the flower-buds would appear to have grown larger since the laying, and are packed together so tightly that it seems impossible that the egg could have been placed beneath them and got into place except when they were smaller. The egg appears to be lightly attached to the base of the bracteole by both surfaces, or by one to the pedicel. The side of the egg is towards the main stem.

Aug. 22.—Received from Mr. Powell five larvae of

L. euphemus, said to be in five heads of *Sanguisorba*; when they arrived all the larvae were on the paper containing the heads, the latter fairly fresh (had been posted 20th). The largest of the larvae was lethargic, seemed dead, but had a firm tone that suggested it was stunned by travelling or more likely sickening for moult. The larvae were reported by Mr. Powell to be in 3rd instar, and that they underwent another moult. The other four larvae were replaced on heads of *Sanguisorba* and were, so far as appeared, all right.

Aug. 23.—The largest larva (about 4 mm.) had clearly been laid up for moult, as this morning the old skin had been moved a little, some air under it and tracheas slightly withdrawn, the larva still immovable, slightly curved. Two of the other larvae were still wandering and two invisible, supposed buried in heads. One of the wandering larvae was offered heads of *Poterium*, this was not accepted.

Aug. 24.—This morning the large larva, which had made no move last evening, had cast its skin, which remained fully distended; the larva itself had spun a few threads to form a resting-place. Shortly after it was found on the move with a fluid globule on the honey-gland. It was placed in nest of *M. scabrinodis*; the ants paid little attention to it. It was moved to a small collection of ants and brood, but a quarter of an hour later the ants had removed the brood and left the larva stranded alone. Later they frequently examined it, apparently sometimes biting it, but without injury. It secreted various supplies of honey, which was lapped up by passing ants, but never sought for and not found by the ants actually examining it.

Aug. 25.—This larva was found dead, a little shrunk, amongst débris; it had been bitten as evidenced by marks, but the skin did not appear to have been pierced.

Of the four smaller larvae, two were dead, one was crawling on the glass, and one was half buried in a head of *Sanguisorba* with some frass behind it. The wandering one was offered the best remaining *Sanguisorba* and heads of *Poterium*. Later its head was buried in the *Poterium*; but there was no definite indication that it was eating.

The larvae are dark red, almost identical with the colour of the *Sanguisorba* heads when just past flowering. The smaller ones are about 3 to 3·5 mm. long; the larger were about 4 mm., but would probably have been a little more stretched. When it had moulted, the dorsal hairs were seated each on a rounded boss, occupying nearly the width of the segment beside the middle line; the lateral hairs were like the dorsal, long and conspicuous. The hair-bases are very closely packed together.

Aug. 28.—Third and fourth stage larvae.

The 3rd stage larva (hardly full grown) is nearly or quite 4 mm. long when stretched, and 0·7 mm. wide; the 4th stage 4·5 to 5 mm. long and 1·5 mm. wide.

The 3rd stage tapers a little backwards; the 4th stage remarkably square, the two sides being parallel, only the ends rounded.

The most notable difference between the two is in the hairs in 3rd stage being distinctly hairs and sparsely distributed, and in 4th being largely hair-bases closely packed. Both are of a deep dark pink-red, almost the same as the colour of the head of *Sanguisorba* when flowering is over, but before it begins to get very dark. In the 3rd stage the incisions are well marked, but the margins on dorsal view show each segment rounded and projecting and not so distinctly a rather separate square projection as in the 4th. The head and legs are dark, but not quite black; the prothoracic plate is also very dark.

In the 4th instar the square outline when the larva is at rest is notable; when actively moving there is a little tapering towards the tail; but when at rest the prothorax in front and the 7th, 8th, 9th and 10th segments behind form semicircles, which are almost identical in size and outline; the eight intermediate segments are also all very similar, the mesothorax and the 4th, 5th and 6th abl. being a little wider than the others, the 1st abdominal smaller.

On Aug. 28 various larvae are noted as looking well in ants' nests (*Myrmica scabrinodis* and *M. laevinodis*), but nest 1 was without a larva, and a new larva was placed in it.

On Aug. 30 this larva was found dead. Another larva was given and was finally accepted. Larvae in other nests well, all near the brood, but not in it.

Sept. 2.—Yesterday I hunted for *Myrmica* to obtain some brood to supplement some of my nests; I obtained, however, only a small quantity of brood, which I left in a tube, putting in with them three larvae of *L. euphemus*. At about 1·45 p.m. (G.M.T.), having previously frequently looked at the tube without result, I found one of the *L. euphemus* larvae eating an ant grub. The latter was already about three-parts eaten, so that what size it was is doubtful, but the width of segments on the portion remaining suggested a half-grown one. The *L. euphemus* was on the side of the tube, so that its under surface was easily examined. It was straight, in its usual resting attitude, and the remaining portion of ant grub stretched from the front of the *L. euphemus* to the end of its thorax; it had a pulsating movement, showing that the jaws of the *Lycaena* were at work. Almost at once it was seen that the legs of the *Lycaena* were appearing round the edge of the ant grub remains, and very soon they had it between them and were actively manipulating it to bring it more directly to the head of the larva. In a few minutes the ant grub was so reduced that the head of the larva could be seen, with the jaws actively at work; the whole observation did not last more than a few minutes, and it may be understood that the eating was rapidly done.

The next immediate stage was that only a bit of skin of the ant remained, and this was then eaten, almost rather swallowed than eaten, as it seemed to be drawn in bit by bit, without the bits being separated. During this last stage, the portion of ant grub was too small to be touched by the legs, and lay as it were in the hollow beneath the prothorax, possibly held there against the side of the tube. So soon as it had disappeared, it was evident that the head of the *L. euphemus* was retracted within the hood of the prothorax, so that the margin of the cavity formed by the hood seemed to be against the glass and the head freely moved within. It continued a sort of eating movement, but quickly changed to moving round, almost rapidly, licking the inside of the hood, which may well have been moistened by the fluids of the half-eaten grub which must have touched it; this continued till the surface all round had been gone over several times and the first pair of legs were also licked. Though the larva has no tongue, I say licked, as the movements had all the aspect, and I should say for practical purposes, all the effects of licking. It then settled down in its ordinary resting position, and was in the same place and attitude half an hour later.

Sept. 6.—Four larvae in nest 3 (*M. laevinodis*) are 6 to 7 mm. long, they rest on the side of the nest, all four head downwards. The small bosses on each side of the dorsum are marked, and especially on the 2nd and 3rd thoracic they are very large, a fact that is accentuated by the lowness and narrowness of the 1st abdominal. The prothorax has a depressed central dorsal area, with the prothoracic plate in the middle. The margin round this area is swollen into a roll continuing round the whole front of the larva; one connects this structure with the method of eating the ant grubs already described, when this thickened roll falls down to form the "hood" mentioned. When advanced a little so that other parts of the prothorax are not just behind it, it is seen to be devoid of the ruddy colour of the rest of the larva.

Sept. 16.—Nest 5 contains eight larvae, some 6·0 or 7·0 mm. long; they don't seem to have grown appreciably during the last ten days. The same remark applies to the larvae in nest 2, one in nest 1 and four in nest 3. Indeed, some of the larvae seem to be hardly as large or thick as some days ago, as though they might be ceasing feeding with a view to hibernation.

The ants themselves seem to be doing well, and eggs and young grubs are present; their present food is honey and earwigs. The amount of brood, however, seems hardly sufficient to feed the *L. euphemus* in the spring, if all goes well with them. Some brood is obtained and added to the nests, but unfortunately *Myrmica* nests are rare within reasonable distance, and those found are almost without brood. Possibly the dry season restricted their food supplies, so that all had to go to completing rearing of the ♂♂ and ♀♀ against swarming.

Oct. 8.—The larvae appear to be about the same size though apparently still eating, at least the ant brood seems less in the nests with little brood, where a slight loss makes a difference; but a remarkable circumstance has been noticed in the last week or ten days, and that is that the long hairs of the *L. euphemus* larvae are being lost. Several were noticed with the hairs very short, about one-fourth of their proper length; one at least still had the hairs long. Now one or two seems to have none of the long hairs left. One suspects that the ants bite them off, but of course they may be thus shed naturally, nothing has been noticed to decide between these possibilities.

Oct. 9.—Examined all the larvae of *L. euphemus* that were within reach of a lens, actually all of them, but some of them were so placed as to prevent their being fully seen. One larva only had about half the long hairs present, three seemed to have no long hairs at all, the remainder were in various intermediate conditions—several with two or three

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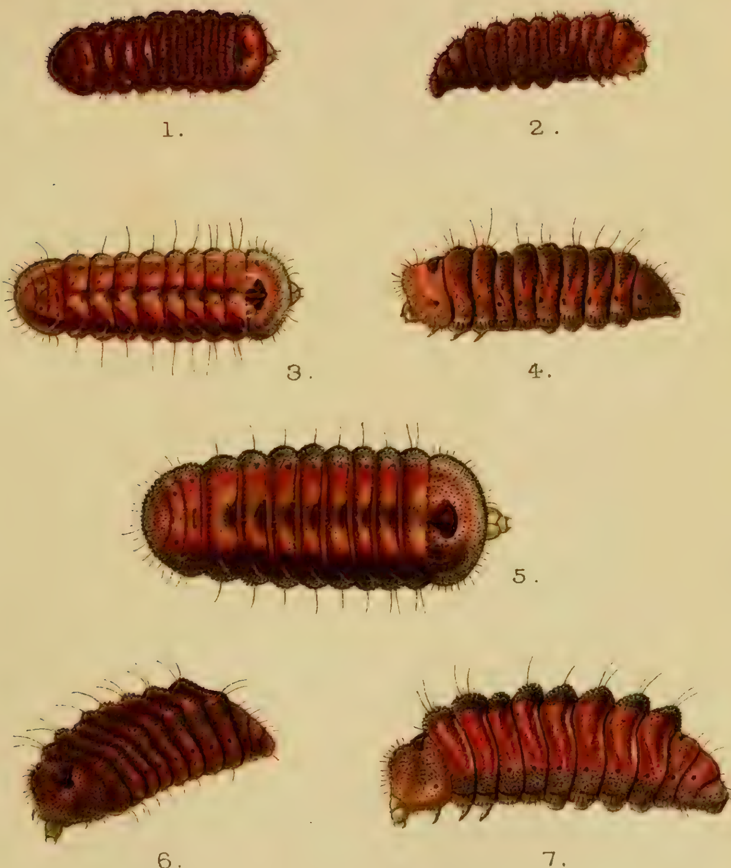
EGG-SHELLS OF *LYCAENA EUPHEMUS* HB.



E. C. Knight del. et chromo.

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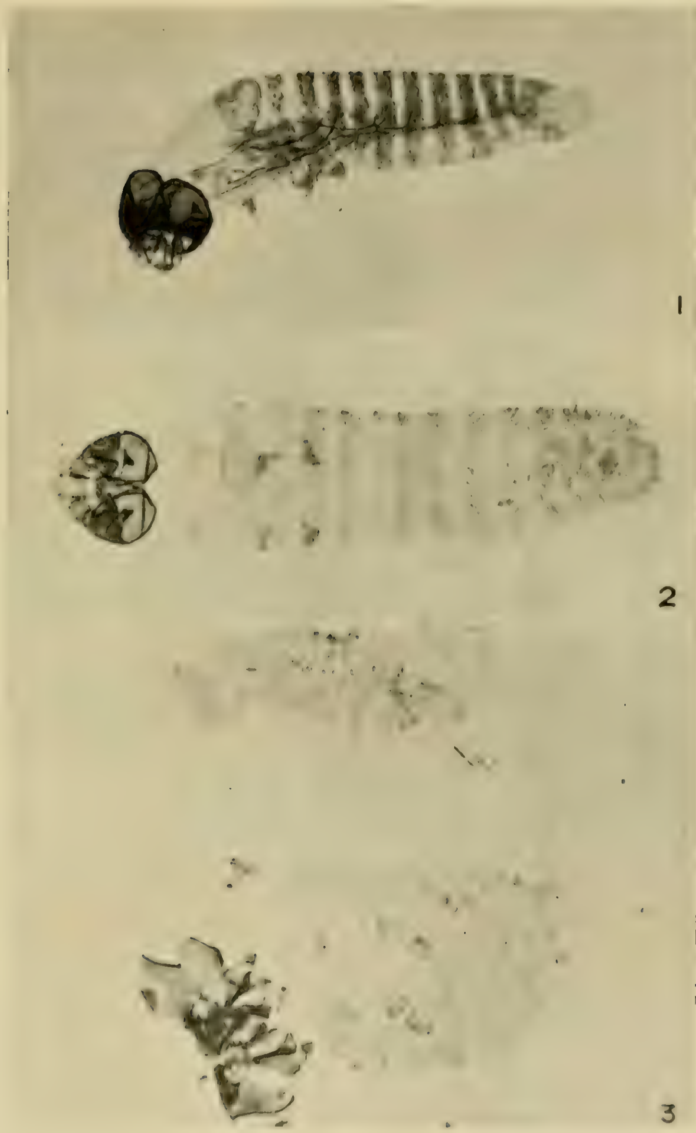
LARVAE OF *LYCAENA EUPHEMUS* HB.



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FIRST STAGE OF *LYCAENA EUPHEMUS* HB.

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SECOND STAGE OF *LYCAENA EUPHEMUS* HB.

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THIRD STAGE OF *LYCAENA EUPHEMUS* HB.

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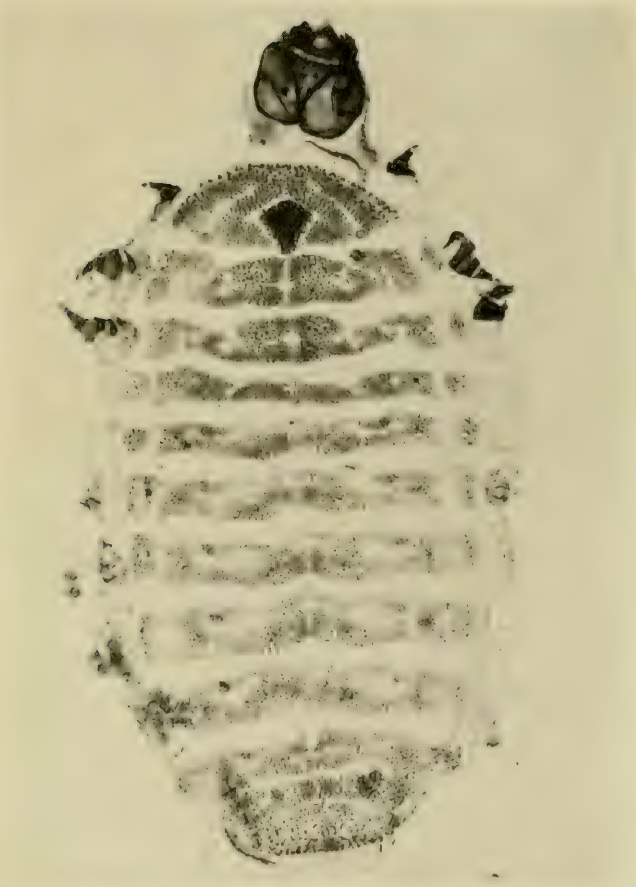
FOURTH STAGE OF *LYCAENA EUPHEMUS* HB.



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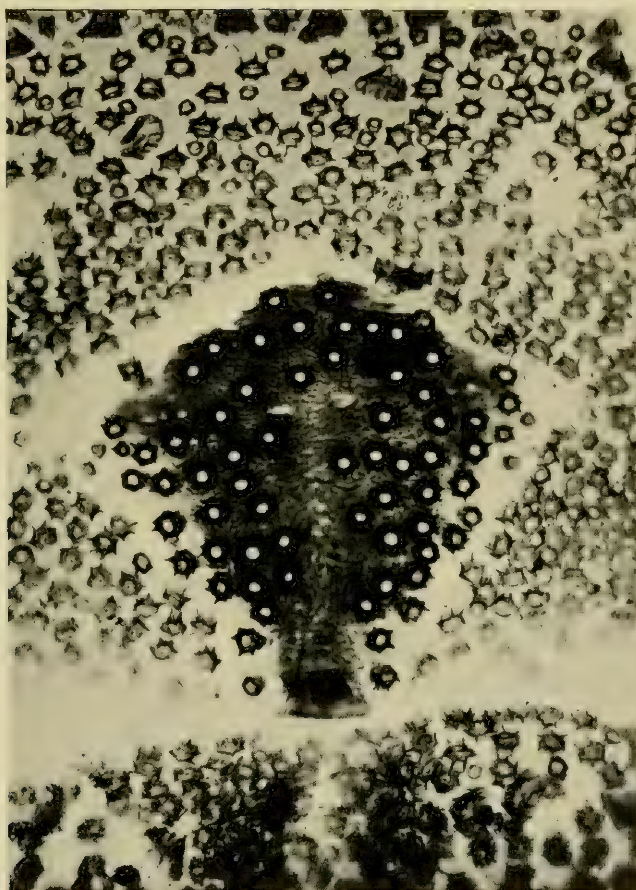
FOURTH STAGE OF *LYCAENA EUPHEMUS* HB.



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PROTHORACIC PLATE OF *LYCAENA EUPHEMUS* HB.

long hairs, the others being either quite absent or represented by stumps of various lengths, but generally very short. This seemed to prove that the hairs were not shed naturally by the larvae, but that they must be bitten off by the ants, equally by *M. laevinodis* as by *M. scabrinodis*.

Explanation of Plates XXIX—XXXVI.

Plate XXIX. Eggshells of *L. euphemus.* Fig. 1 × 32.

Fig. 2. × 52.

Plate XXX. Larvae of *L. euphemus.*

Figs. 1, 2. Third instar × 8.

Figs. 3, 4. Fourth instar, at entry to ants' nest, × 8.

Figs. 5, 6, 7. Fourth instar, after 14 days in nest, magnified about × 7.

Plate XXXI. Skin of first stage larva × 41.

Fig. 1. Lateral view of larva in which the tracheae remain conspicuous.

Fig. 2. Ventral view of skin, but transparent enough to show dorsal armature.

Fig. 3. A badly prepared skin; it shows, at least, the very large size of spiracles.

Plate XXXII. Skin of second stage larva × 36.

Plate XXXIII. Skin of third stage larva × 31.

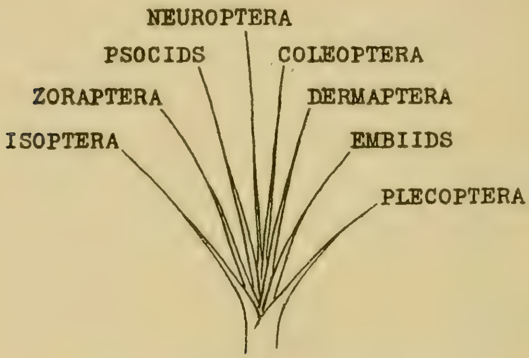
Plate XXXIV. Skin of fourth stage larva × 22.

Plate XXXV. Skin of fourth stage larva, another specimen × 23.

Plate XXXVI. Prothoracic plate of fourth stage larva × 170.

[*The following Addendum to Dr. Chester Crampton's paper, on page* 93, *has been received.*—Ed.]

Since sending the foregoing paper I have been able to make an anatomical study of the interesting Zorapteron, *Zorotypus hubbardi*, recently described by Mr. A. N. Caudell, and this has convinced me that the Zoraptera, which are anatomically intermediate between the Isoptera and the Plecoptera (with their strongest affinities on the side of the Isoptera), occupy a position at the base of the lines



of descent leading to the development of the Psocid type of insect. The Psocidae and Zoraptera are thus ultimately related to the Isoptera on the one side, and to the Embiid-Plecopteron "coterie" on the other, and their lines of descent originated in forms occupying a position intermediate between the two, as may be seen from the appended diagram, which represents a little more acurately than the foregoing one (p. 97), the relative positions of the lines of descent of the more primitive relatives of the Neuroptera and Psocidae.

The statement that *Plectrotarsus gravenhorsti* has a coiled proboscis (p. 113) is incorrect. I have just received a specimen from Dr. Tillyard and find that it is merely bent at an angle, not coiled, so I hasten to correct my previous statement.

[*The following Addendum to Mr. H. E. Andrewes' Note on Bonelli's "Tableau Synoptique,"* pp. 89–92, *has been received.*—Ed.]

As a result of the publication of this note, my friend Mr. G. de Lapouge, of the University of Poitiers, kindly sent me for examination an original separate of Bonelli's "Observations Entomologiques-Première partie," in which the "Tableau" (printed) is inserted between pp. 12 and 13. Mr. Sherborn has compared the MS. copy of the Natural History Museum Library with this, and corrected one or two copyist's errors. The chief one is the omission of the star against *Agonum* and *Anchomenus*, and these genera must therefore rank with those referred to in the note "Genus novum aut cujus caracteres elaborantur."

The reference to the genus *Diplochila* will not, I fear, have been understood, for the line containing the characters attributed to *Carabus impressus* F., and following the genus *Amara*, was inserted in MS. by Bonelli in his own copy and is not to be found in the copy now before me.

H. E. A.

January 15, 1920.

THE

PROCEEDINGS

OF THE

ENTOMOLOGICAL SOCIETY

OF

LONDON

1919.

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THE

PROCEEDINGS

OF THE

ENTOMOLOGICAL SOCIETY

OF

LONDON

FOR THE YEAR 1919.

Wednesday, February 5th, 1919.

Nomination of Vice-Presidents.

In the absence of the PRESIDENT through illness, the SECRETARY, at his request, announced that he had appointed Dr. C. J. GAHAN, Dr. G. A. K. MARSHALL, and the Rev. F. D. MORICE as Vice-Presidents for the ensuing session.

The Rev. F. D. MORICE, M.A., F.Z.S., then took the Chair.

Election of Fellows.

Dr. REGINALD HEBER PROWDE HICK, Eaglescliffe, co. Durham, and Messrs. J. H. JURRIAANSE, Schickade, 75, Rotterdam, and F. G. WHITTLE, 7, Marine Avenue, Southend-on-Sea, were elected Fellows of the Society.

Owing to a combination of snow and a strike on the Tube and District Railways, the attendance was small and there were no exhibits.

Paper.

The following paper was read :—

" The Synonymy and Types of certain Genera of Hymenoptera, especially of those discussed by the Rev. F. D. Morice and Mr. J. Hartley Durrant in connection with the long-forgotten "Erlangen List" of Panzer and Jurine, by J. Chester Bradley, M.Sc., Ph.D., Assistant Professor of Systematic Entomology in Cornell University, Ithaca, New York; communicated by Prof. Gordon Hewitt, F.E.S.

The Chairman explained that this paper was to some extent a criticism of the paper referred to in the title, accepting the List as valid, but taking exception to some of the principles on which the resulting conclusions were drawn.

Mr. Bethune-Baker pointed out that the points at issue were covered by the International Nomenclature Code, but Mr. Morice remarked that the interpretation of the code was not so clear as was generally supposed, and that certain American Entomologists did not understand it in the generally accepted way.

Discussion on Flight of Male Butterflies.

Dr. Longstaff asked whether Dr. Neave had ever seen butterflies flying as it were in patterns, one behind another, independently of sex, as he had himself seen male butterflies doing in Ceylon.

Dr. Neave replied that he had seen certain common African Papilios doing so. Col. Jermyn added that he had seen Pierids doing so in Assam.

Mr. Bethune-Baker suggested that they might have been following the scent of a virgin female, but it was pointed out that this was not likely as they went over the same ground in a somewhat complicated pattern, over and over again.

The Chairman instanced the dashing backwards and forwards of the males of an *Anthophora*, and of certain humble-bees, but in these cases the cause was a female, and they did not come in orderly succession.

Mr. Sheldon referred to the Processionary Caterpillars which were, however, guided by a thread, and Dr. Neave said that the leading instinct in certain African species, which were not guided by a thread, seemed to be individual rather than specific, as he had frequently broken the line experimentally, and found that the then leading caterpillar was at a loss how to proceed.

Wednesday, March 5th, 1919.

Comm. J. J. Walker, M.A., R.N., F.L.S., President, in the Chair.

Election of Fellows.

Mr. H. H. Corbett, 3 Thorne Road, Doncaster, and Major W. J. Patton, I.M.S., Stoke St. Gregory, nr. Taunton, were elected Fellows of the Society.

Death of a former President.

The President announced the death of Mr. F. Ducane Godman, D.C.L., F.R.S., formerly President of the Society, and read the following appreciation written by Lord Walsingham :—

The death of Frederick Du Cane Godman, D.C.L., F.R.S., has deprived the Entomological Society of the unique personality of one of its oldest and most distinguished Fellows, who was its President in 1891 and 1892.

It would not be too much to say that no single individual in the lifetime of the present generation has rendered greater service to the systematic study of Natural History, or contributed more generously to promote scientific work in the various branches of zoology, especially of ornithology and entomology, in which he himself took so great an interest. The preeminent labours of a Darwin or a Hooker are rendered possible only by the patient study of accumulated material, together with the recorded observations of intelligent collectors. No one recognised more clearly than Mr. Godman, from the days when he travelled widely in early life, that if a thorough knowledge of species and of the geographical distribution of species was ever to be obtained this could be accomplished only by patient and extensive collecting, and by bringing the results together to enable students to draw conclusions by the arrangement of specimens in systematic order. He desired at the same time to render all information widely available by means of scientific descriptions and illustration. It was evident to him that no exotic fauna had yet been completely studied as a whole, and he proceeded by example to convey the idea of how this should be done.

Such was the origin of the great work in which his dear and intimate friend Osbert Salvin, another distinguished and popular President of the Entomological Society, was so long associated with him.

The publication of the fifty-eight large quarto volumes of the "Biologia Centrali-Americana," for which Mr. Godman bore the whole expense, including the employment of the necessary staff of collectors, occupied some thirty-five years, and was completed in 1915. Botany and archaeology formed important parts of this great enterprise, the predominant features being zoology and entomology. Moreover, the type-specimens and series of many thousands of new species described and illustrated in its pages have been generously presented to the National Museum. His contributions in Lepidoptera alone amounted to 107,000—without counting sundry entire collections separately purchased. How important the aid thus given to any author competent to correlate the information derivable from this mass of valuable material, and to draw from it sound scientific conclusions, could have been best estimated by Darwin or Hooker themselves had they been still with us.

Great as must be our appreciation of the magnificent services rendered by our former President to the aims of the Entomological Society, it is not by any means on this account only that we shall miss his kindly presence among us. He was a very constant attendant at our meetings, and to those who knew him intimately his loss is the loss of a really valued friend. There was a peculiar charm of personality which pervaded his whole nature; a generous sympathy with all those whose tastes, pursuits, or studies were kindred to his own; a genuine desire to help, encourage and enlighten their efforts, and to contribute to the objects for which they were striving.

The serious and practical side of zoological study was ever kept in view, but without impairing the genial warmth of an earnest good-will accorded to the humblest workers in the field he was so keen to cultivate. As a Trustee of the British

Museum he knew personally what every one was doing or not doing in the Natural History departments, and was ever ready with useful suggestions and advice. Even up to some few days before his death, when unable to attend the meetings, he did not neglect to make his views known to his colleagues, who valued his opinions as those of one whose whole heart and soul was centred in the welfare of the great national institution he had long helped to administer and to enrich. His memory will be cherished and beloved alike by observers and students of nature in field and laboratory, and by his fellow-sportsmen in whose pursuits he was no mean companion. In short, it has been well said of him that " his many talents added to his fine nature made a combination which inspired a marvellously affectionate admiration."

A vote of condolence with Dame Alice Godman was unanimously passed, the Fellows present rising in their places.

Exhibitions.

ABERRATION OF BRENTHIS SELENE.—Mr. O. E. JANSON exhibited, on behalf of Mr. C. E. Stott, an aberration of *Brenthis selene*, taken near Denny Bog, New Forest, on June 28th, 1918, and having the black markings of the fore-wings blurred and extended, and the hind-wings entirely black with the exception of the marginal spots and a few scales in the central area.

MODEL AND MIMIC FROM THE MURMAN COAST.—Dr. E. A. COCKAYNE exhibited specimens of the bee *Bombus lapponicus*, and its mimic *Oedimagena tarandi*, a parasite of the Reindeer, from Yukanski on the Murman coast of Russian Lapland, near the entrance to the White Sea. One specimen of *Oe. tarandi* was taken on July 7th, and another on August 1st, 1918, at the same time and place as one of the bees, and two more at the same time and place as the other four bees. The latter are quite common, the fly much scarcer, only six having been seen.

PIERIS RAPAE, L., AB. NOVANGLIAE, SCDR., [Can. Ent. 4, p. 79 (1872)].—Mr. J. H. DURRANT exhibited a specimen of *P. rapae*, ab. *novangliae*, a very scarce American form with yellow coloration, described from the Eastern States and Canada, which at one time, it was supposed, would be the

American form of this common European species, but which was now quite rare in collections, and the British Museum was much indebted to Mr. Winn for presenting this fine specimen through Mr. Lachlan Gibb.

Occurrence of a Californian "Plume," Platyptilia (Amblyptilia) Pica, Wlsm. (var. an sp. ?), in Scotland.—Mr. Durrant also exhibited a Pterophorid which had been submitted to him by Prof. Poulton. This specimen was beaten from Juniper at Aviemore (Inverness), in September 1918, by Mr. P. C. Reid, when searching for larvae of *Eupithecia helveticata.* Among British species this could only be regarded as a variety of *Platyptilia* (*Amblyptilia*) *punctidactyla*, Hw. (= *cosmodactyla*, Hb.) with black markings on a white ground-colour—thus exactly similar to *Amblyptilus pica*, Wlsm. (California), and also a ♀, like the only two specimens in the British Museum (Wlsm. Coll.). The occurrence of a single specimen in Scotland, of a Californian species founded on three specimens, taken in 1872, and not since met with in America, would seem to indicate that *pica*, Wlsm., was an extreme variety of *punctidactyla*, Hw., rather than a distinct species, but this could not be determined with certainty until we were acquainted with the ♂. Mr. Durrant asked Lord Walsingham to examine the specimen and had received the following notes :—

"The Pterophorid, collected at Aviemore by Mr. Reid, is precisely similar to two specimens out of three (I gave one away) collected by me in the Redwood forests not far from Crescent City, in northern California, in June 1872. I named the species *Amblyptilus pica* [Pterophoridae of California and Oregon 21–3 Pf. 2·1 (1880)] from its black and white markings reminding me of a magpie. Crescent City is about 26° south of the Scotch locality, and, having regard to the improbability of a distinct Californian species occurring in Scotland, it has been suggested that this is a mere variety of *Platyptilia* (*Amblyptilia*) *punctidactyla*, Hw. (= *cosmodactyla*, Hb.). In a very long series of this, and of *acanthodactyla*, Hb., I can find no specimen with distinct black and white markings, indeed, a true black spot is not to be seen on any other American, or on any European specimen that I have examined.

The typical form of our English species did not occur where I took my three '*pica*,' for, although travelling at the time, I worked for an hour or more, without success, to take a better series of what I saw was a species unknown to me. The place was in a slight opening in a very thick and dark forest of Redwoods (*Sequoia sempervirens*), and if darkness with moisture has a tendency, as has been supposed, to produce melanic coloration, it is possible that further search in the Scotch locality may disclose intermediate varieties and connect *pica* with *punctidactyla*. So far as I know the four examples mentioned are the only known specimens of this species, which I cannot regard as a mere variety until a series including males can be examined. Fernald was unacquainted with it when studying the genitalia of the North American *Pterophoridae*."

NOTES ON NATAL BUTTERFLIES BY CECIL N. BARKER.—Prof. POULTON said that the following interesting notes had been copied from letters written to him by Mr. C. N. Barker of the Durban Museum :—

The sudden rapid increase in the numbers of the Nymphaline Hamanumida daedalus, F.

Aug. 3, 1918.—" In Proc. Ent. Soc., 1915, p. lxi, you commented upon the recent introduction of *Hypolimnas bolina*, L., into Madagascar and its extraordinarily rapid increase. Your remarks on the subject, recalled to my mind a somewhat similar occurrence; *i. e.* the suddenly rapid increase in *Hamanumida daedalus*, F., in our coastal areas. Up to about the year 1891 it was, with us, a decided rarity, much as *Acraea satis*, Ward, is to-day. It appeared to increase very rapidly about that year, and has since maintained itself as a decidedly common insect about roads and paths. It is not so plentiful in Durban and the coastal flats as upon hill-side roads and paths behind.

" Col. Bowker, as Trimen mentions in 'South African Butterflies,' p. 310, had only sent him *a single example*, dated February 1883. Previous to November 1890 (when I started on a wagon trip into Swaziland, returning at end of March 1891, and where I came across the species plentifully, between the Umkwempisi and Usutu Rivers and elsewhere) my notes of its capture are—1st capture, Dec. 22nd, '88; observed one, Augt., '89; capture, Dec. 19th, '89; capture, Mch. 30, '90; observed, Apl. 22, '90; capture, Nov. 22, '90. These notes show that it had already made some headway but was still a rarity. On my return from the Swaziland trip I at once noticed the increased frequency of its appearance, and soon after dropped noting its capture or occurrence.

" In Mr. Morant's time (1872) it was evidently a rare species about Pretoria, as he only records the capture of two examples, ♂ and ♀. It would be interesting to trace, if only we had some reliable data, its migration in a south-westerly direction; for its introduction to this part of the world, except as an occasional visitor, is certainly very recent. Its larva is almost identical with that of *Euphaedra*, a tropical group, only one of which, *neophron*, Hopff., has got so far south as Delagoa Bay."

The carpenteri, Poult., mimetic form of the Nymphaline Pseudacraea poggei, Dew.—The following note supplies additional data concerning the distribution of this interesting mimic (Proc. Ent. Soc., 1918, p. v.) of the *dorippus*, Klug, form of *Danaida chrysippus*, L. :—

Oct. 29, 1918.—" In a collection made by a German in the neighbourhood of Morogoro, late German East Africa, and presented to the Durban Museum by Col. Molyneux, there is a single example of this variety of *poggei*. It is the only *Pseudacraea* in the collection, which is a large one. There are a few *D. chrysippus*, type, but none of the *dorippus* form. I thought you would like to know of its occurrence in this locality. It is labelled ' Fima (12/13),' which I am told is the name of the place close to Morogoro, where this German naturalist was residing. The collection had been continued from 1910 to July 1916, and the localities all appear to be stations along the Central Railway line."

Possible origin of the pollen on the wings of P. lyaeus, Doubl., described in Proc. Ent. Soc., 1918, p. lxxxv :—

Aug. 20, 1918.—" As regards the pollen covering the *Papilio lyaeus* that I sent you, I am wondering whether it might be that of the Arum lily. The lilies are common about the flats below the Stella bush, where I caught the butterfly, and it is quite possible that he had got caught up by his haustellum.

The weather for some days before had been very wet, which would help to make the pollen adhere."

Notes on Papilio dardanus, Brown :—

Aug. 20, 1918.—" This month has already produced several inches (between 4 and 5) of cold rain, and the ordinary dry-season forms seem unaffected by it, either on their upper or undersides. For instance, I took *P. dardanus* of the usual *merope*, Cr., form and a second example as lightly marked as that of *antinorii*, Oberth., ♂. On the other hand, the excessive wet of our last summer (December, January, and February) did produce more heavily marked forms. *P. dardanus tibullus*, Kirby, were quite common. I will send you dated specimens later. I must say I had hoped to procure some *extreme forms of melanism* under the abnormal weather conditions, and so far I am disappointed." After referring to the two *leighi* ♀ forms of *dardanus* Mr. Barker continued : " *Hippocoon*, F., ♀ has remained throughout last summer and even till now as numerous or more so than *cenea*, Stoll, ♀. *Trophonius*, Westw., ♀ has also been unusually common."

Oct. 28, 1918.—" The only thing I can recall at present (I am writing this at home) of interest to tell you, is the capture on October 18th of a *Papilio dardanus* of the female form *leighi*, Poult., with rich orange ochreous markings on the upper and lighter on the lower wings. Last season I saw two of this form within a few weeks of one another, but failed to capture them. These are the only occasions I have come across the *leighi* female in life, and all three of them were observed by me within a radius of about a quarter of a mile. It seems like a case of a single family breeding true to this very rare coloration."

Mr. Barker had also figured two examples of the *leighi* form in " Annals Durban Museum," vol. ii, Pl. vii, figs. 13, 14 (1917). No. 13 bore the date May 3, 1900; No. 14 was bred by Mr. G. F. Leigh on Oct. 19, 1910. Both were in the Durban Museum. Prof. Poulton said that he could not believe that climatic influences provided the stimuli for the production of the heavily or lightly marked males of *dardanus*. Thus, the moist equatorial belt of Uganda, in which only the wet forms of certain *Precis* occurred all the year round, produced lightly marked males like those of the W. coast *dardanus*, whereas the same zone of British East Africa with marked wet and dry seasons, where both seasonal forms of the *Precis* occurred, produced the heavily marked males of the *tibullus* subspecies, although *hippocoon* females with larger white markings than those of the corresponding form in Uganda. In fact, if moisture or heat with moisture be the efficient cause, it produced opposite effects in the two sexes of *dardanus*—less black in the male, more black in the female.

FURTHER NOTES ON HESPERIDAE OF THE GENUS SARANGESA RESTING IN HOLES IN THE NUBA MOUNTAINS PROVINCE OF THE SUDAN.—Prof. POULTON read the following note, written Jan. 26, 1919, at Talodi, by Lt.-Col. R. S. Wilson, in continuation of his former observations recorded in Proc. Ent. Soc., 1917, p. lxvii :—

"Whilst at Talodi I had a couple of Fridays out, one at Tereida and one at Sallamat. The black skipper *Sarangesa laelius*, Mab., is about in enormous numbers both in hollow trees and in well mouths, native underground grain stores and any other similar places just now. With it is associated a species with yellow on the under surface—*S. eliminata*, Holl., or *pertusa*, Mab., which occurs in the proportion of about one to a hundred of the black ones. The skippers, in this proportion, were present in incredible numbers at Goghran, between Talodi and Torga, in the mouth of a well and inside some iron tanks—dry but intended for storing water." Among the specimens in the accompanying box was an example, exhibited to the meeting, of each of the above *Hesperidae*, bearing the label "10.I.19. Tereida. In hollow Gomeiza Tree."

THE POVERTY OF THE BUTTERFLY FAUNA OF MESOPOTAMIA.—Prof. POULTON said he had received the following note on the butterflies observed by Capt. P. A. Buxton, R.A.M.C. His letter was dated April 30, 1918, from the Central Laboratory, Amara.

"The spring in this country isn't much better than the autumn, and that's pretty bad. Total list of butterfly species so far: *P. rapae*, *C. edusa*, *P. daplidice*, ? *Teracolus* sp. (eats Caper), *Danaida chrysippus*, a common *Junonia*, 3 Blues, 1 Skipper. I really believe that's the lot."

THE ECCENTRIC MOVEMENTS OF THE HIND-WINGS IN CYANIRIS ARGIOLUS, L.—Prof. POULTON said that he had received the following note from Dr. R. C. L. Perkins :—

"*Park Hill House*,
"*Paignton*,
"*Aug.* 6, 1918.

"It became very bright and sunny at 12 (noon) to-day after heavy rain, and just outside my door at 1 p.m. I saw a ♀ Holly Blue (*C. argiolus*) settle in a sheltered place on a foreign myrtle. I watched it for ten minutes exactly. At first it made slight up and down movements of the hind-wings—hardly perceptible, but after two or three minutes it made, in the most pronounced manner, the characteristic movement of the hind-wings seen in tailed species. When the right-hand wing was elevated the left was depressed; they were not moved alternately. The movements only lasted for at most thirty seconds. Except that it opened and shut its wings—opened at most to about one-third—at various times no further movement was made till just ten minutes after I first observed it. It then again performed the up and down movements very vigorously. These movements were continued for fully a minute, but with two slight pauses of a few seconds. The raising of the hind-wing was sufficient to hide about one-third of the exposed surface of the front one, and therefore very conspicuous. The movement in tailed and untailed Lycaenids alike is interesting, and it would be worth while to get observations on many species. I have often observed the movements in *L. boetica*, L. (tailed), and many exotic *Lycaenidae* (Australian and others), but have no notes of details."

Prof. Poulton said that he too had observed on the same day (Aug. 6) the movements of a ♀ of the same species at rest in the garden of St. Helens Cottage, St. Helens, Isle of Wight. In this individual the vestigial character of the movements was suggested by their feebleness. They took place when the wings were partly open as well as when they were closed, and were renewed after long intervals of motionlessness.

Prof. Poulton said that he had received a note from Dr. Mortensen, commenting on the suggestions in Proc. Ent. Soc., 1918, p. xlvi :—

" I beg to recall that my observations on *Th. w-album*, Knoch., were exactly under the conditions described—short rests on flowers between flights in hot sun—and there were no movements. The Panama species *always* showed the eccentric movements during rests."

The use of the " Palisades " of Lygaeonematus compressicornis, F.—The Rev. F. D. Morice called attention to a paper by Mr. J. J. Ward, F.E.S., in the Christmas number of the Strand Magazine, which appeared to explain the object of the so-called " palisades " (erect columns of piled-up froth-bubbles) with which the young larva of the Sawfly *Lygaeonematus compressicornis*, F. (= *vallator*, v. Vollenh.) surrounds itself while feeding on a leaf of poplar. (*Cf.* Proc. Ent. Soc., Oct. 1917, and " Zoologist," xx, 1862, p. 7855—the latter being an English translation of Vollenhoven's " Mém. d' entom. soc. entom. Pays-Bas," 1, 1858.)

Mr. Ward found that ants placed on such leaves invariably ran about till they collided with one of the columns. The latter instantly collapsed, sticking to the ant's head, evidently causing it not only alarm, but extraordinary discomfort, as shown by the strange convulsions into which the insect immediately fell, and from which it did not recover for a considerable time. Afterwards the mere sight of even a fragment of such a column made it recoil in utter horror : so that it would seem that the palisades, in spite of their extreme fragility, are really *an efficient obstacle*, preventing certain kinds of enemies from approaching the feeding larva.

Papers.

The following papers were read :—

" Notes on the Ancestry of the Diptera, Hemiptera, and other Insects related to the Hymenoptera," by G. Chester Crampton, Ph.D., communicated by G. T. Bethune-Baker, F.L.S., F.E.S.

" Note on Bonelli's Tableau synoptique," by H. E. Andrewes, F.E.S.

" On a Migration of Yellow Butterflies (*Catopsilia statira*) in Trinidad," by C. B. Williams, M.A., F.E.S.

Wednesday, March 19th, 1919.

The Rev. F. D. Morice, M.A., F.Z.S., Vice-President, in the Chair.

Election of Fellows.

Lieut. L. A. Box, 80, Northampton Road, Croydon; Prof. J. Chester Bradley, M.Sc., Assistant Professor of Systematic Entomology, Cornell University, Ithaca, New York; Messrs. E. J. Burnett, M.A., 9, London Road, Forest Hill, S.E. 23; Bernard Douglas Cumming, Royal Exchange Assurance, Royal Exchange, E.C. 3; Capt. Tickner Edwardes, R.A.M.C., The Red Cottage, Burpham, Arundel, Sussex; Lt.-Col. William Henry Evans, D.S.O., R.E., c/o Messrs. Cox & Co., 16, Charing Cross, W.C. 2; Mme. Fournier, 90, Boulvarde Malesherbes, Paris; Messrs. H. C. Hayward, M.A., Repton, Derby; N. Marumo, Zoological Institute, Agricultural College, Imperial University, Komaba, Tokyo, Japan; Louis Nell, Imperial Bureau of Entomology, British Museum (Natural History), S. Kensington, S.W. 7; William George Fraser Nelson, 6, Craven Hill, W. 2; John Peel, Whittlesey, Cambs.; Capt. Leslie Rawdon Stansfield, R.G.A., c/o Army and Navy Club, Pall Mall, S.W. 1; Major Watkin Temple, East Mersea, Essex; and M. P. Wytsman, Quatre Bras, Tervueren, Brussels, were elected Fellows of the Society.

Letter from M. Charles Oberthür.

Mr. H. Rowland-Brown communicated the following extract from a letter addressed to him in reference to the death of the late Dr. Godman.

"Je vous demande de vouloir bien faire part à la Société entomologique de Londres, de mes sentiments de la plus cordiale et sincère condoléance, à l'occasion de la mort de M. Godman.

"Je vous serai reconnaissant de faire connaître à vos honorables collègues de la Société entomologique de Londres toute la respectueuse affection que je portais à M. Godman. Je conserverai de lui le souvenir le meilleur. Il était, comme vous le dîtes si exactement et si justement, 'the kindest and courtliest of men, encouraging, sympathetic, and generous.'"

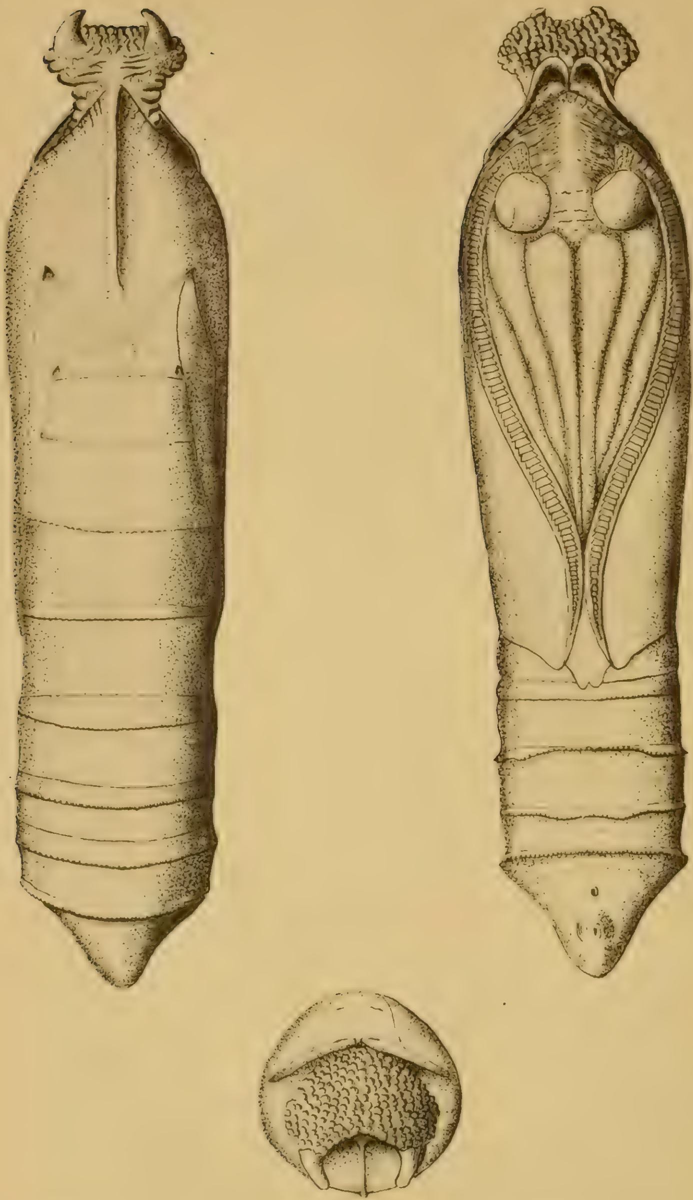
Occurrence of Areniphes sabella, Hmsn. (Galleriadae), in London.—Mr. J. H. Durrant exhibited a ♀ of *Areniphes sabella*, Hmsn., which he had bred (July 23rd, 1917) from a larva found feeding in dates (May 3rd), purchased in London. The larva was not carefully described, but it was noted as being an inch long, of a dull pinkish brownish colour with the spots darker, the head and pronotal plates being darker brownish. This species, which may prove to be of economic importance as attacking dates, was described by Sir G. F. Hampson [Rmf. Mém. Lp. 8. 501 sp. 63 Pf. 24·1 (1901) : Nov. Zool. 24·36 (1917)] from Persia, and is now known to occur also in Arabia and Algeria, while a ♀ was captured at Canterbury (*Joannis*), probably also bred from imported dates. When the larva was found it was thought to be that of *Myelois phoenicis*, Drnt. (*Phycitidae*), another date-feeding species which has also been bred in this country, and the emergence of the fine Galleriad was indeed a surprise—there may be still others awaiting us in imported dates.

Note on a remarkable Pupal Structure.—Dr. H. Eltringham exhibited specimens of the pupa and imago of *Cryptophaga rubescens*, and read the following notes :—

Some time ago my friend Prof. Poulton called my attention to a remarkable pupa, which had been shown to him by Mr. J. H. Durrant, F.E.S., specimens of which are now in the British Museum (Walsingham Collection), having been collected by Mr. F. P. Dodd, F.E.S. The species is *Cryptophaga rubescens*, McLeay, of the Tineid family *Xyloryctidae*.

The larva burrows in the stems of species of Acacia, and is found at Toowong in Queensland. The female moth resembles in size and colour one of the paler varieties of our common *Tryphaena pronuba*, but without the black hind-marginal band. The male is much smaller and usually has some dark purple-brown markings on the fore-wing.

When the larva is about to pupate it takes up a position close to the entrance of its burrow, and closes the opening with a plug of silky material. These habits appear to be common to other related species, but the pupa differs from them in having a special chitinous growth on its anterior end, of such a shape as to resemble very closely the head of a wasp.



H. Eltringham, del.

(Oxford University Press.)

PUPA OF CRYPTOPHAGA RUBESCENS, McL.

I have made drawings of the pupa which are reproduced on Plate A. It will be seen that there is at the anterior end a large more or less rounded mass of somewhat nodular structure, from which project two curved and bluntly pointed processes suggestive of mandibles. But perhaps the most curious development is that of a double ridge of chitin, the significance of which is only realised from a frontal view, when it is seen to give the appearance of two backwardly directed antennae. The extreme " waspishness " of the general effect is doubtless much enhanced when the structure is viewed in its natural position at the entrance to the burrow. It will be observed that the formation is so arranged that when the pupa is lying on its dorsal surface the wasp head is in the natural position, *i.e.* with the mandibles pointing downwards. It would be interesting to know if the pupa always lies in this position in the hole. Moreover, the roughened surface of the head gives a remarkable resemblance to compound eyes.

It may be remarked that since the burrow is plugged with silk the wasp-like mask cannot be seen in any case. This is true, but it would be of service to the pupa at the critical moment between forcing off the silk plug and the emergence of the moth. Also many pupae of this habit protrude slightly from the burrow for an appreciable period before the imago emerges, and this probably happens in the present case. It should be noted, however, that a certain wasp makes use of the deserted burrows of these and allied wood-boring larvae, whilst there is a tree cricket which preys upon the pupae, and thus the species is probably protected from the cricket by its resemblance to the wasp. The other allied species all have a roughened cap to the pupa, probably used in pushing out the silk plug, but none exhibits even an approximation to this wasp-like formation. It is one of those structures for which it seems impossible to account on any theory of mutation. It is hoped that further observations will be made, especially on the habits of the wasps which use these burrows, and the predaceous crickets. It should not be difficult to discover whether the pupae are in reality protected by their disguise.

I am grateful to my friend Mr. J. H. Durrant for assistance in making these notes.

REAPPEARANCE OF A SAWFLY IN BRITAIN. The Rev. F. D. MORICE exhibited 2 ♂♂ and a ♀ of *Tenthredella flavicornis*, F. (*Tenthredo flava*, auct., *nec* L.), taken with many other specimens of the same at Lichfield in 1917. The only other British specimens are those recorded by J. F. Stephens, said to be from Plymouth.

EXTERMINATION OF MOSQUITOES.—Mr. BACOT exhibited, on behalf of Mr. Main, a card setting forth the habits, description, and rules for mosquito extermination, with illustrations of Culicine and Anopheles mosquitoes and their larvae. The card in question was issued by the Health Department of the city of Stamford, Connecticut, U.S.A. He remarked that, although the specialist did not agree at all points with the writer, the information conveyed was both sound and clearly put; while this system of instructing the general public on the evils of mosquitoes and the methods of destroying them was simple and convenient.

EARWIGS IN FLIGHT.—With reference to a question recently asked at a meeting of the Zoological Society, the CHAIRMAN inquired whether any of the Fellows had ever actually seen the common earwig (*Forficula auricularia*) flying. Mr. DURRANT replied that he had seen and captured one flying round a lamp. Mr. E. E. GREEN said that though he had not seen them flying he had several times found them floating dead on water in tanks, with the wings spread fully out as in flight. They appear to fly only at night.

Wednesday, April 2nd, 1919.

Comm. J. J. WALKER, M.A., R.N., F.L.S., President, in the Chair.

Election of Fellows.

Dr. SEYMOUR HADWEN, D.Vet.Sci., Biological Central Experimental Farm, Ottawa, Canada; and Messrs. LLEWELLYN LLOYD, Chief Entomologist in N. Rhodesia, Cartref, Slingsby, nr. Malton, Yorks.; and AUSTIN AUGUSTUS TULLETT, The Hill Museum, Witley, Surrey, were elected Fellows of the Society.

Exhibitions.

VARIETY OF PANORPA COMMUNIS, L.—Mr. W. J. LUCAS exhibited three specimens, 1 ♂ and 2 ♀ ♀ of the var. *unifasciata*, Luc., of the common Scorpion Fly, from the Marlborough district, taken by Mr. E. A. C. Stowell, B.A., in 1917. A pair of the typical form were exhibited with them for comparison.

A SAWFLY NEW TO BRITAIN.—The Rev. F. D. MORICE exhibited specimens (3 ♂♂ and 2 ♀♀) of a sawfly hitherto recorded only from Germany and Holland, *Lygaeonematus wesmaeli*, Tischb. (= *solea* v. Vollenh.), and stated to be attached in both countries to the Larch (*Larix decidua*), but not to be generally common in either, so that it is scarcely reckoned as a serious pest by Continental foresters.

The larvae, however, from which these specimens were bred in the Pathological Laboratory at Kew Gardens by Mr. Fryer, F.E.S., of the Board of Agriculture, appeared last year on an estate in Yorkshire in such numbers as to do considerable damage to a fourteen-year-old plantation of Larches. They were supposed, at first, to belong to the better known species of the same genus, *L. laricis*, Hartig; but the imagines reared from them differ from those of *laricis* both in structure and colour, the underside of the whole body being entirely pale, whereas in *laricis* it is practically black throughout. (For this reason v. Vollenhoven called the species *solea*, fancifully comparing its style of coloration with that of the fish so named.) In this respect, and also in the form of the ♀ saw-sheath, *L. wesmaeli* more resembles certain of its congeners which feed on *Pinus* (e. g. *L. saxeseni*), but it differs from these in several points of structure, the saw being shorter and somewhat less abruptly truncate, and the abdomen much less compressed laterally towards its apex. Viewed from above the insect has so much the appearance of *laricis*, that it might easily be mistaken for it, and it is quite possible that collectors may find the two forms mixed under the latter name in their collections.

Mr. Fryer has kindly given a pair of his specimens to the exhibitor, and another to the Natural History Museum, in which the species was previously represented neither by British nor Continental specimens.

Wicken Fen.

The Treasurer announced that subscriptions were needed for the upkeep of Wicken Fen; observing that permits would be given preferentially to subscribers. He stated that two acres in the middle of the fen had been offered for sale at a very reasonable price, and had been acquired by the National Trust.

Date of Dr. Ris' Names in Odonata.

Dr. GAHAN said that M. Severin had written to him asking whether it would be possible to give to Dr. Ris' names in Odonata the date at which they were ready for publication, the actual publication having been made impossible by the war.

Several Fellows joined in the ensuing discussion, but it was universally held that such a course would be impossible.

A Judge on Entomology.

Mr. BETHUNE-BAKER called the attention of the Society to the disparaging remarks made in a recent case by Mr. Justice Darling with reference to Entomology, and asked whether it would be possible and wise to take official notice of the matter. It seemed, however, to be generally felt that it was not worth while, Dr. Longstaff remarking that even though the " learned Judge " had displayed a want of knowledge, the Society was not a finishing school for Judges.

Wednesday, May 7th, 1919.

Commander J. J. WALKER, M.A., R.N., F.L.S., President, in the Chair.

Exhibitions.

A GIGANTIC SCARAB.—Mr. O. E. JANSON exhibited a specimen of the extraordinary and gigantic ball-rolling beetle, of the family *Scarabaeidae,* described by Mr. G. J. Arrow in last month's number of the Ann. Mag. Nat. Hist., under the name of *Mnematium cancer.* The type specimen in the British Museum is a male, and that exhibited a female, in which the intermediate legs are of more normal size. Both specimens were contained in a collection made in various parts of South-West Africa, and the precise locality in which these were taken was not indicated.

COCCINELLA DISTINCTA, FALD., AND ITS ASSOCIATION WITH FORMICA RUFA, L.—Mr. DONISTHORPE exhibited this Coccinellid and contributed the following observations:—

Synonymy.—I do not propose to spend much time on this point, as my chief problem is its association with ants.

Faldermann described and figured the species in 1837, but with only five spots. Although this has to be the type form I believe it is exceedingly rare, and is only a case where an individual has lost a spot, and is really an aberration. I have only seen a single specimen with five spots, taken by Mr. Ashdown in Switzerland with a number of other examples all possessing seven spots. I have never seen a British specimen, but exhibit the nearest form to it I have taken, in which the 1st spot is very small. Redtenbacher in 1844 again described the species under the name of *magnifica*; also with only five spots.

Mulsant in 1846 described the usual form with seven spots under the name of *labilis.* I may mention that there is an aberration with nine spots (ab. *domiduca,* Weise, 1879) which occurs in Britain, and which I exhibit.

Distribution.—*C. distincta* appears to be widely distributed in Europe and occurs in the Caucasus.

British Distribution.—In Britain it has been found in Hants, Sussex, Kent, Surrey, Essex, Berks and Worcester. Edward Newman first recorded it as British in 1847; but Stephens stated that he had placed British specimens in the Museum Collection in 1816.

Association with Ants.—The first time in literature that this Lady-bird was mentioned as actually being connected with ants, was in 1888, when C. H. Morris recorded it from near Lewes, and stated it was attached to the nests of *Formica rufa.* It is, of course, most probable that the single example of *C. 7-punctata* recorded from Finland in 1843 as being taken with *F. rufa*, by Mannerheim, was really *C. distincta.*

In 1895 I recorded it with *Formica rufa*, and pointed out it was a myrmecophilous species.

As a matter of fact, it is only to be found in the immediate neighbourhood of ants' nests, and in this country with *Formica rufa.* My problem, which I have been working at for over twenty years now, is to try and account for its association with ants.

I have taken it, in every month in the year, on and about the nests of *F. rufa.* In 1900 I proved by experiment that this species was more protected against the attacks of its host than is the nearly related *C. 7-punctata*, and that the ants were far less aggressive to it than they were to the latter. This point I was able to demonstrate to Mr. Blair in the field last year, when he was with me at Weybridge.

I may here mention that Dr. Sharp has kindly dissected the ♂ genitalia of *C. distincta* and *C. 7-punctata* for me (which I exhibit), and he found they differ greatly; those of *C. distincta* being very highly specialised.

In 1900 I suggested that the larvae of the beetle fed upon the Aphidae and Coccidae dwelling with the ants. This point was seized on by Wasmann in a paper published in 1912 (the first and only real record of the Lady-bird with ants on the Continent). He writes: "The larvae of this *Coccinella* lives from analogy with the other Coccinellid larvae without doubt, as Donisthorpe already in 1900 has remarked on the Aphidae and Coccidae dwelling with ants." He then goes on to say that the ant species with which it occurs do not keep any Aphidae or Coccidae in their nests, and that this is a Darwinian paradox. In this he is not quite correct, as *F. rufa* does keep a few species of both in the nests; but not, of course, in anything like sufficient numbers to serve as food for the Lady-bird's larvae. However, on July 3rd, 1918, I found a large number of the larvae feeding on Aphids, attended by the ants, on fir-trees over *rufa* nests. I brought a number home, with fir-boughs covered with Aphids, and introduced them into my large *rufa* observation nest. They all pupated and hatched by July 20th; eight to nine days only being spent in the pupal state. I exhibit larvae and pupae and bred insects and the pupal skin.

Both the larva and pupa differ in various ways from those of *C. 7-punctata*, but we need not go into that here.

In 1908 I wrote: "My present view is that these beetles seek the nests of *Formica rufa* for hibernation, and leave in the spring or early summer." I endeavoured to settle this point this winter. I brought a number of the beetles home on August 27th and established them on the small fir-tree planted in my large *rufa* observation nest. Of course, my Aphids died off, but I found the beetles would feed with the ants on the honey supplied for the latter. I may mention that a number of them passed the whole winter on the fir-tree, and sides of the nest (I exhibit two of them taken off the small fir-tree to-day), but a number disappeared. On Feb. 29th this year I dug up the whole nest, all the ants being down below, but only found one Lady-bird right beneath the débris with the ants.

On Feb. 28th I had been down to Weybridge and dug up a *rufa* nest in nature there. The ants were right below the hillock in earth chambers some 2½ feet down, and I found one Lady-bird with them; dormant, but quite alive. There were others as usual on the fir-trees above the nests.

I fear this is not sufficient evidence to prove my point, and one must still ask why is *C. distincta* only found with *F. rufa*, when it could as easily find plenty of its food away from ants' nests?

Another point which may be a factor in the problem is the fact that *Coccinella distincta* is often found in company with *Clythra 4-punctata*, the latter beetle passing its earlier stages in the *rufa* nests. I stated as long ago as 1900 that I considered the *Clythra* to be a mimic of the *Coccinella* [Ent. Rec. xii, p. 174 (1900)]. This is a case of Müllerian mimicry as I suggested might be the case in 1901 [Trans. Ent. Soc. Lond., 1901, 367]. Experiments with *Clythra* at the Zoological Gardens proved it to be distasteful to various birds and insectivora [Trans. Ent. Soc. Lond., 1902, p. 17]. It might be that the *Coccinella* was a mimic of the *Clythra* in the first place, as the latter always lives in *rufa* nests in its early stages. *C. distincta* has larger spots than *C. 7-punctata*, and this may have been brought about by mimicry as the spots on the *Clythra* are still larger.

Prof. POULTON suggested that this was possibly the beginning of an association which might gradually develop.

The PRESIDENT observed that he had seen a number of Coccinellids emerging from ants' nests in Blean Woods at the end of April 1914, all immature.

Mr. CHAMPION suggested that the instinct of the Coccinellid to lay its eggs might be stimulated by the presence of the Aphids, and have no relation to the ants, with reference to which Prof. POULTON said that he understood from Mr. Donisthorpe that the Coccinellid larvae were not found indiscriminately on colonies of the *Aphis*, but only on those in the neighbourhood of the ants' nests.

FEMALE FORMS OF PAPILIO POLYTES, L., BRED AT HONG-KONG.—Prof. POULTON exhibited 4 females bred in 1914 by Mr. R. W. Barney of St. Stephen's College, Hong-Kong. Accompanying these was a *stichius*, Hübn., form of female (without white in the hind-wing cell), captured Aug. 1, 1914, and described by Mr. Barney as closely resembling the female parent. Of the 4 bred specimens one (bred Nov. 27) was a *stichius* form with a minute vestige of the white mark in the hind-wing cell, one (Nov. 23) a *polytes* form but with a very small white patch in the same position, two (Nov. 24 and 26), the ♂-like form *mandane*, Rothsch., corresponding to the *cyrus*, Hübn., ♀ f. of the more western subspecies, *polytes romulus*, Cram. The three first-named specimens afforded some slight evidence that the amount of white in the hind-wing cell was a hereditary feature, but further investigations on a large scale were greatly needed.

THE ETHIOPIAN HESPERID RHOPALOCAMPTA ANCHISES, GERST., ATTRACTED BY LIGHT.—Prof. POULTON exhibited a male and female of *R. anchises* captured by the President under the circumstances described in the following note from his diary of June 18, 1893 :—

"In the evening I caught two specimens of a fine large slaty-black Skipper, with broad white bar on the under-side of the hind-wings (? *Ismene* sp.), which were attracted to the light of the lamps in the saloon (of H.M.S. 'Tyne')."

The "Tyne" was lying about ⅓ of a mile off the shore at Aden, and the time was, Commander Walker believed, between 9 and 10 p.m. The Rev. K. St. Aubyn Rogers had called attention to the crepuscular habits of the genus in Proc. Ent. Soc., 1918, p. xxvii. The species is well known at Aden as well as from many parts of Africa. It is certainly usually on the wing by day, and an account of its resting habits at night, at Aden, was published by Col. J. W. Yerbury in the Bombay Natural History Society, vol. vii, 1892, p. 217. Col. Yerbury found it not uncommon in June and July 1883 on the Aden coast, but only once met with it inland. Three specimens taken by him at Aden on July 8, 1884, are in the collection of the British Museum.

OBSERVATIONS ON NEOTROPICAL INSECTS.—Prof. POULTON gave an account of the following observations by Mr. C. B. Williams, and exhibited the specimens referred to. The notes were contained in two letters written from Trinidad on Oct. 12, 1918, and Feb. 11, 1919. Prof. Poulton had been kindly helped in the determinations by his friends, Mr. G. J. Arrow, Major E. E. Austen, Mr. J. H. Durrant, Sir George Hampson, Dr. G. A. K. Marshall and Mr. N. D. Riley.

(1) "Two specimens of a Skipper butterfly which went through some curious migration-like movements on the border line of Panama and Costa Rica. On certain evenings they would fly past in thousands, from about 4.30 p.m. onwards, at full speed in a S.E. direction, only to return (but in much smaller numbers) later the same evening. I will give all the particulars in another paper I am preparing on Butterfly migrations. I find the species is quite common in Trinidad; in fact, it is one of our commonest Skippers. Yet no one has ever seen it migrating in the way I saw it in Panama. They are almost impossible to catch."

The Hesperid butterfly was *Calpodes ethlius*, Cram.—two labelled Panama, Guabito, Bocas del Toro, Apr. 3, 1917, three Guabito, May 24, 1917. All were females. [This fact and the observations on the habits of *Hesperidae* recorded by C. O. Farquharson, J. C. Kershaw, Dr. S. A. Neave and others (Proc. Ent. Soc. 1917, p. lxxvii and references there quoted) seem to offer strong support to Mr. G. C. Champion's suggestion (p. xxviii) that the flight of *Calpodes ethlius* was in search of water.]

(2) " I enclose two dark slightly metallic Microlepidoptera (marked ' gyrans ' on the label), which, with their relatives, are not uncommon in this part of the world. Their remarkable characteristic is the inability to move any distance in a straight line (by walking). If a specimen wishes to get from a point A to B, usually on the upperside of a leaf of some low plant, the track is as follows [a drawing was here given], including a large number of complete turns as if waltzing. At first I thought that the turns were always in the same direction, but I found that this was not so, and that the same individual turned indiscriminately to right or to left. I feel sure that the group must be well known, but they are new to me. I have dubbed them—for want of a better name—*Inebriatidae*, which really sounds quite scientific ! "

The two species belonged to the *Strobisia* group of *Gelechiadae* (*Tineina*): (1) *Holophysis* sp. nr. *stagmatophora*, Wlsm., from Rio Claro, Trinidad, Apr. 27, 1916, (2) *Systasiota* sp. nr. *leucura*, Wlsm., from Issororo, British Guiana, June 1916. Mr. J. H. Durrant, who had kindly examined the specimens, has drawn my attention to B. Clemens' description of the habits of the species of *Strobisia*, in Stainton's " Tineina of North America," 1872, pp. 117, 118 :—

" The perfect insects are most commonly found in shaded places, on the surfaces of leaves. They are active and restless in their motions, and *turn in circles* on their resting-places, especially after short flights; withal they are disposed to be quarrelsome and drive away from the leaves on which they may happen to be enjoying themselves, other ' little people ' of the shaded wood."

(3) " A remarkable moth that I found in St. Vincent with two protrusible tails. These tails are apparently hollow and can be straightened out (? by pressure from within), when

they are almost as long as the body of the moth, or curled up as you see them in the dead specimen. I have never seen anything similar before or since."

Harrisina coracina, Clem., ♂ (*Zygaeninae*), from St. Vincent, Dec. 11, 1917. The structures described are male secondary sexual characters, and are doubtless of epigamic significance. Their eversion is almost certain to be effected as Mr. Williams suggests, and introversion by an axial muscle attached to the inside of each apex. Observations on their use in courtship would be extremely interesting.

(4) " When in Panama last year, I got 20 or so small Lepidoptera from the fur of a Three Toed Sloth just shot. As soon as the body fell to the ground they started flying from it like Hippoboscids from a large bird. I think quite as many again escaped, so that there must have been 40 or 50 on the one animal. I made a very close search over the skin the same day, but could find no trace whatever of caterpillars, nor did the fur seem in any way damaged. I was assured by a local hunter that every sloth that he has shot has these moths upon it.

" I see there is a mention of a moth living on a sloth in the 'Cambridge Natural History,' but without reference or identification. In the hopes that they may be of interest I am sending specimens by this mail and should be glad of their name or any information about them."

The moths were 8 ♂ and 3 ♀ of *Cryptoses cholaepi*, Dyar (*Pyralidae, Semnianae*), from Chiriquicito, Panama, March 12, 1917. Mr. Williams obtained altogether 13 ♂ and 5 ♀. The females are larger, with rounder wings and duller markings, but otherwise similar in appearance to the males. The larvae are believed to feed on the symbiotic alga to which the sloth owes its greenish colour. The sloth-haunting moth mentioned in the "Cambridge Natural History," Insecta, II, p. 430, is spoken of as a *Tinea*, but the only three species known to have these habits are Pyrales, belonging to the *Semnianae* (*Chrysauginae*). Sir George Hampson has kindly given the names and references:

" *Bradypodicola hahneli*, Spüler, Biol. Centralbl., xxvi, pp. 690–7 (1906). **Amazons.**

"*Cryptoses cholaepi*, Dyar, Proc. Ent. Soc. Wash., ix, p. 148 (1908). **Costa Rica; Panama; Colombia.**

"*Bradypophila garbei*, Ihering. Rev. Mus. Paulista, ix, p. 124, Pl. III, f. 4 (1913). **S. Brazil.**

(5) "Two beetles, with, in life, the most disgusting odour. At the time I was smelling everything I caught, and these nearly made me sick."

Canthon triangularis, Drury (*Copridae*), ♂ ♀, from Yarikita Portage, N.W.D., British Guiana, July 28, 1916. It would be interesting to determine whether the smell is due to a special secretion, to the dung frequented by the beetle, or to the dung acted on in the body so as to become more powerfully offensive.

The three remaining observations refer to the mimicry of Aculeate Hymenoptera by insects belonging respectively to the Lepidoptera, Diptera, and Hemiptera.

(6) "A wasp-like moth from Panama that has even managed to fold its wings longitudinally in its efforts to deceive."

Tinthia sp. ♀, nr. *tabogana*, Druce (*Aegeriadae*), Sàn San, Bocas del Toro, Panama, Mch. 22, 1917.

(7) "A large dipteron which very closely resembles a bee, even to the thickened hind tibiae which it replaces with hairs—for the moment I was quite deceived—but the antennae give it away. It hasn't managed to imitate these ——yet!"

A female of *Mallophora craverii*, Bellardi (*Asilinae*), from Surelka, Costa Rica, Apr. 6, 1917. It was especially interesting that these *Asilinae* mimicking hairy bees should incidentally have come to resemble mimetic Asilids of a different sub-family, the *Laphrinae*.

(8) "A Reduviid which closely resembles one of the fossorial wasp types. I am sorry I can give you no notes on it alive. It would be interesting to know if it has developed the habit of shaking its wings at intervals, or wagging its antennae, that one sees in the model."

Spiniger spinidorsis, Gray, ♀, Talamanca, Costa Rica, at light, Apr. 21, 1917. The apical section of the antenna, rather over $\frac{1}{3}$ of its length, is dark, of hair-like fineness and would be invisible at a little distance. The short basal joint, also dark, is followed by the most conspicuous element. This, made up of a long single joint, is yellow and thus resembles the antenna of many of the large Fossors, although the likeness is here brought about by colour alone, and not, as in the Locustid described in Proc. Ent. Soc., 1913, p. lii, by a change of form. The most striking feature of the resemblance is provided by the reddish orange brown colour of the wings which, seen in sharp contrast against the black body, are wonderfully like those of several well-known Neotropical Fossors. There could be no doubt that the movements in life were consistent with the mimetic resemblance; for Thomas Belt wrote of a Nicaraguan species which is evidently *spinidorsis* (*luteicornis* is non-existent in the genus, but *lutescens*, Walk., is a synonym of *spinidorsis*): "I one day observed what appeared to be a hornet, with brown semi-transparent wings and yellow antennae. It ran along the ground vibrating its wings and antennae exactly like a hornet, and I caught it in my net, believing it to be one. On examining it, however, I found it to belong to a widely different order. It was one of the Hemiptera, *Spiniger luteicornis* (Walk.), and had every part coloured like the hornet (*Priocnemis*) that it resembled. In its vibrating, coloured wing-cases it departed greatly from the normal character of the Hemiptera, and assumed that of the hornets." See "Naturalist in Nicaragua," 2nd Ed., Lond., p. 319, also the illustrative woodcut.

Dr. Seitz had observed the mimetic movements in the Brazilian species *Spiniger ater*, Lep. and Serv. (Proc. Ent. Soc., 1913, p. li), and had also published a description of similar movements in probably the same species of Reduviid from the Corcovado, which "exactly resembles one of the dark stinging-wasps of the genus *Pepsis*, and the bug makes the same sort of movements as the wasp does, though these are of a kind quite different from those of ordinary bugs." (Ent. Zeit. Stettin, li, 1890, p. 281, quoted by Dr. David Sharp in "The Cambridge Natural History," Insecta, II, p. 558.)

Mr. Durrant observed that several moths have been recorded as being found on sloths.

Referring to the crepuscular "Skippers" Dr. NEAVE remarked that in Africa the flight was not a long one, but took place before settling down.

Mr. GREEN said that in Ceylon allied "Skippers" were day-fliers, but took shelter in culverts from which they could be disturbed.

Referring to the migration-like flight of *Calpodes ethlius* Mr. G. C. CHAMPION said that the dates given by Mr. Williams fell into the dry season, and that his experience in Central America led him to believe that the insects were seeking water in damp spots in some nearly dry river bed.

Papers.

The following papers were read :—

"On the Types of Oriental *Carabidae* in the British Museum, and in the Hope Collection in the University Museum at Oxford," by H. E. ANDREWES, F.E.S.

"The British Species of Genera *Andrena* and *Nomada*," by R. C. L. Perkins, M.A., D.Sc., F.Z.S., F.E.S.

Wednesday, June 4th, 1919.

Comm. J. J. WALKER, M.A., R.N., F.L.S., President, in the Chair.

Death of a Fellow.

The sudden death of Mr. W. E. SHARP, a former member of the Council was announced.

Election of Fellows.

Messrs. CHRISTOPHER HOWARD ANDREWES, 1, North Grove, Highgate, N. 6, and J. WINTERSCALE, Sungei Klah Estate, Sungkai, Perak, were elected Fellows of the Society.

Exhibitions.

A BRED SPECIMEN OF LOBESIA PERMIXTANA.—Mr. SHELDON exhibited a specimen of *L. permixtana*, Hb., bred from the egg, nd reared on oak, its supposed usual food-plant.

Pupation of Chattendenia w-album.—The Rev. G. Wheeler exhibited, on behalf of Mr. Prideaux, some larvae (full grown, and after the colour-change) and pupae of this species, which were found in the open on twigs of Wych-Elm, near Brasted, on June 1. The larvae seem fond of choosing the deserted domicile of some other leaf-spinning larva, such as *Cheimatobia brumata* or a *Tortrix*.

Spider and Butterfly Prey.—Mr. Wheeler also exhibited for Mr. Prideaux a specimen of *Hesperia alveolus*, seen on May 28 near Brasted, on a spike of bugle, with wings outspread, and which refused to move on being approached. It was found to be dead, though still limp, with a spider (also exhibited) with its fangs embedded in the back of the thorax. The spider allowed itself to be boxed, without relinquishing its hold on its victim, and retained this position for several hours. Subsequently a live specimen of *Cabera pusaria* was offered to the spider, which it treated in the same way as the Skipper. A specimen of *Hadena dentina*, however, was differently approached, the fangs being inserted beneath the thorax, between the 2nd and 3rd pair of legs.

Ova of Coccinella distincta.—Mr. Donisthorpe exhibited eggs of *Coccinella distincta*, found at Weybridge on May 30, on oak, fir, and birch over *rufa* nests; the empty egg-cases of eggs laid on 21. v. 19, which hatched on 25th; young larva hatched on 25th, 1st moult on May 30; also a live ♀ *C. distincta*, which was observed at Weybridge laying eggs on an oak-leaf, together with the eggs in question.

The life-history appears to be briefly as follows :—Copulation takes place in May (I observed it on May 14 and 21 this year; the ♂ sits far back on the ♀, and his front tarsi rest on the large black central spots on the elytra of the ♀). The eggs are laid in May; a few were laid in captivity on May 17, but were subsequently eaten by the Lady-Birds themselves. One bunch of some twenty eggs was found on the underside of a pine-needle on May 21, at Weybridge, but as no more could be found it was probably early. On May 30, however, bunches of eggs were found on pine-needles, oak, and birch over *rufa* nests, and a ♀ was observed laying eggs on the underside of an oak-leaf. When she had finished she walked quickly away.

The eggs are long and of a bright yellow colour, and are laid in rows like a lot of little barrels placed close together. When the young larvae hatch in about five days they feed on the Aphidae on the trees. Judging from my experience last year they become full fed by the beginning of July, pupate on the trees and remain in the pupal state for eight and nine days. The perfect insect then remains on the trees and near the *rufa* nests for the rest of the year, hibernating on the trees and sparingly in the nests.

Many Fellows, including Dr. MARSHALL, Prof. POULTON and Messrs. CHAMPION, CORBETT, ROWLAND-BROWN, BLAIR and CRAWLEY, discussed Mr. Donisthorpe's observations.

PUPARIA UNIDENTIFIED.— Mr. E. E. GREEN exhibited some puparia found on decayed wood, at the margin of a lake near Shrewsbury, in the month of September. The puparia are of the shape of a limpet-shell, open below, with a sub-acute apex; of a dense structure and pitchy black colour; the outer surface rugose. The material of which they are composed is probably excrementitious. The pupa of the insect occupies the concavity of this cover and is exposed below.

Mr. Green asked whether any Fellows present were acquainted with these puparia, which he thought might be those of a Coleopteron. Mr. COLLIN suggested that they might be those of a mycetophilous Dipteron, Mr. Green then remarking that he had seen somewhat similar Mycetophiled cases in Ceylon.

EVIDENCE OF MENDELIAN HEREDITY IN PAPILIO DARDANUS, BROWN.—Prof. POULTON said that he had received, on May 27, a letter from Mr. C. F. M. Swynnerton, giving an account of some interesting breeding experiments on *P. dardanus*:—

"*Chirinda, S.E. Rhodesia,*
"*April* 13, 1919.

"I have a little news for you at last, not about *ethalion* this time but about *dardanus*. Mr. E. E. Platt sent me last year 2 families of *cenea* pupae. The first got here *just* in time, the second just too late (emerged and dead). Each had a slight *hippocoon* taint, shown by 2 or 3 of the ♀♀ in each being *hippocoon*. There were no *dardanus* obtainable here then, though I searched myself and put on my good native collector and offered a big reward. So I got 3 pairings of the *cenea inter se* and a few pupae from each, to try again later (= Families 1, 2 and 3). These started emerging on Jan. 24, and between some of the ♀♀ and local ♂♂, now present, I secured pairings. The evidence already suggested strongly that in Fam. 1 a pure *cenea* strain had been secured. Fam. 3 showed the *hippocoon* element again. It was from 5 ♀♀ of these two families that I secured further eggs, now pupae and emerging. The emergences so far are most interesting, and if those yet to come don't upset things, they seem already to amount to a proof of Mendelian inheritance.

" Here is a summary of the whole experiment so far.

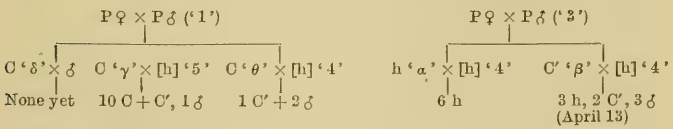
" P = *cenea* ♀♀ and ♂♂ ex Platt's pupae.

" C = subsequent complete *cenea* ♀♀ (defined below).

" C′= ,, incomplete ,, ,, ,, ,,

" h = *hippocoon* ♀♀, [h] = captured ♂♂ (presumably *hippocoon*)

" The figures are brought up to April 19.



So that from—

complete *cenea* × *hippocoon* I have in F. 1 *cenea* only (incomplete and other).

cenea-mothered *hippocoon* × *hippocoon* I have in F. 1 *hippocoon* only.

cenea out of a mixed family × *hippocoon* I have in F. 1 *hippocoon* and *cenea*.

" So far as I have gone (and it was the same in my 1915 experiments which got no farther than F. 1) I am able, I think, to recognise complete *cenea* by the presence of dark shading at the base of the h.-w. under-surface; incomplete *cenea* by the absence, complete or nearly, of this shading and by the presence, usually, of pale scales (whitish or yellow) below the main f.-w. spot—corresponding, that is, to the extension in *hippocoon* of the big h.-w. patch into the f.-w. The underside difference is the constant one, or nearly so. The upperside approach to *hippocoon* in my first experiments (1915) varied much from family to family being *great* in at least one of them (and involving the whole f.-w. pattern); while, in one, some individuals were actually *hippocoon*. There may of course have been a little *hippocoon* in the mother's ancestry, though it didn't show in the emergences of her generation. It will be interesting to see if the segregation will be complete in F. 2--into *hippocoon*, complete *cenea* and incomplete *cenea*. I shall attempt F. 2, but do not expect success because I am due to go on another tsetse expedition (this time for the Rhodesian Govt.) as soon as a bad foot is better, and because of another journey which cannot be avoided. My plan (already begun) is to pair the 'γ' females with their own and 'θ' males and to pair these same ♂♂ a second time with the 'α' (*hippocoon*) ♀♀, to ascertain the ♂♂'s composition. But, as I have just said, the chances of being able to carry the experiment through are, unfortunately, almost *nil*.

"Pairing now offers little difficulty. I have made it compulsory! The genitalia are brought into correct juxtaposition, very slight pressure is exercised on the sides of the two abdomens with finger and thumb of each hand and, as soon as the ♂ is seen (by abdominal movements) to take on, he is allowed to hang, and both are placed in a box, better dark. Some ♂♂ refuse. The pairings of which I am now seeing the results were obtained in this way. The only infertile pairings were some obtained with *cenea* ♂♂ that I had had to keep some weeks to await the emergence of a *hippocoon* family. It was doubtless a matter of senile decay, hastened by captivity! Even cripples are usable by this method: ♀ δ (*v.* above) from which I obtained the continuation of my pure *cenea* strain (a few eggs only, it is true) was a bad cripple. *Some* cripples, of course, couldn't lay.

"*April* 19.—I have added to the table emergences to date, all corroborative.

"My first *cenea* paired and put out to lay was killed by driver ants, which also destroyed all the larvae of a lot of local *hippocoon* families I had in hand (for your inheritance of small variations work). I have three more (all γ) paired, two with θ ♂♂, one with own, and a *hippocoon* × γ ♂ is laying. Now that a wet spell is over I'll try and make a start before leaving home, but unluckily my foot is better and I can't postpone long!

"It is unlucky for further breeding that the ♂ emergences have been so few. Only one γ or θ ♂ until the day before yesterday."

Prof. Poulton said it was very interesting that Mr. Swynnerton had now confirmed—although larger numbers were very desirable—the conclusions set forth in Proc. Ent. Soc., 1914, p. lxviii. The predominant form in Natal and the south coast of Cape Colony, *cenea*, was thus shown to be a dominant relatively to *hippocoon*, while the predominant form everywhere else in Africa was the recessive *hippocoon* itself. The facts brought forward in 1914 also seemed to prove that *hippocoon* was recessive to *trophonius*, *planemoides*, a *leighi*-like ♀ at Chirinda, and *dionysus*, inasmuch as all these had given a mixture, often approximately half and half, of their own form with *hippocoon*, the male parent having presumably carried the tendencies of the latter. The Mendelian relationship of these forms to each other and to *cenea* is still uncertain.

African Papilios of the nireus, Cram., group attacked by birds.—Prof. Poulton said that he had received from Mr. C. N. Barker of the Durban Museum the following observation contained in a letter, written to him from the Durban Zoological Gardens on April 9, 1919, by Mr. Harold Millar:—

"You will be interested to learn that recently by my office here a sparrowhawk caught, on wing, one of the large blue-banded Papilios and ate it. Have never suspected they would feed on butterflies."

The butterfly must have been, as Mr. Barker states, *Papilio lyaeus*, Dbl. It was a curious coincidence, in view of Mr. Barker's comment—"Such occasional incidents are very interesting, but do not influence my contention that the persecution is not sufficient to justify the results claimed for it"—that the first record of an attack on this *Papilio* to reach this country should have been at once followed by another observation, which was, in fact, made a little earlier. Capt. W. A. Lamborn wrote as follows from Dar-es-Salaam on March 26, 1919:—

"I saw a most interesting incident only this evening. Two tiny birds, no larger than the little Cordon Bleu [*Estrilda phoenicotis*, Swains.] or Rouge, were vieing with each other in pursuit of what at a distance I took to be a large black Noctuid now common in the house. The two birds got it down and pecked it vigorously, but it escaped, only to be attacked by another similar little bird near by. Then all three attacked it, and so I flung a stick at them, and they flew off. To my astonishment the insect turned out to be a *Pap. nireus*, Cram., or one of the closely allied species, with both fore-wings, the right especially, badly torn behind, but its energies were little impaired. I could not catch it, and by and by it flew into a lime tree and finally escaped."

Observations on the larva and pupa of Uropteryx sambucaria, L.—Prof. Poulton exhibited a pale yellowish-grey pupa of *sambucaria* in its open network cocoon spun among strips and small pieces of white paper. It had been already shown that the colours were adjusted so as to harmonise with those of the normal surroundings—dark or pale ("Colours of Animals," London 1890, pp. 111, 112; Trans. Ent. Soc., 1910, pp. 143, 144). Although this power was present in many butterflies, *sambucaria* was the only moth pupa in which it had been observed. The chrysalis also resembled that of certain butterflies, e. g. *Pyrameis atalanta*, L., in the rapid lashing movements of the abdominal segments which took place on disturbance and were probably a defence against enemies.

The larva, found upon pear in the summer of 1918, was over $2\frac{3}{4}$ in. long when mature. Living by itself in a large sleeve out of doors in almost normal conditions, this single larva offered the opportunity of studying certain instincts with a precision unattainable when many caterpillars are kept together and disturb one another. I especially wished to determine the time at which the rigid, wonderfully twig-like, diurnal attitude was abandoned and feeding begun. The hours are summer time.

May 18, 1919, 6.40 p.m.—Gently feeding on the leaf with which its head was in contact in the day position. 10.45 p.m., had moved to a different part of the stem, the head now towards the base of the twig instead of towards the tip—the invariable position when observed by day.

May 19.—Morning: resting on another twig. There is certainly no tendency to "home" like that observed in limpets. 9.10 p.m., day position; 10.45, crawling about.

May 20.—Day position maintained at 9.10 p.m. (third observation); 9.43, eating without moving.

May 21.—Day position at 9.20 p.m. (third observation); 9.55, eating vigorously in new position and with back curved.

May 23.—Day position at 9.30 p.m. (third observation); 9.45, moving about freely.

May 24.—Taken to museum to be photographed. The disturbance caused the larva to alter its attitude, and when the twig was fixed upright in front of the camera, it was standing out at right angles to its support. Although in this position it appeared to be rigid, close inspection showed that it was not really so : the strain was too great, and the caterpillar was continually making rapid movements of small amplitude, but sufficient to prevent the taking of a photograph. When its head was gently raised and supported in a notch cut in the edge of a leaf the larva had no difficulty in maintaining sufficient rigidity, although minute movements, perhaps caused by the contraction of the dorsal vessel, are indicated in the negative.

Cessation of feeding, already imminent, was perhaps determined at this date by the disturbance. When the sleeve was again fixed on the pear tree the larva went to the living twig and assumed the rigid day position, still maintained at 9.17 p.m. and at 9.30, although at this time a thick line of silk was first observed joining the head to a leaf. By 10 p.m. the line appeared to be longer, but 15 minutes later the larva was walking about.

May 25.—The threads observed on the previous day were probably abortive attempts at spinning, for on this evening the caterpillar had fixed a small loose leaf to stem, suspending it by a silken cable. The caterpillar, close beside it, also hung vertically from its hind claspers and was clearly shorter and stouter.

May 26.—In same position. About noon taken down and found to be about $2\frac{1}{8}$ in. long in the extended position. The larva was then dropped into the white surroundings and wriggled violently for a second or two directly it fell among the paper strips. It then became perfectly still, holding with its true legs to one strip, the middle of the body lying across another with the hinder half hanging free. In this uncomfortable position it remained for probably an hour, but by 1.20 p.m. it had ventured to raise the hinder part sufficiently to seize another strip with the claspers. There can be no doubt that the behaviour witnessed was instinctive and such as to protect the caterpillar when attacked, first by burying it more deeply in the undergrowth after it had fallen, secondly by promoting its concealment in the depths it had reached. By 3.37 it had climbed to the position in which it very deliberately constructed its cocoon, the labour being postponed and also, I think, interrupted by long pauses during which the larva hung vertically from its hind claspers. Pupation took place on May 31. It is during this long prepupational period—seven days in the larva under observation—that the colour of the pupa is doubtless determined, and it is possible that the long pauses in a vertical position are specially related to the incidence of environmental stimuli.

As regards the earlier phase it was evident that the larva maintained its day position until about 9.30 p.m., when the light was becoming dim. It is unfortunate, however, that the hour could not be observed on May 18, when the larva began feeding, although without change of position, as early as 6.40 p.m.

THE MIMICRY OF AN ANT BY AN AUSTRALIAN FOSSORIAL WASP.—Prof. POULTON said that he wished to call the attention of the Fellows to an interesting example of mimicry described in Mr. R. E. Turner's systematic paper in Ann. Mag. N. H., Ser. 8, vol. xv, Jan. 1915, p. 64. The mimic was *Aphelotoma tasmanica*, Westw. (*Ampulicinae*), found in S.E. Australia and as far north as Brisbane, as well as in Tasmania. Mr. Turner's observations were as follows :—

"Taken running on dead *Eucalyptus*-logs in which old beetle-holes were numerous. Although of considerably smaller size, this wasp bears a considerable resemblance to ants of the genus *Myrmecia*, especially *M. esuriens*, Fabr., and another species with red legs, *Myrmecia pilosula*, Sm. When alarmed the wasp often picks up a fragment of dead stick or leaf, which it carries in its mandibles, thus increasing the resemblance to the ant. *Aphelotoma auriventris*, Turn., a species with a wide range in the southern half of Australia, also bears a considerable likeness to *Myrmecia mandibularis*, Sm., though the difference in size is very great; I have never seen this species or any of the Queensland species of *Aphelotoma* [except *A. tasmanica*] carrying anything in their mandibles. The Tasmanian species is considerably larger than any other of the genus."

It was of much interest that the species of *Aphelotoma* which was nearest in size to the model should have developed this additional mimetic feature. The extreme abundance of ants in Australia rendered them especially feasible as models.

THE CLOSE MIMETIC RESEMBLANCE BETWEEN TWO LARGE CHINESE SAWFLIES.—Prof. POULTON said that Mr. R. E. Turner had kindly drawn his attention to the remarkable likeness between *Athermantus imperialis*, Sm. (*Arginae*) and *Abia vitalisi*, Turn. (*Cimbicinae*). Specimens in the British Museum were from N. China and N. Indo-China respectively. The two species were of the same size, and both had yellow wings and an iridescent violet-black body. In spite of their wide systematic difference they would, at first sight, pass for the same species. The mimicry was probably Müllerian, for there was evidence—although as yet insufficient—that the sawflies were a protected group. Certain British species were mimicked by Diptera which frequented the same flower-heads, and the larvae of *Croesus* had been shown to be distasteful to lizards.

GLOSSINA PALPALIS, R.D., FROM CAPT. CARPENTER'S SHELTERS ON ISLANDS IN THE VICTORIA NYANZA.—Prof. POULTON exhibited the specimens described in the following extracts from letters by Capt. G. D. H. Carpenter. None of the puparia had produced flies since they had been received.

Capt. Carpenter's method was founded on the fact that the fly always seeks shelter for depositing its larvae, which were killed by the sun. Hence the idea of making artificial shelters from which the puparia could be collected at intervals. Prof. Poulton thought that if the destruction of the puparia were the end in view this could be achieved more certainly and simply by moving the shelters from time to time, and exposing everything beneath to the rays of the tropical sun. The shelters could be made with two handles on each side and of such a weight that each could be easily moved by two men. Later on, if the method proved a success, automatically-moved shelters with a clockwork release could be employed. In bringing forward these interesting and, it was to be hoped, fruitful, experiments, Prof. Poulton wished also to draw attention to the important researches in the same field of inquiry by Mr. W. A. Lamborn (Bull. Ent. Res., May 1916, vii., p. 38).

"*March* 31, 1919. *Entebbe.*

"I'm sending you per registered post, the batch of pupae collected from my island shelters. I wrote about a week ago to say the number was going up satisfactorily every week, and this last week showed a further increase, so that I got an average of 48 per shelter on Bulago and 64 on Kimmi, a total of about 700 pupae from the two islands, most of which I now send. Since they were deposited between March 19 and 26 they are still young, so that I think many will be still unhatched by the time they reach you. When you open the box you will find a horrid mass of squashed emerged flies, undeveloped, but if you put the pupae that remain in warm, damp atmosphere, on dry sand (*e.g.* a tray in a fern case), they should develop all right, and may be of interest to entomologists at Oxford.

"Perhaps it would be an interesting exhibit at the Entomological Society, and Fellows who like the experience, by placing their bare arms against the gauze side of the cage can have the privilege of being bitten by *G. palpalis* without any risk whatever! If you like to feed them regularly (they will bite a fowl if the feathers are cropped and it is held against the cage) there is no reason why they shouldn't breed in the fern case—you can easily arrange a sloping piece of bark over a tray of dry sand."

"*March* 23, 1919. *Entebbe.*

"My experimental trial of my new method of destroying *Glossina palpalis* so far promises well. I knew from my previous work that the maximum effect was reached about 2 *months* after the erection of the shelters. They have been going three weeks now. The totals obtained for the three weeks from Bulago Island (7 collecting places) are 48, 157, 260; and from Kimmi Island (6 collecting places) 104, 200, 313. So the number is going up by leaps and bounds and it looks as if I should get a couple of hundred weekly from each shelter, which is what I expect if the method is to succeed. The interesting thing is that on each island I have left untouched one ideal *natural* collecting spot (a tree trunk)—and my shelters are just as attractive judging by the comparative numbers obtained. So I'm feeling quite cock-a-hoop!! The fact that the maximum effect is not reached for some weeks seems to show that the ♀ fly hunts very carefully all over the island until she is satisfied which is the best place!!"

NOTE ON THE LOCUSTID ANT-MIMIC MYRMECOPHANA, SP. ? FALLAX, BR.—Prof. POULTON said that he had received the following note from Mr. C. N. Barker who had written from Durban on March 7, 1919. The Locustid referred to was probably *fallax*, Br., and was certainly the species spoken of by Dr. G. A. K. Marshall in Trans. Ent. Soc., 1902, pp. 535–6. The insect, with its very long antennae, was shown in the accompanying Plate XIX, fig. 59, together with Camponotine ants of three species (figs. 53–56) and an ant-mimicking bug (figs. 57, 58), all captured, Feb. 17, 1901, on a small bushy vetch at Salisbury, Mashonaland. Dr. Marshall stated that the Locustid, "in spite of its long antennae, bears a very strong resemblance to an ant" (p. 535). The fineness of the antennae was such that they were probably invisible at a short distance. Mr. Barker wrote :—

"I came across lately whilst staying at Winkle Spruit some of those curious little Locustids (*Mrymecophana* sp.) (a North African species is figured by Dr. Sharp in "Insecta," Part I, p. 223), which mimic ants. The illusion is wonderful in the freshly caught specimens, but the whitey-green under part of the abdomen unfortunately shrivels and discolours a great deal soon after death. Our species has far longer antennae than those shown in Sharp's figures. Remarkable as the deception is, the long waving antennae detract from it, and I cannot conceive any protective value for it. A year or two ago I saw an Asilid fly pounce upon what I took to be an ant. I caught both and put them in the cyanide bottle together, and it was only after I examined them at home that I found the victim was a spider instead of an ant."

Butterflies from the Malayan Islands.—Mr. G. Talbot, on behalf of Mr. J. J. Joicey, exhibited the following species :—

Papilio androcles, Bdv., a new race from the Sulla Islands. It differs chiefly by increase of black and reduction of the white markings. This species was only known heretofore from Celebes.

Papilio gigon mangolinus, Fruhst. The race from the Sulla Islands, which differs chiefly from the type form in the same way as does the *androcles* race. There is, however, a reduction in the extent of the patches of modified scales on the fore-wing. The type is common in Celebes, and the only other known form inhabits Talaut and Sangir.

Delias, sp. nov., from Buru. A single ♀ specimen of a distinct species related to *isse*, Cram., which is already represented on Buru by the race *echo*, Wall.

Hypolimnas misippus, Cram. The female from Tenimber, together with *Danaida plexippus larantensis*, and *Limnas chrysippus petilea*, Stoll., f. *cratippus*, Feld. There are several specimens of the *Hypolimnas* ♀ in the Tenimber Collection as well as a series of males. The *D. laratensis* appears to be the commonest white-banded Danaine in the island. The *chrysippus* form was not common, and is never so in the eastern islands, where it becomes darker with a reduced white band.

Papers.

The following papers were then read :—

" Notes on the exotic *Proctotrupidae* in the British and

Oxford University Museums, with Descriptions of new Genera and Species," by ALAN P. DODD.

"The Scent-scale of *Pinacopteryx liliana*, Grose-Smith," by F. A. DIXEY, M.A., M.D., F.R.S., etc.

Dr. DIXEY exhibited a large-sized model of the scent-scale in illustration of his paper, of which the following is an abstract:—

The outline of the lamina of this scale is like that of a chemist's thin glass flask. At the junction of the neck with the body of the flask there is an oval or circular area, which under a low power of the microscope appears dark by transmitted light, and contains a highly refracting, roughly circular patch in the middle. This appearance is seen in sections of the scale, made by Dr. Eltringham, to be due to the presence of a definite body, fusiform in both longitudinal and transverse section, staining readily with "light-green" (Grübler) or safranin, and in contact with the upper layer of the scale. In the region of this body, which Dr. Eltringham suggests may be a mass of dried secretion, the two layers of the scale separate, leaving a clear space between the body itself and the lower layer. The footstalk of the scale makes a sharp bend between the base of the lamina and the accessory disc. It appears to arise from the latter on the surface adjacent to the wing-membrane. Nearly opposite to its point of insertion, and on the other side of the disc, there is a beaded chitinous ring surrounding an oval or circular aperture. The sockets belonging to the scent-scales are easily distinguished from those of the ordinary scales by their large size and peculiar shape. Their outer lip ends in a row of minute spines. The disc articulates with the socket by the middle portion of its proximal margin, the greater part of the disc being outside the socket.

Further light would no doubt be thrown on these structures by the examination of material properly prepared in the fresh condition. It is hoped that before long this may be obtained.

The life-history of Mosquitoes.

Mr. A. W. BACOT, at the request of the Council, exhibited with the Epidiascope a number of slides illustrating the life-history of *Culex* and *Anopheles*, including every stage of insects of both genera, and various kinds of breeding places which they affect, especially in Africa, drawing special attention to comparative illustrations of the resting positions of both genera, and the difference in the appearance of the proboscis.

Androconia in a Bee.

The Rev. F. D. Morice, in exhibiting photographs with the Epidiascope, said that in May 1918 he had shown three photographs (afterwards reproduced in Plate XI of the Society's Transactions for that year) of some aggregations of scale-like hairs, which he had thought might probably be "androconia," occurring *in ♂♂ only* of certain Australian sawflies belonging to the genus *Perga*, on the undersides either of all the wings (*P. castanea*), or of the front pair only (*P. polita* and others).

He had since, acting on a suggestion made to him in a letter from Prof. Cockerell, compared with these structures something apparently similar which appears, in the fore-wings only, of an exotic genus of Bees, viz. *Thrincostoma*, Sauss., first described from Madagascar, but represented also in the Collections of the British Museum of Natural History by several species from S. Africa and the Oriental Region (Borneo, etc.). As with *Perga*, the structure occurs only in ♂♂. It differs from those to be found in the above Sawflies, in occupying a slightly different and smaller part of the wing (being confined to the *cubital* area), and situate on its *upper*, and not, as in *Perga*, on its *under* side. It is, however, large and dense enough to be seen with the naked eye; and when magnified appears as an oval patch of long hairs, irregularly matted together into a sort of oval "mask" lying across the middle of the second cubital nerve, which seems to be distorted at this point, viz. bent twice abruptly (almost at right angles) above and below the centre of the mask. Some of the hairs appear to be simple, differing only in length from the general microscopic pilosity of the wing-surface. But others are evidently much modified, flattened and dilated (more on one side than the other) from their middles towards their sharply pointed apices (i.e. *asymmetrically lanceolate*), while their basal halves appear simply cylindrical and slender throughout, except for a slight bulb-like swelling where they emerge from the membrane of the wing. They are arranged something like sticks heaped loosely together in a roughly built bird's nest, their apices, however, all seem to point inwards, *i. e.* towards the centre of the patch.

The exhibitor showed photographs of this structure at various magnifications (from × 10 to—approximately— × 350), as it appears in a wing of *T. torridum*, Smith, captured by Dr. Neave in South Africa, which Mr. A. Cant of the Natural History Museum has mounted (entire) in balsam, by permission of the keeper of the Entomological Collections of the Museum, Dr. C. J. Gahan.

Mr. Bethune-Baker in commenting on this exhibit, expressed his opinion that the scales were androconial, and remarked that in many Lepidoptera the androconia were very firmly fixed, and that when they came off they frequently left the basal disc within the socket.

Dr. Dixey also expressed his strong opinion that these scales were true androconia.

Wednesday, October 1st, 1919.

The Rev. George Wheeler, M.A., F.Z.S., Secretary, in the Chair.

Election of Fellows.

Mr. Cyril F. Carpenter, Sunrise, 140, Verdant-lane, Hither Green, S.E. 6; Miss L. Evelyn Cheesman, Entomological Dept., Zoological Society, Regent's Park, N.W. 8; Prof. E. Chester Crampton, Massachusetts Agricultural College, Amherst, Mass., U.S.A.; and Mr. Albert H. Elston, Delemont, Childers Street, N. Adelaide, Australia, were elected Fellows of the Society.

In consequence of the railway strike the attendance was very small; there were no exhibits, and it was decided to postpone the reading of the paper, illustrated by the Epidiascope, which was to have taken place that evening.

Wednesday, October 15th, 1919.

Comm. J. J. WALKER, M.A., R.N., F.L.S., President, in the Chair.

Election of Fellows.

Messrs. JAGAMATH LAXMAN KHARE, Lecturer in Entomology, Nagpur Agricultural College, Nagpur, India; CHARLES MELLOWS, M.A., The College, Bishop's Stortford; ARTHUR W. JOBBINS POMEROY, Govt. Entomologist in Nigeria, Ibadan, S. Nigeria, and Kneesworth House, 78 Elm Park Road, S. Kensington; Capt. JOHN G. ST. AUBYN, c/o Sir Charles McGrigor & Co., 39 Paulton Street, Haymarket, S.W. 1; and Lt.-Col. R. S. WILSON, Governor of Western Desert Province, Mersa Matruh, Egypt, were elected Fellows of the Society.

Exhibitions.

ALLONONYMA DIANA, HB.—A GENUS AND SPECIES NEW TO THE BRITISH LIST (LEP.-TIN.).—Mr. DURRANT exhibited two specimens of this species taken at Fasnakyle (Inverness), Aug. 12–31, 1919, by Mr. C. W. Mackworth Praed, who had kindly presented the specimens to the British Museum. Mr. Praed had found *diana* not uncommon, but had only pinned a few specimens. This insect is the *Simaethis diana* (2316 of Staudinger and Rebel's Catalogue), and occurs in Germany, the Alps, Italy, Russia, Sweden, Lapland, etc., and also in North America. Among British species *diana* most nearly resembles *pariana*, Cl., but is at once separable by its green colour and by having veins 7 and 8 of the fore-wings stalked (instead of separate), for which reason it was separated by Fernald from *Simaethis* as *Orchemia*, Gu. The adoption of Guenée's generic name for this species being erroneous, Burck (1904) proposed the new name *Allononyma* in lieu of * *Orchemai* (nec Gu.), Fern.

The life-history of *Allononyma diana* is apparently not

1.

2.

Photo A. E. Tonge. Half-Tone Eng. Co., Ltd.

MALE GENITALIA X 15.

1. DIANTHOECIA LUTIAGO 2. DIANTHOECIA BARRETTII

known, but a very closely allied species (or form), *luridana*, Wkr. (=*betuliperda*, Dyar), occasions considerable injury to Birch trees in America, where it has also been bred from Alder. It will doubtless be found that *diana* is also attached to Birch in this country. This is a most interesting addition to our fauna, as it is obviously not an introduced species.

EGGS OF ENNOMOS AUTUMNARIA.—Mr. E. E. GREEN exhibited a cluster of eggs of *Ennomos autumnaria*, and drew attention to their superficial resemblance to the eggs of certain Hemiptera. Each egg is of a long-oval form, sharply truncate at the upper extremity, where there is a raised whitish ring contrasting sharply with the dark brown colour of the remaining area.

Mr. Green also showed an enlarged drawing of one of the eggs.

DIANTHOECIA LUTEAGO AND DIANTHOECIA BARRETTII.—Mr. EDELSTEN exhibited specimens of *D. luteago*, and *D. barrettii*, and contributed the following notes:—

There has been a considerable discussion in the past as to whether *D. barrettii* was the same species as *D. luteago*, and having bred *D. barrettii* in considerable numbers in 1910, I determined to go further into the matter. I wrote to Staudinger and got specimens from him of *D. luteago* and its form *D. argillacea* from various localities. I sent them all to Mr. Pierce, and when he had examined their genitalia he reported that one of the *D. argillacea* which came from Digne in the Basses Alpes differed from the others. I at once wrote for more specimens from this locality, but had to wait until the next season, when Staudinger sent me several more specimens. Mr. Pierce examined all these, and the result is as follows:—

The genitalia of *D. luteago* and its form *argillacea* (from all localities except Digne) differ from the genitalia of *D. barrettii*. The genitalia of *D. barrettii* and those of *argillacea* from Digne are similar. The chief difference in the genitalia is in the spine on the aedeagus. In *luteago* it is an elongate spike (angle of 12°), and in *barrettii* a short broad rose-thorn-shaped spike (angle of 45°). (See Plate B.) Our British insect can now be raised to a species and considered distinct from *luteago*. The

Digne insect must also be looked upon as a local race of *barrettii*. My friend, the late Rev. F. E. Lowe of Guernsey, sent me a specimen of the insect described by Tutt as *D. luteago* var. *lowei* (Ent. Record, 1898, vol. x, p. 150), but this proves on examination to be the same as *D. barrettii*. It is rather more ochreous than *D. barrettii* from England and Ireland, and more like the insect from Digne. Pierce substitutes the following description of the genitalia for that appearing in " The Genitalia of the Noctuidae " (p. 64).

Barrettii.

Valva (harpe) roughly battledore, spinose, harpe (clasper) reduced to a fold. Sacculus produced (divided) at the apex where it forms a lobe. Uncus broad and tapered. Aedeagus set with a short broad spine (angle of 45°), (in *luteago* an elongate spine, angle of 12°). Cornuti, 2 sets: patch of short teeth, and a small bunch of fine spines.

Anellus lobes (Juxta) scobinate.

My best thanks are due to Mr. Pierce for the trouble he has taken in making the preparations.

The preparations on the slides are as follows :—

No. 1 slide.

Sent as	Really	Locality	Spine
1. *Luteago*	*luteago*	Tunis	elongate
2. *Barrettii*	*barrettii*	Ireland	broad
3. *Luteago* sub. sp. *argillacea*	*barrettii*	Digne	broad
4. *Luteago*	*luteago*	Saratow	elongate
5. *Luteago* sub. sp. *argillacea*	*luteago*	Uralsk	elongate
6. Ditto	*luteago*	Amasia	elongate
7. *Luteago*	*luteago*	Batna	elongate
8. *Luteago*	*luteago*	Hungary	elongate
9. *Barrettii*	*barrettii*	Cornwall	broad

No. 2 slide.

Sent as	Really	Locality	Spine
1. *Luteago* sub. sp. *argillacea*	*barrettii*	Digne	broad
2. Ditto	*barrettii*	Digne	broad
3. Ditto	*barrettii*	Digne	broad
4. Ditto	*barrettii*	Digne	broad
5. *Barrettii*	*barrettii*	S. Devon	broad

References to both *D. luteago* and *D. barrettii* will be found in "The British Noctuae and their Varieties" (Tutt), vol. i, pp. 134–6; vol. iii, pp. 24–6; vol. iv, p. 110.

I would also like to call attention to the food-plant of the larva of *D. barrettii*. The principal food-plant is rock spurrey, *Spergularia rupestris*, and not *Silene maritima*. The rock spurrey grows in the crevices of the rocks amongst the *Silene*; it makes a very large tap-root, and in this the larva feeds. My brother first discovered it, and quite by accident. We were searching amongst *Silene* to see if we could find the larvae, when he noticed a withered plant of spurrey, which broke off when he touched it. He noticed that a larva had been feeding just under the crown, and called my attention to it. We dug out the root and the larva was in it. Nearly every plant of spurrey was infected in this locality. The larva does sometimes feed on *Silene*, but prefers the spurrey; where the latter occurs it can be taken in some numbers. It leaves the plant when full fed and pupates just under the surface on the rocky ledges. Rock spurrey being a very local plant no doubt accounts for the scarcity of the insect in many apparently suitable localities. Spurrey likes to grow right on the cliff face if it can, and in some places is quite inaccessible except by being let over the cliff by a rope.

Coccinella distincta.—Mr. Donisthorpe exhibited specimens of *Coccinella distincta* bred from the eggs (which together with the living eggs and the female parent of one of the specimens, he had exhibited at the last meeting) and their pupal skins, and read some notes on them. Also an abnormal specimen of the Lady-bird with a sharp spine on the left shoulder, with black head and thorax, and quite black beneath; the antennae being very short, but of normal joints.

He stated that the larvae had been bred with great difficulty, as they died if kept too damp or too dry, and also devoured each other. In the end each larva had to be kept by itself in a glass-topped box with damp cotton-wool and supplied with plenty of Aphidae.

The time-table of the two bred specimens exhibited was as follows :—

A. Eggs found on pine-needle at Weybridge, 21.v.19.	B. Eggs laid by ♀ on oak leaf at Weybridge, 30.v.19.
Hatched, 25.v.19	Hatched, 6.vi.19
1st moult, 30 and 31.v.19	1st moult, 10.vi.19
2nd ,, 4.vi.19	2nd ,, 15.vi.19
3rd ,, 12.vi.19	3rd ,, 18.vi.19
4th ,, 15.vi.19	4th ,, 21.vi.19
Larva pupating, 22.vi.19	Larva pupating, 23.vi.19
Pupa, 25.vi.19	Pupa, 28.vi.19
Imago, 9.vii.19	Imago, 11.vii.19

An Egyptian Trypetid Fly, and three Diptera new to the British List.—Mr. F. W. Edwards made the following exhibits :—

1. *Urellia augur*, Frauenfeld. An Egyptian Trypetid fly with wing-markings curiously resembling a small fly or flea. The resemblance is most probably purely accidental, but is at the same time quite striking. The specimen was brought to the British Museum by Mr. R. H. Greaves, who pointed out the peculiar marking. Major E. E. Austen, D.S.O., who has also taken the fly, did not observe any particular resemblance to another fly in life.

2. Three interesting new British Diptera :—

(a) *Orthopodomyia albionensis*, MacGregor. A mosquito recently discovered breeding in the water in hollow beech-trees in Epping Forest. The other species of the genus are mostly Tropical American; one occurs in the Oriental region.

(b) *Ochlerotatus curriei*, Coquillett. A North American mosquito found by Dr. H. Scott on Wareham Heath, Dorset. The British specimens differ very slightly from the American ones in colour, hence are almost certainly native with us.

(c) *Crypteria limnophiloides*, Bergroth. A remarkable Tipulid described from Finland in 1913; found in August 1919, by Capt. J. Waterston, at Bonawe, Argyllshire.

LARVAE OF SAWFLIES.—The Rev. F. D. MORICE exhibited with the Epidiascope some life-size photographs of the larvae of various *Perga* spp. clustering together on *Eucalyptus* leaves, which had been kindly sent to him by Mr. Hacker of the Brisbane Museum in Queensland. He also called attention to a recent remarkable discovery published by Messrs. H. E. Burke and S. A. Rohwer in Proc. Ent. Soc., Washington, vol. xix (1917), viz. that the previously unknown larva of *Oryssus* differs both in structure and habits from those of either the *Siricidae* or the *Tenthredinidae*, and is parasitic on certain wood-boring Coleopterous larvae (*Buprestidae* and probably also *Cerambycidae*).

Papers.

The following papers were read :—

"The Male Abdominal Segments and Aedeagus of *Habrocerus capillaricornis*," by F. MUIR.

"On the Mechanism of the Male Genital Tube in Coleoptera," by the same.

"A New Family of Lepidoptera, the *Anthelidae*," by A. JEFFERIS TURNER, M.D.

"A new *Hydroptila*," by MARTIN E. MOSLEY.

"Scent Organs in the Genus *Hydroptila* (Trichoptera)," by the same.

The last paper was illustrated by many photographs shown in the Epidiascope.

Dr. ELTRINGHAM congratulated the author on his important discoveries, and Mr. F. W. EDWARDS compared the scent-organs found at the back of the neck in certain Diptera (*Psychodidae*).

Wednesday, November 5th, 1919.

Comm. J. J. Walker, M.A., R.N., F.L.S., President, in the Chair.

Election of Fellows.

Messrs. James Meikle Brown, B.Sc., F.L.S., F.C.S., 176 Carterknowle Road, Millhouses, Sheffield; Alfred Francis John Gedye, 4 Runwell Terrace, Westcliff-on-Sea, Essex; Arthur Francis Hemming, Oxford and Cambridge Club, Pall Mall, S.W., and Cambridge Lodge, Horley, Surrey; Williams Hugh, J.P., Tresaison, Cloverdale, British Columbia, Canada; Murdoch Campbell McLeod, The Fairfields, Cobham, Surrey, and McLeod & Co., Calcutta, India; Dr. W. Mansfield-Aders, Zanzibar; S. Gordon Smith, Estyn, Boughton, Chester, and James Davis Ward, Limehurst, Grange-over-Sands, Lancashire, were elected Fellows of the Society.

Papers.

In consequence of the number and importance of the Papers they were taken before the exhibition of specimens. The following papers were read :—

"A contribution to the Classification of the Coleopterous Family *Endomychidae*," by Gilbert J. Arrow, F.E.S.

"New moths collected by Mons. A. Avinoff in W. Turkestan and Kashmir during his Journeys in 1909–1912," by Sir George F. Hampson, Bart., communicated by J. Hartley Durrant, F.E.S.

"On the Histology of the Scent-organs in the Genus *Hydroptila*, Dal.," by H. Eltringham, M.A., D.Sc., etc.

"Contributions to the Life History of *Lycaena euphemus*, Hb.," by T. A. Chapman, M.D., F.R.S., etc.

"Notes on *Lycaena alcon*, F., as reared in 1918 and 1919," by the same.

"Cocoon softening in some *Agrotids*," by the same.

"*Pseudacraea eurytus hobleyi*, its Forms and its Models on the Islands of Lake Victoria, and the bearing of the Facts on the Explanation of Mimicry by Natural Selection," by G. D. H. Carpenter, D.M., B.Ch.

Dr. ELTRINGHAM, Dr. CHAPMAN and Dr. CARPENTER gave illustrations of their papers by means of the Epidiascope, and Dr. Chapman exhibited a nest of *Myrmica laevinodis* containing four living larvae of *L. euphemus*, and also one larva in spirit at the stage in which it enters the ants' nests.

Several Fellows commented on these papers, especially on Dr. Eltringham's and Dr. Chapman's paper on *L. euphemus*, and Dr. Carpenter was warmly congratulated on the success of his observations and experiments.

Photograph of Former President.

A very interesting photograph of the late H. W. BATES, which Mr. Donisthorpe was presenting to the Society, was also shown in the Epidiascope.

MEGACOELUM BECKERI, FIEB., A HEMIPTERON NEW TO BRITAIN.—Mr. Donisthorpe exhibited specimens of *Megacoelum beckeri*, a species new to Britain, which he had first captured at Weybridge, August 27, 1918. His total captures were as follows :—

One on fir tree over *F. rufa* nest . .	27.viii.18, Weybridge.
One on fir tree over *F. rufa* nest . .	4.ix.18, ,,
Three on fir trees over *F. rufa* nests . .	20.ix.18, Oxshott.
Several larvae on fir tree over *F. rufa* nest	11.vii.19, Weybridge.
Several larvae on fir tree over *F. rufa* nest	15.vii.19, ,,
One larva on oak tree over *F. rufa* nest .	15.vii.19, ,,
One larva on fir tree over *F. rufa* nest .	24.vii.19, ,,
Several larvae on fir trees over *F. rufa* nest	3.viii.19, Oxshott.
One larva on birch tree over *F. rufa* nest	3.viii.19, ,,
One imago and one larva on fir trees over *F. rufa* nest	26.viii.19, Weybridge.
One imago on fir tree over *F. rufa* nest .	31.viii.19, Oxshott.

It was always found over nests of *Formica rufa*, but he had so far been quite unable to trace the cause of the connection between the insects.

HERSE CONVOLVULI, L., ATTACKED BY SMALL BIRDS IN B. E. AFRICA.—Prof. POULTON read the following note contained in a letter from the Rev. K. St. Aubyn Rogers :—

"*August* 7, 1919. *Nairobi.*

"During May and June the Convolvulus Hawkmoth was flying freely by day and I three times saw birds with freshly caught specimens. The culprits were *Ploceus reichenowi* (Fischer), *Lanius humeralis* (Stanley), and *Pycnonotus barbatus* (Desf.). As regards the last named the moth was still living when I first saw it, and I watched the bird struggling with it until it succeeded in getting rid of the wings and flew off with the remains (I secured the wings for you). This observation seems to me of some interest, as it shows what a powerful insect can be tackled by a comparatively weak bird like a bulbul (*Pycnonotus*), and effectually disposes of the suggestion that Danaines and even Acraeines are neglected because they are too large to be managed."

Further notes by W. A. Lamborn on the habits of the fly Bengalia.—Prof. Poulton said that he had received the following observations, together with the numbered specimens, now exhibited to the meeting, from his friend Mr. Lamborn. He had been kindly helped in the determination of the flies by Major E. E. Austen, and the ants by Mr. W. C. Crawley. The evidence seemed to prove clearly that *Bengalia* seeks prey already bitten by ants because it is unable to perforate the surface of any but very thin-skinned insects such as female Termites, the larva of *Sphex* or the pupa and freshly emerged imago of the ants themselves. In the succeeding communication Dr. G. D. H. Carpenter showed, as Dr. Gaillard had also observed in 1908, that the African *Bengalia* resembles the allied Oriental *Ochromyia* in its attacks on Termites. References to earlier observations on both these genera of Diptera will be found in Proc. Ent. Soc., 1913, pp. cxxviii–cxxix. To these must now be added "The Mouth-Parts of *Ochromyia jejuna*, a Predaceous Muscid," with Pl. XLVIII, by Capt. F. W. Cragg, M.D., I.M.S., in Ind. Journ. Med. Res., vol. v, 1917–18, p. 516. The paper contains a detailed description of the mouth-parts and their probable use, although the author omits to notice Mr. E. E. Green's much earlier investigation of the tongue of the Ceylon species of *Ochromyia* (Proc. Ent. Soc., 1908, pp. xxvi, xxvii). Capt. Cragg quotes Mr. Howlett's observations on *O. jejuna*, at Pusa, where the flies were not seen attacking Termites but often robbing various kinds of ants of their larvae. Mr.

Howlett had not seen "the flies plundering any quite small species."

Mr. Lamborn's interesting observations were as follows:—

"I have repeated on many occasions in B. E. Africa, E. Africa, and Nyasaland the observation originally made in S. Nigeria as to the fly *Bengalia* robbing Doryline ants on the march of their immature forms or food material, as described in the Proc. Ent. Soc., 1913, pp. cxxv–cxxviii.

"A further study of the fly has shown that the 'Driver ants' are by no means the only species favoured by its attentions. On 6th January 1919, at Lindi, E. A., as I was watching a column of the Myrmecine ants, 389*a* [*Cremastogaster castanea*, Sm. (*tricolor*, Gerst.), var.: many workers], some passing up and some down a baobab tree, a Muscid, *Bengalia* species [*B. peuhi*, Br. and v. Berg., ♀], alighted near by and made various attempts to rob some of the ants of their food material —tiny unrecognisable fragments. [Accompanying the ants was the hind end of a small beetle of the genus *Onthophagus* of a sp. unrepresented in the B.M.] The fly was very alert, retiring immediately any stray ant happened to come its way. As it was soon nearly dusk I was not afforded an opportunity of an extended study of its movements, and was compelled to take it.

"On 11th January, as I was studying at the mouth of their burrow in the ground at the foot of a baobab the Myrmecine ants, 392*a* [*Pheidole liengmei*, For.: many workers], some engaged in bringing up fragments of earth from the depths and others returning food-laden, I noticed several *Bengalia*, 392*a* [*B. gaillardi*, Surcouf, prob. tropical f. of *depressa*, Walk., ♂♂♀], near by, which, from time to time, made a dash at various ants and were occasionally successful in robbing them of their supplies. By and by I saw at a little distance from the nest the similar ants, 392*b* [several workers of same sp.], clinging to the protruding viscera of an unfortunate Carabid, a small black species, on which I must inadvertently have trodden. The beetle was making frantic attempts to escape and did succeed in dragging himself along laboriously, despite the numerous ants by which he was assailed. One of the *Bengalia*, 392*b* [♂ of same sp.] then attempted repeatedly to get hold of the viscera with its proboscis but was obviously too frightened of the ant to be successful. After watching it for some little time I took it, in doing which I disturbed the ants; and the beetle, freed from most of its assailants, escaped into a fissure in the ground, where I was unable to secure it.

"The next day I again saw *Bengalia* [2 ♂ of same sp.] robbing the same ants, 392*a*, 393*a* [many workers of same sp.], as they returned food-laden to their burrow, and farther on found three or four more of the flies [2 ♂ of same sp.] at rest near a column of the Ponerines, 393*b* [three workers of *Leptogenys pavesii*, Emery], emerging from a hole at the base of a dead tree, in formation as for a marauding expedition. In this case the instincts of the Diptera were evidently much at fault, for they had failed to distinguish between the outgoing army and one returning laden with spoil, and from time to time, poised over the ants, occasionally swooped down as if they could hardly conceive that prey might be entirely absent.

"Continuing my observations on 13th January, I saw at the base of a baobab the Camponotine, 394*a* [☿ min. of *Camponotus* (*Myrmoturba*) sp.,* impossible to identify without ☿ maj.], climbing up backwards and dragging up after it the dead and fully grown larva of the Pierine butterfly *Catopsilia florella*, F., held head down. Near by was a *Bengalia*, 394*a* [♂ of same sp.]. Whenever the ant had got a little distance away, the fly followed but did nothing, as if loth to let it get out of sight but uncertain what action to take; and in the course of about five minutes the ant had dragged its prey up the tree for about a couple of feet. The *Bengalia* then suddenly made up its mind, for it ran up, seized the larva just behind the head in its forelegs so strongly as markedly to constrict it, and made most frantic suctorial efforts with its proboscis, deeply depressing the surface of the dorsum but without puncturing it. The ant was too strong for the

* This *Camponotus* is superficially extremely like the Ponerine ant *Leptogenys stuhlmanni*. It is possible that the likeness has been increased by the shrinkage of the former, but it is difficult to believe that no bionomic principle is at work. It would be very interesting to examine a long series of the apparent mimic.—E. B. P.

fly and gradually dragged it up the tree and I then took both.

"Further on I came on a nest of the small Ponerines 394*b* [1 ☿ *L. pavesii*, 4 ☿ *Leptogenys* (*sensu stricto*) *stuhlmanni*, Mayr.], similar to 393*b*, which, at about 10 a.m., were bringing up from their nest in a rotten stump their pupae [three examples] and callows for a sunning. Near by were some Bengalias [three ♂ of same sp.], one of which from time to time seized a callow [one of these is evidently indicated by 394*c*, the label on an immature ☿ probably of *L. stuhlmanni*], as it was carried up by one of the ants and frequently got away with it to a distance, when, the ant having relaxed its hold, the fly was able to suck out the juices at its leisure.

"On 14th January a further series of *Bengalia* [2 ♂ of same sp.] were taken, each detected in the act of robbing more of the ants, such as 395*a* [several ☿ of *Pheidole liengmei*], but belonging to a different nest, returning food-laden. On the ground and near to the nest was a pupa of *Catopsilia florella*, too heavy for the ants [several ☿ of same sp.] to drag away, but in which they were gnawing a small hole behind the left wing case. A *Bengalia* 395*b* [a ♂ and ♀ of same sp. bear this number], walked round the pupa several times and eventually approaching warily suddenly thrust its proboscis into the breach, momentarily however, for it was extremely suspicious of the ants; but it repeated the manœuvre many times.

"The possibility of the fly feeding on dead animal matter not found by ants, or attacking living insects, had been constantly borne in mind, but though dead insects, such as it had been seen to hanker after when taken by ants—the larvae and pupae of *C. florella* for instance were fairly numerous, there being an absolute plague of these butterflies at Lindi—yet *Bengalia* was never seen to approach any untouched by ants, perhaps because it is unable to effect by itself a breach of surface in cuticle hardened by exposure postmortem. However, on several occasions the fly was seen to attack living larvae of *Catopsilia*, in each case sickly and rather shrivelled specimens; for, owing to the voracity and abundance of earlier broods, the leaves of the food plant, a

Leguminous shrub near to *Cassia podocarpa*, Guill. and Perr., which is eaten by this species on the West Coast, had disappeared, and the later broods were forced to endeavour to feed to maturity on leaf-stalks and green bark, so that many appeared unhealthy and many had perished.

"In each attack the procedure was the same. The fly followed for about six inches close behind, almost touching its prospective victim, and then leapt on it suddenly, frantically endeavouring to make an impression with its proboscis on the surface of a posterior segment, generally the 10th or 11th. The first two feeble larvae which were seen to be attacked did not respond in any way but continued to crawl off. The assault, which was entirely without result, lasted for about ten seconds, and was repeated in one case twice more at intervals of about half a minute, the fly then giving up the attempt.

"In a second case two attacks on a larva took place; and in a third the fly seized a larva approaching maturity, which then, as is usually the case, made a sudden convulsive movement whereby the fly was forthwith dislodged, then proceeding on its way. The fly made one further attack with similar result and then desisted.

"The ants already studied in relation to *Bengalia* being of the average size it was with some surprise that on 14th January I saw the fly [♂ of same sp.] near the diminutive Camponotine ants, 396 [6 ☿ of *Prenolepis* (*Nylanderia*) *longicornis*, Ltr., far more metallic than usual, but similar in this respect to some in Mr. Crawley's collection from Ocean Island], bringing back tiny burdens to their burrows. With an abundance of fairer prey it hardly seemed possible that the fly would waste its energies in paltry theft: but it was just as guilty in robbing these little creatures as their larger brethren, the procedure adopted being precisely as before, an equal degree of wariness being exhibited.

"Transfer to Dar-es-Salaam in January afforded an opportunity of studying *Bengalia* in a new locality. In the immediate neighbourhood of the town the Camponotine ants, 399 [several ☿ of various sizes of *Plagiolepis custodiens*, Sm.], and 401 [4 ☿ of same sp.], which were not seen at all near the town of Lindi, were by far the most dominant species. They nest both in holes in trees and in the ground, favouring sandy soil, and seem to occur everywhere so as to be an absolute nuisance, running up one's legs whenever one stands still a few seconds. They are savage and very active, so that one hardly expected to find *Bengalia* molesting them. But on several occasions in the middle of the month, the indefatigable fly was watched pursuing its usual methods, more often than not guarding against possible danger from roving ants by watching them from an elevation, usually a blade of grass or a small stone. The examples observed, which are now sent, are numbered 399, 400, 401, 402, 408, 409, 410, 411. [Each number is borne by from 2 (410) to 12 (399) workers of *P. custodiens*, and, with the exception of 401 (no fly bearing this number), by a single *Bengalia gaillardi*, of which all are males except 411.]

"On 26th January an instance of faulty perceptions in regard to this species of ant, also, was noticed, for a ♂ *Bengalia*, perched on a blade of grass, suddenly swooped down on a large worker, 400 [*custodiens*], carrying one of equal size, which the fly endeavoured to seize. The attack was unsuccessful, but the ant dropped its fellow which then ran away, there having been, so far as one could see, no urgent reason for its porterage.

"Though these ants are so excessively numerous at Dar-es-Salaam, there is no corresponding increase in the number of the flies; indeed at Linde, where the species of ants were more numerous though the total number of individuals seemed far less, the fly was more abundant, possibly because of the greater ease with which it seemed able to obtain its livelihood from less redoubtable foes.

"On 31st January at Dar-es-Salaam a further experiment was made on the feeding habits of *Bengalia*. A living larva of the Sphegid *Sceliphron spirifex*, L., resting prior to pupation, was put into a cage containing one of the flies which had been without food for 24 hours. The fly straddled across it without the least hesitation, and, gripping the thoracic region with its fore-legs, applied its proboscis just behind the head. A bead of exuded body fluid proved almost at once that the fly had pierced the cuticle, while the rapid diminution in size and falling in of the body indicated the substantial meal the fly was making. When it desisted, the larval remains were removed but were again offered to the fly in an obviously decomposed state 24 hours later. It unhesitatingly made a second meal."

THE FLY BENGALIA DEPRESSA, WALK., ATTACKING A WINGLESS TERMITE.—Prof. POULTON gave an account of the following observation recorded by Dr. G. D. H. Carpenter in a letter from Mombasa dated May 13, 1919. The fly, a female, which closely resembled Walker's type of *B. depressa*, was exhibited to the meeting together with its victim, a female of *Termes* sp., probably *bellicosus*, Smeathman.

"On May 4th in the evening I saw at Kilindini a Termite that had shed its wings, crawling about on the ground endeavouring to get away from a medium-sized fly that seemed to be in some way attacking it.

"Thinking the fly might be a Tachinid desirous of laying eggs upon the Termite I approached closely and watched; but it soon became evident that the fly was looking after number one, and not a future generation. It persistently applied its protrusible proboscis to the Termite's abdomen, and after many repeated failures, being shaken off by the movements of the Termite, it at last appeared to get the proboscis through the chitinous exoskeleton, for it was so firmly fixed that the fly was dragged about passively as the Termite hurried along, the fly then not using its legs at all.

"I watched for a period during which it seemed to me (though the wish *may* have been father to the thought!) that the fly's abdomen grew fatter. At any rate, there seems little doubt it was sucking the juices of the fat Termite! I was without any collecting apparatus, but managed to catch the fly by its wings with my fingers and tie it up, with the Termite, by a grass blade in the corner of my handkerchief, and now send them to you for identification."

MANTIS PIA, SERV., AND A NEMATODE; A COMPLICATED INSTINCT.—Dr. G. D. H. CARPENTER exhibited the specimen of *Mantis pia* referred to in the following notes which he read :—

On Kibibi Island, S. Victoria, Jan. 22, 1919, I was lying on the sandy shore a few yards away from the edge of the water, where the ripples were breaking. A green *Mantis*, which is exhibited and has been identified as a male *Mantis pia*, Serv., was noted to be at the water's edge and seemed to be rather unpleasantly knocked about by the breaking ripples. It seemed very curious to me that every time it was thrown a little way up the beach by a larger ripple it steadfastly walked down again towards the water, as if determined to drown itself. My attention being attracted by this, I watched for some minutes. At last the *Mantis* got left on a little ridge of sand, but seemed quite suddenly to have been overcome, for it lay on its back with legs feebly moving. This seemed so curious that I got up to look and found a long Nematode or "Thread-worm" (like *Gordius*) protruding from the end of the *Mantis*' abdomen. I pulled out the last inch or so—it must have been some five inches long—and the *Mantis* seemed much relieved. Now I put it down again at the edge of the water, but this time it just as steadfastly walked directly *away* from the water, although I put it back at the water's edge once to make sure it had not lost its sense of direction.

The behaviour of the *Mantis* was such that one felt sure that instinct had forced it to go down to the water in order that the Nematode parasite, when adult, might escape from the body of the host and get into the water, where, presumably, reproduction takes place. It is a very remarkable case of adaptation of a host to a special need of a parasite. These Nematodes are often obtained from insects, and may be seen in England on damp earth. They are supposed to account for the country superstition that if a bunch of horsehair is thrown into a ditch it will turn into "Eels."

An interesting species known as the "Guinea worm" is parasitic on man. Its early stages are passed in the little crustacean *Cyclops*, and if one of these is swallowed in water the Nematode develops to the adult beneath the skin of the host. It usually finds its way to the legs or feet, and when the skin over it is wetted by water the female Guinea worm manages to protrude the end of its body through the skin and drops its eggs in the water.

Mr. GREEN observed that in Ceylon certain beetles used to be attracted to the light and come in and deposit Nematode worms even on the dinner-table.

MELANIC MOTHS FROM SCOTLAND.—Dr. E. A. COCKAYNE, on behalf of Mr. ROBERT Y. HORN of Glasgow, exhibited :—

(1) A specimen of *Anaitis plagiata* showing extreme melanism, the thorax, abdomen, basal area and central fascia of fore-wings being almost black and the rest of the fore-wings and the hind-wings dark grey.

(2) A specimen of *Acronycta menyanthidis* with black marginal area to fore-wings.

Both were from Dumbartonshire, 1919. Two slightly less melanic *Anaitis plagiata* have been taken at the same place.

BRED SESIA FORMICAEFORMIS.—Mr. H. M. EDELSTEN exhibited bred specimens of *Sesia formicaeformis* from the Lea Valley; also an osier stem in which the larva had fed, and photographs to show the emergence hole of the imago. The larvae were found in an old osier bed which had not been cut for several years. The osiers were in a most unhealthy state, and there were numerous dead and dying stems. The stems were infested with Willow Weevil (*Cryptorrynchus lapathi*) and Willow Wood Midge (*Cecidomyia saliciperda*), and were covered with rust canker, and had been much pecked by birds. The larvae appear to feed under the bark in their early stages in a similar way to those of *Sesia andrenaeformis*, afterwards boring up the dead or dying stems to pupate. They make no cap over the emergence hole, but eat away the inner lining until only the cuticle of the bark remains. The emergence hole is oval in shape and reminds one very much of that of *Nonagria neurica*. The pupa is head upwards, though in two cases he had found them head downwards. (These were ichneumoned, and had probably entered an old boring.) In osiers that are cut regularly the larva feeds under the bark and pupates there like *Sesia myopaeformis*.

Some larvae were still feeding on May 20, and others were quite small, so it is evident that they take two years, if not three, to come to maturity. The pupae were enclosed in tough cocoons made of wood gnawings, and silk lined. They were very badly stung by ichneumons.

HYMENOPTERA FROM THE TURIN AND VICENZA DISTRICTS OF NORTHERN ITALY.—Lt. E. B. ASHLY exhibited the following species from these districts taken in 1919:—

Cimbex femorata, Clavellaria amerinae, Ammophila sabulosa, Vespa crabro, V. vulgaris, V. germanica, Polistes gallica, Eumenes unguiculus, Vill., *E. pomiformis*, Rossi, *Apis mellifica* var. *Ligustica, Bombus terrestris, B. hortarum* and var. *harrisellus*, K., *B. pomorum, B. agrorum* var. *pascuorum*, Scop., *B. sylvarum, B. lapidarius, B. ligusticus, Xylocopa violacea, Eucera longicornis, Anthophora quadrifasciata, A. acervorum*, L., *A. dispar*, Lep., *A. grisea, Osmia cornuta, O. aenea, Andrena thoracica, Nomada succincta.*

The above species were kindly identified for him by his friend, Prof. Zavateri, Head of the Natural History Museum at Turin.

Wednesday, November 19th, 1919.

Comm. J. J. WALKER, M.A., R.N., F.L.S., President, in the Chair.

Election of Fellows.

Mr. WILLIAM FALCONER, Wilberlee, Slaithwaite, Huddersfield; Sir NORMAN LAMONT, 4, Queen Street, W., and Palmiste, Trinidad, B.W.I.; and Mr. CYRIL WINTHROP MACKWORTH-PRAED, Dalton Hill, Albury, Surrey, were elected Fellows of the Society.

Nomination of Officers and Council.

The following list of Fellows was read, as the nominees of the Council as Officers and Council for the next session:—*President*, Comm. JAMES J. WALKER, M.A., R.N., F.L.S.; *Treasurer*, W. G. SHELDON, F.Z.S.; *Secretaries*, the Rev. GEORGE WHEELER, M.A., F.Z.S., and S. A. NEAVE, M.A., D.Sc., F.Z.S.; *Librarian*, G. C. CHAMPION, A.L.S., F.Z.S.; *Other Members of Council*, H. E. ANDREWES; G. T. BETHUNE-

Baker, F.L.S., F.Z.S.; K. G. Blair, B.Sc.; Surgeon-Comm. M. Cameron, M.B., R.N.; J. Hartley Durrant; H. Eltringham, M.A., D.Sc.; A. D. Imms, M.A., D.Sc., F.L.S.; G. A. K. Marshall, D.Sc., F.Z.S.; the Rev. F. D. Morice, M.A., F.Z.S.; H. E. Page; the Rt. Honble. Lord Rothschild, M.A., F.R.S. etc., Capt. the Rev. J. B. Waterston, B.D., B.Sc.

Donation to the Library.

Amongst the donations to the Library was a MS. Entomological Diary of the well-known entomologist J. Curtis, which after his death had passed to the late J. O. Westwood, by whose representatives it had been given to the Ratcliff Librarian Dr. W. Hatchett Jackson, who now presented it to the Society, being anxious that during his lifetime it should find a suitable and permanent resting-place.

Exhibitions.

A contrast in Measurements of a Beetle, etc.—Mr. Donisthorpe exhibited a very small specimen of *Hylotrupes bajulus*, L. only 8·5 mm. long, taken by Mr. R. S. Mitford, C.B., F.E.S.; and a very large one 24 mm. long, taken by himself (both from near Weybridge).

Fowler gives the measurements as 14–20 mm.; so that both specimens appeared to be records.

Also *Eupteryx melissae*, Cart., a frog-hopper breeding on garden-sage in his garden at Putney; and a species of *Aleurodes* (*A. lonicerae*, Walk.), from honeysuckle in a cold conservatory, also Putney. Both were still breeding in spite of the frost, cold and rain.

Ancylis tineana, Hb.—an addition to the British List (Lep.–Tin.).—Mr. Durrant exhibited a specimen of *Ancylis tineana*, Hb., taken casually in the daytime by Mr. F. G. Whittle at Camghouran (Perthshire) June 3rd, 1919. He said that this species (Stgr. Rbl. Cat. 2268) is recorded from Germany, Austria, Holland, Galicia, Russia, Sweden, France, Italy, Labrador, etc., so its occurrence in Scotland is not surprising. On the Continent it has been bred from *Crataegus oxyacantha*, *Prunus spinosa* and *domestica* and *Populus tremula*

—the last record is marked with a "?" by Ragonot (MS.) and requires confirmation.

Mr. SHELDON observed that Rannoch was so well-worked a locality that it was surprising to find a species of Lepidoptera new to Britain there, and especially one so distinct. He knew the exact spot where the specimen was taken. Of its reported food-plants on the Continent, there is a clump of *Populus tremula* near by, and also scattered trees of *Pyrus malus*; the only British Crataegus, *C. oxyacantha*, does not grow in the district, neither, so far as he was aware, does *Prunus spinosa* or *P. domestica*, but *P. padus* is not uncommon.

SPINES ON THE ELYTRA OF TROPICAL CARABIDAE.—Mr. H. E. ANDREWES exhibited some tropical *Carabidae* to show spines at the apex of the elytra. The specimens shown were *Macrocentra quadrispinosa*, Chaud., from New Guinea; *Stricklandia nigra*, Sl., from tropical Australia; *Catascopus mirabilis*, Bates, from Laos; *Catascopus regalis*, Schm. Goeb., from Assam; *Colpodes saphyripennis*, Chaud., from Sarawak; *Cordistes aculeatus*, Chaud., from the Amazons; *Agra foreigera*, Chaud., from the Amazons. The spines generally occurred as a single pair, but there might be four spines, or even six—as in *Catascopus mirabilis*. The longest spines seemed to occur in species whose habitat is near the Equator.

His attention had been specially directed to these spines by his friend Mr. Sloane, the authority on Australian *Carabidae*, who had lately sent him the following note:—"*Spines of elytra.* I have often thought of these. Why do they occur in tropical genera, not very nearly related, e. g. *Colpodes*, *Calophaena*, *Coptodera*, *Catascopus*, etc.? As far as I remember all we have in Australia belong to our geologically recent immigrant fauna (I mean in *Carabidae*), e. g. *Stricklandia nigra* Sl., *Aristolebia* (*Sarothrocrepis*) *mucronata*, Sl., *Colpodes violaceus*, Chaud. Can any of the wise men of London give any explanation? Or has anyone treated of the subject? Likely these spines are protective: if so, it cannot be against birds, but must be against some peculiarly tropical enemy. Empirically I have thought it might be against some of those lizards that shoot out the tongue to capture their prey. The spikes would only protect against some soft instrument of capture. Anyway these spine-tailed things are mostly in South America, and the Oriental and Austro-Malayan regions (I do not know about Africa). There must be some reason for this. What is it?"

The only two genera about which he had any information both occur in India, viz. *Catascopus* and *Colpodes*. In North India *Catascopus facialis*, Wied, in which the apex of the elytra is toothed only, occurs under the bark of felled trees, which has become partially detached from the trunk. His notes all referred to the same tree, known in N. India as "sál" (*Shorea robusta*), but that might be because it is the common timber tree of those parts. Regarding *Colpodes* he could only suggest that it sometimes lives in trees, and lizards sometimes live also in trees, but he thought that any connection between these two facts could only be determined by actual observation.

Several Fellows commented on this exhibit, Mr. DONISTHORPE observing that there was also a genus of Australian ants (*Polyrhachis*) remarkable for their spines.

NORTH ITALIAN BUTTERFLIES.—Lt. E. B. ASHBY exhibited the following species taken recently in North Italy:—Males and females of *Thais polyxena* ab. *meta*, from Stupinigi Wood, Turin, April 1919; 2 fresh specimens of *Euvanessa antiopa*, from Arquata Scrivia, Piedmont, July 1918, also a hybernated specimen from Lakes of Avigliana, April 1919; 1 male of the spring brood of *Chrysophanus dispar*, var. *rutilus*, from the banks of the Stura, Turin, May 1919; and a series of 7 males and 7 females of the autumn brood from Stupinigi Wood, Turin, September 1919; 4 males and 1 female of *Satyrus statilinus*, from Arquata Scrivia, Piedmont, August 1919; and 3 males and 2 females of *Enodia dryas*, from Stupinigi Wood, Turin, July 1919.

A NEW RACE OF PLEBEIUS AEGON MASSEYI.—Mr. J. J. LISTER exhibited a collection of *P. aegon* var. *masseyi*, Tutt, made in N. Lancashire and Westmoreland in July 1918 and 1919, with series of the heath form from the New Forest, of var. *cretacea* from the North Downs, and of the forms from Delamere Forest, Cheshire and Great Orme's Head, Caernarvonshire, for comparison. He said:—Var. *masseyi* appears to be now limited to the estuarine mosses which lie along the courses of the rivers

Kent (Westmoreland) and Leven (Lancashire). The two estuaries are separated by the Cartmell Fells, which attain a nearly uniform height of about 700 ft.

As is well known this form of *aegon* differs from the other races of the species, which range from Great Britain to China and Corea and from Lapland to Portugal, in the fact that the females are hardly ever without a wash or sprinkling of blue; the only race which resembles it in this respect being var. *corsica*, limited to that island, but differing markedly in the characters of the underside. It appears that the only satisfactory way of examining the characters of a population varying so much as this form does is to take "samples" in different localities, carefully abstaining from selecting specimens, except for condition, and in numbers sufficient to include at least the commoner variants. It is obvious that this method if pursued by many collectors might lead to the extermination of a species. It is also obvious that unless a series is known to have been collected in this manner, as a sample, its value for comparison is diminished.

The results arrived at from the examination of the specimens are:—

(1) That the population of this species inhabiting Holker moss, on the Leven estuary, differs slightly from that of the mosses about the river Kent and its tributary, the Gilpin. If the females from different localities are arranged in order of blueness it is seen that the Holker females at the beginning of the series are not so blue as those from the Westmoreland mosses, and that there is a longer "tail" to the series of nearly brown females. In other words, the Leven females vary about a less blue mean than do those inhabiting the Kent estuary to the east, and separated from them by the intervening hill barrier.

(2) Delamere Forest and Great Orme's Head are, or have been (for it is doubtful if the species still exists at the latter locality) inhabited by forms intermediate between those found elsewhere in England (illustrated by the series from the New Forest and the North Downs) and var. *masseyi* from the estuarine mosses. For examples of these intermediate forms I am indebted to the generosity of Mr. Wm. Mansbridge,

who gave me his specimens from Delamere Forest, and has borrowed those from Great Orme's Head from Dr. John Cotton, who collected them there some twenty years ago.

The distinguishing characters of the races of *P. aegon* contained in the collection may be set out as follows :—

(1) Sandy heath form, from the New Forest.

♂. Upperside reddish purple, fairly deeply bordered with black; underside dull warm grey.

♀. Upperside warm brown, only very rarely (perhaps 1 in 100 specimens), washed or sprinkled with purple; underside full cinnamon brown.

(2) Var. *cretacea*, Tutt, from the North Downs.

♂. Upperside bluish purple, narrowly bordered with black; underside French grey.

♀. Upperside brown, only very rarely (perhaps 1 in 100 specimens) washed or sprinkled with blue; underside pale cinnamon brown.

(3) Form from Delamere Forest.

♂. Resembles (1). ♀. Resembles (1), but blue forms much commoner. In a sample of 17 females 10 have some trace of blue on upperside, 1 has the hind-wing nearly blue except the costal border.

(4) Form from Great Orme's Head.

♂. Upperside of the reddest shade of purple of any in the series, narrowly margined with black; underside warm grey intermediate between that of (1) and (2).

♀. Upperside ground-colour as in (2), but in a sample of 12 all are more or less purple, of the shade of the ♂; underside pale cinnamon brown.

These specimens approach (5) in character; they differ in the redder shade of purple of the upperside and the warmer shade of the underside in the ♂, and the warmer colour of the brown upperside of the ♀.

(5) Form from Leven estuary (Holker moss).

♂. Upperside varies from purplish to nearly pure blue, black margin rather narrow; underside ground-colour very pale French grey.

♀. Upperside ground-colour is of a blacker, less warm, shade of brown, in all my (40) specimens more or less washed with blue, of the colour of the ♂. None of them show the grey tint sometimes present in (6); underside pale cinnamon brown, often paler than in (2).

(6) From the Kent river mosses.

♂. As in (5), but in some cases the blue of the upperside of the wings changes to grey towards the margin of the hind or of both wings—a variation parallel with that which in *coridon* culminates in ab. *fowleri*. Black margin rather narrower.

♀. Upperside. In all my (83) specimens blue is present on the upperside. It is always most extensive on h.-w. It is generally, not always, divided by black nervures, and very rarely extends to costa of h.-w. If little developed it is often limited to wedge-shaped interneural patches internal to the marginal spots of h.-w., a condition much commoner in (5). The pure shade of blue is commoner in ♀ than ♂. On the outer side of the disc the colour is often grey rather than blue, and may be almost white.

In 30–40% of the females of my moss forms a narrow band of white, interrupted by the black nervures, precedes the black marginal band. This is comparatively rare in the other forms. Underside as in (5).

The var. *masseyi* is thus a very varying form in the shade of the blue colour in both sexes, in the degree of the blueness of the female, in the occurrence of the greyish borders of the uppersides of the wings of the ♂, and in the occurrence of a white submarginal border on the upperside of h.-w. of ♀. It differs from other British forms in the frequent occurrence of a purer, less purple, shade of blue on the upperside of both sexes, in the paleness of the ground-colour of the underside in both sexes, and in the blacker shade of the ground-colour of the upperside of the female. It attains its most aberrant and splendid characters on the Westmoreland mosses, the form found on Holker moss, on the Leven estuary, being in some respects an intermediate or penultimate step in the series.

In some of its features *masseyi* approaches *hypochiona*, Rambur, from the Pyrenees and Spain.

VARIATION IN EUMORPHA ELPENOR PROBABLY PRODUCED BY HEAT.—Mr. W. KAYE exhibited various series of the Sphingid *Eumorpha elpenor* to illustrate the probable effect of heat in enlarging or even producing the small white discoidal spot. The spot is as a rule very minute or absent in British specimens under normal conditions. A series of bred specimens from Byfleet was shown which had been reared normally, and a smaller series from the same place, but bred another year, which had been subjected to considerable sun-heat in a greenhouse, but with no artificial heat. These latter showed a small white discoidal spot in all the specimens, one of which showed it quite large and distinct, while another was only a little less distinct. These two were out of but seven examples thus reared. A small series of specimens from Germany and Greece scarcely showed the spot more than ordinary British specimens. A small series from Yokohama, Japan, of the race *lewisi*, showed the spot distinctly in at least two cases and slightly in all; while three specimens from N. India of the race *macromera* showed the usual well-marked spot as well as the characteristics of this race. It appeared possible that the stimulus of strong sun-heat tended to develop this discoidal dot, for the Indian examples probably experience most heat, while Japanese examples would most likely have less than the Indian, but more than our own.

A Thomisid Spider apparently protected from the attack of an Attid Spider.—Prof. Poulton said that on September 9th, 1919, at St. Helens, Isle of Wight, he observed a Thomisid spider slowly walking up a lamp-post followed by an Attid, probably the common *Epiblemum scenicum*, Cl. When he first saw them the Attid was about an inch behind but it soon overtook the other and leapt upon it, and then, as quickly, jumped off again and walked away. It seemed probable that the Attid had instantly recognised some effective powers of defence or some unpleasant or unpalatable quality in the Thomisid. The observations of Dr. and Mrs. Peckham on the elaborate courtship of the *Attidae* and immense risks run by the male rendered it improbable that the behaviour was due to a mistaken sexual impulse.

A Queen Wasp capturing prey before hibernation.—Prof. Poulton said that on September 20th last, at Oxford, he saw a large wasp carrying a burden and flying very heavily. It came down in the middle of the Banbury Road and he was then able to see that the prey was a large Syrphid fly, *Catabomba pyrastri*, L., carried in the mandibles. He was unable to capture the wasp, which, in a few seconds, succeeded in rising from the ground and flew off with its victim. The wasp was a queen, almost certainly of *Vespa germanica*, F., or *vulgaris*, L., probably the former, which is the commoner at Oxford.

VESPA ORIENTALIS, L., REJECTING THE KILLED BUT CARRYING OFF STUNNED INDIVIDUALS OF THE SAME SPECIES.—Prof. POULTON drew the attention of the Fellows to observations made on this hornet in Palestine by Mr. C. H. Hamm, late R.A.F. The insects were abundant in the Ramleh district, from July to October, 1918: they were also seen, singly, visiting a large Umbelliferous plant in April and May. They were never seen to catch other insects. They nested in the ground.

When they became common, the workers in large numbers visited the mess-tents, feeding on jam and other sweet foods. When so occupied they were often knocked down—sometimes stunned, sometimes killed. It was then observed that other hornets would examine the bodies lying on the ground and carry off, generally after considerable effort in rising from the ground, those that were still alive. The dead were always left as they lay.

THE MIMETIC ASSOCIATION BETWEEN TWO SPECIES OF EUPLOEA AND ONE DANAINE IN FIJI.—Prof. POULTON said that ever since 1899 when he had received examples of the two common Fijian Euploeas, *Nipara eleutho*, Quoy, and *Deragena proserpina*, Butl., collected at the same time and place by his friend Prof. Gustav Gilson, he had longed for the opportunity of studying a long series. In the meantime his friend Mr. J. C. Moulton had figured both species from the Gilson series and had given an account of the mimetic modification in the pattern of *proserpina* (Trans. Ent. Soc., 1908, p. 603, Pl. XXXIV, figs. 4, 9). The interpretation adopted in Mr. Moulton's paper was criticised by Col. Manders in the "Entomologist's Record" for May 1909 (pp. 120, 121) and defended by the present writer in Proc. Ent. Soc., 1909, pp. xxxvii, xxxviii.

Prof. Poulton had recently received a fine set of these two Euploeas taken by Mr. H. W. Simmonds on the dates and in the localities shown in the accompanying tabular statement. Accompanying them were two examples of *Tirumala neptunia*, Feld., both transitional towards the New Hebrides form *moderata*, Butl. One of these and one of the male *proserpina* exhibited symmetrical injuries to the hind-wings, indicating attack by birds or lizards; the other *neptunia* and a second male *proserpina* were asymmetrically injured, probably by the same cause.

Mr. Simmonds wrote on June 7, 1919, that "Waidoi is in the very wet district where butterflies are very rare, probably owing to the absence of sunshine. The *Tirumala* flies with the Euploeas and is very difficult to distinguish when on the wing. They occur as 1 to 20 or 30 of the two Euploeas. The common *Euploea* has a strong smell of Dumb-nettle when crushed." The table below showed that all three species fly together.

	Dates in 1919.	*Eleutho.*	*Proserpina.*		*Tirumala neptunia.*
		♂ and ♀ alike.	♂	♀	♂
Suva.	April 7	1 ♂	1	—	—
	,, 22	—	4	—	—
Waidoi Rubber Plantation, nr. Navua, S. Viti-Levu.	May 27	1 ♀	—	2	—
	,, 28	—	2	1	—
	June 1	—	1	3	1
	,, 2	—	1	1	—
	,, 4*	1 ♂	5	2	—
	,, 5	—	3	1	—
	,, 6	—	2	2	1
	,, 8	1 ♀	—	—	—
	,, 9	—	6	4	—
	,, 10	—	1	2	—
	Totals	4	26	18	2

* From this date onwards the collection includes every specimen captured.

When the examples of *proserpina* were separated into sexes it became obvious that the lengthening inward of the fore-wing spot (bringing about the resemblance to the chief marking of *eleutho*) is carried much further in the females than the males, thus following a very general rule in mimicry, viz. when the pattern of a mimetic species differs in the two sexes, the female is a better mimic than the male. The further mimetic advance of the female was associated with a highly dyslegnic pattern (λέγνον, an edge or border; δυσ-, bad), commonly found in mimetic butterflies in relation to their models and in females in relation to their males—generalisations illustrated by many examples projected on the screen.* The pattern of the male *proserpina* was less dyslegnic, and that of the model *eleutho* still less so, parts of it being in fact eulegnic (ευ-, good).

The mimicry here referred to concerned the fore-wing only. In the hind-wing it was possible that *eleutho* is a mimic of *proserpina*. One out of Mr. Simmonds' four specimens (that of June 4) differed in the much higher development of the hind-wing submarginal pattern, which in this respect resembled forms of *eleutho* from some other islands. The reduction of this pattern in the other three examples as well as in those collected by Prof. Gilson promoted a resemblance to *proserpina*.

It will be noticed that the numbers of *eleutho* are very small as compared with those of *proserpina*.† Further collections were needed in order to test these proportions: they might be seasonal or local. Prof. Gilson's small series, taken Oct. 15–16, 1897, on Nukulau, a coral island, south of the mouth of the Rewa River, S.E. Viti Levu, included one *eleutho*, five *proserpina*. Another *eleutho* was captured Oct. 8, at Suva.

* For a fuller development of these principles and the introduction of the terms dyslegnic, etc., see Proc. Linn. Soc., 1915–16, pp. 37–41.

† In a letter written from Waidoi, Oct. 18, 1919, Mr. Simmonds states that after June 10 "*eleutho* undoubtedly became relatively more common, although never so abundant as *proserpina*. It is a more deep bush species than the other and is still continuing to emerge. When crushed the male of *eleutho* gives off a decidedly pleasant scent like cachou. Its flight is rather more like a Nymphaline than a typical *Euploea*.

"Nov. 1, 1919. To-day I went up into the bush a long way, and saw 3 worn *proserpina* and 1 fresh *eleutho*."

Wednesday, December 3rd, 1919.

Comm. J. J. Walker, M.A., R.N., F.L.S., President, in the Chair.

Death of a Former President.

The President announced the death of Lord Walsingham, a former President of the Society, which had taken place shortly after the previous midnight. A vote of condolence with Lady Walsingham was passed, the Fellows present rising in their places.

Election of Fellows.

Messrs. A. S. Buckhurst, 9, Souldern Road, W. 14; Nibaran Chandra Chatterjee, B.Sc., Forest Research Institute, Dehra Dun, United Provinces, India; Miss Florence B. Constable, 17, Colville Mansions, W. 11; Messrs. Conrad Theodore Gimingham, O.B.E., F.I.C., Lynwood, Long Ashton, Bristol; William Hawker-Smith, Speedwell Cottage, Hambledon, Godalming, Surrey; Miss Gertrude M. Jeans, Penn Court, 54, Cromwell Road, S.W. 7; Messrs. Herbert William Mills, N.D.A., The Gardens, Lydney Park, Gloucestershire; Louis Paravicini, Villa Aleucita, Arlesheim, Bâle, Switzerland; L. N. Staniland, Trewint, Coppett's Road, Muswell Hill, N. 10; P. Susainathan, Assistant in Entomology at the College of Agriculture and Research Institute, Coimbatore, S. India; E. B. Watson, The Grange, Winthorpe, Newark; and H. Worsley Wood, 31, Agate Road, Hammersmith, W. 6, were elected Fellows of the Society.

Exhibitions.

Lepidoptera from Argentina.—Mr. H. J. Turner exhibited two specimens of *Citheronia vogleri* and a photograph of the full-grown larva, from Argentina, on which he read the following notes by the sender :—

" Probably one of the most interesting insects I send you is *Citheronia vogleri*, and I have a number of males, but only three poor specimens of females. The female is nearly double the size of the male. I believe this insect is confined entirely to the centre of the Argentine Republic—at least, I have never seen it or heard of it from other parts. It is not found south of Cordoba, as its food-plant does not grow further south, and I believe the food-plant is not found much further north than Santiago del Estero. It has taken me about six years to find the food-plant of this moth, or rather caterpillar. I caught a bad specimen of a female about six years ago, and got it to lay eggs. The eggs came out in due time, and I tried all the food-plants I could find in the neighbourhood where I caught the female, which by the by was while it was flying round an arc lamp. All the caterpillars died, as I could not get them to feed on anything. Since then I have caught males around the arc lamps near the outskirts of the city, but I never saw another female till this year (1918), and again I got it to lay eggs. As I always found the insect in the outskirts of the city, I thought perhaps the food-plant might be some fruit tree not generally found except in the fruit gardens. The tree I decided on was apricot, and when the eggs hatched I put the caterpillars on apricot trees. They started to eat, but were very restless, and after a few days some died. Meanwhile I made inquiries from the gardeners, if they had ever found a caterpillar with long horns; but no one had, so I came to the conclusion that this could not be the food-plant. I accordingly went out into the country and collected samples of the various shrubs and trees. Meanwhile, out of sixty caterpillars only about twenty were left. The one plant they seemed to take to was a tree known as 'Quebracho Blanco,' one of the Argentine hard-wood trees with thick leaves. I thought I had now discovered the right food-plant, and so one Sunday went out with the idea of trying to find the caterpillar. I did not find any on this particular tree, but found it on a shrub belonging to the same class known as 'Quebracho flojo,' its Latin name being *Todina rhombifolia*. All the caterpillars I had left now changed over to this food-plant except two, which kept to the apricot, became full grown and pupated. I have altogether about thirty pupae now; one so far has emerged. They have been in the pupa stage about a month now, and I am not sure that they wont lie over till spring. The caterpillar is a typical *Citheronia*, with four long horns at the front and one at the back. When full grown it is about 11 cm. long and $1\frac{3}{4}$ cm. thick. Its colouring is like the bark of the tree. The pupa is very like that of *Basilona imperialis*, but smaller and jet black. They go to earth to pupate. The food-plant is thorny, and the leaves have three spikes and are very thick. The caterpillar when first emerging from the egg has the characteristic spikes on the horns, but as it changes its skin this disappears, till the horn of the full-grown caterpillar developes only rows of papillae.—F. Lindeman, Cordoba, Argentina."

Seasonal Forms of Teracolus rogersi.—Dr. F. A. Dixey exhibited specimens of *Teracolus rogersi*, and remarked on them as follows :—

"Some years since, the Rev. K. St. A. Rogers, who has done such excellent work on the Rhopalocera of British East Africa, sent home specimens of a new form of *Teracolus*, belonging to the *achine* group, which had been captured and bred by him at Taveta in the months of July and August, 1905 and 1910. These were figured and described in our 'Transactions' for 1915 as *Teracolus rogersi*.* They were all of the dry-season form, the wet-season phase being then, and for a long time after, unknown. Specimens have, however, now been received from Mr. Rogers which there is no difficulty in recognising as the wet-season forms corresponding to the dry-season types.

"I exhibit a male and female of this latter phase, both captured at Kiboriani on March 23, 1918. They are, as might be expected, more heavily marked than the dry-season types; and show beneath a well-marked dark veining, and a pale ground-colour with yellowish bands in place of the dusky reddish-ochreous of the types.

"The form is nearly related to *T. halyattes*, Butl., the type of which came from Natal. It may no doubt be considered as the representative of that species in British and 'German' East Africa."

Lord Rothschild asked whether the small size of the dry-season form, the opposite of what occurs in *Precis*, was characteristic in *Teracolus*, to which Dr. Dixey replied that it is usual but not perhaps universal; Dr. Marshall said that the

* Trans. Ent. Soc. Lond., 1915, p. 1, Pl. I, figs. 1–4.

difference was to be expected as the dry-season *Precis* larvae feed up in the wet season, whilst *Teracolus* larvae feed through the dry season..

CONTINENTAL NEUROPTERA and PSEUDO-NEUROPTERA.—Lt. E. B. ASHBY exhibited the following species:—

Myrmeleon libelluloides, Le Trayas, French Riviera; *Ascalaphus longicornis*, La Granja, Digne, and Vernet-les-Bains; *Panorpa communis*, Turin and Haywards Heath, Sussex; *Perla bicaudata*, Arquata Scrivia and Vernet-les-Bains; *Sympetrum sanguineum*, Turin; *S. scoticum*, Turin; *Libellula depressa*, Turin; *L. erythraea*, Turin; *L. pedemontana*, Turin.

A BEETLE NEW TO THE BRITISH LIST, AND FORMS OF CETONIA AURATA, L.—Mr. K. G. BLAIR exhibited a specimen of *Abax parallelus*, Duft, an addition to the list of British Coleoptera, from the Scilly Islands, with specimens of *A. ater*, Vill. (*striola*, Fab.), for comparison.

Also series of *Cetonia aurata*, L., showing:—

1. A series from Swallowfield, Berks. (June, 1919, A. Campbell-Smith), with the white markings very much developed.
2. A series from the Scilly Islands, much less heavily marked with white.
3. Two black specimens (var. *nigra.*, Gaut.) from the Scilly Islands, July 1919 (recorded in Ent. Mo. Mag. for Sept. 1919).

This black form, originally recorded from Corsica, where it has also been taken by Mr. Champion, is known also from Italy and S. Russia, but does not appear to have been observed hitherto in Britain.

FORMS OF THE AFRICAN CHARAXES ETHEOCLES, CR.—Prof. POULTON said that at the corresponding meeting last year the late Mr. H. Dollman showed his beautiful series of bred *Charaxes* of the *etheocles* group from N.W. Rhodesia. Mr. Dollman had proved that there were, in his locality, two distinct species differing in larval and pupal characters and in food-plant as well as in the patterns of the imagines. Of these the first had blue-marked, white-barred females resembling *manica*, Trim., and, like it, mimicking the females of *Ch. bohemanni*, Feld.; the females of the second resembled *phaeus*, Butl., lacking the white bar and mimicking the males of *bohemanni*. Prof. Poulton had suggested that the first might be forms of *ethalion*, Boisd., and the second true *etheocles* (Proc. Ent. Soc., 1918, p. lxxx and footnote). This suggestion was no longer tenable, for Dr. Karl Jordan, after examining the genitalia, had come to the following conclusions :—

" No *ethalion* are included in Mr. Dollman's series. What we call *etheocles* probably consists of *two* species, both having ♀♀ of the *phaeus*-type and of the *etheocles*-type. Dewitz figures a ♂ close to Dollman's with *phaeus*-like ♀♀, but the ♀ of the former is white-banded. Our ♀ *coryndoni* (Nov. Zool. vi, pl. 8, f. 7) is almost the same as one specimen of Dollman's *phaeus*-series, sub-marginal spots rounded, not arcuate."

Lord Rothschild had also pointed out to Prof. Poulton that one of the series of *phaeus*-like ♀♀ in the Dollman collection in the British Museum really belonged to the series of *manica*-like, white-barred ♀♀, although without the white bar. Its under surface showed the pattern which Mr. Dollman had recognised as characteristic of his white-banded females, and had shown to Prof. Poulton after the meeting of December 1918. Its inclusion in the *phaeus*-like series was clearly accidental.

Mr. Dollman's most interesting discovery suggested that the *etheocles* group required re-examination throughout in order to determine the relationship of the two N.W. Rhodesian species respectively to all the other forms. How numerous and distinct these are was indicated by a series of coloured slides illustrating nearly all the mimetic females of the group, together with their models among the larger species of *Charaxes*. Attention was specially directed to the least perfect mimic *viola*, Butl., and its model *epijasius*, Reiche. Although the likeness in the cabinet is by no means close, it is probable that the two would resemble each other upon the wing. Both were open-country butterflies, whereas most of the other forms of *etheocles* and their models were forest-lovers. Dr. S. A. Neave had kindly written :—

" As far as I recollect—and such of my material as is in the B.M. seems to confirm it—I only took the ♀ *viola* form in the open country in Northern Uganda. It occurs on both sides of the Victoria Nile, but chiefly on the east. In that region apparently nothing but this form occurs, and it is more or less *all* open country. *C. epijasius* is common there, but owing to its being hard to catch and still harder to find in good condition, its numbers in collections probably do not represent its real incidence."

Dr. Jordan had kindly informed Prof. Poulton that in addition to the localities given in the monograph in Nov. Zool., vol. vii, *viola* has been received from Yelva, Bornu, Niger; Meridi, Bahr-el-Ghazal; Ujiga and Kajomba, Lado Enclave; Mohoroni, Uganda; and Toro: *epijasius* from Uganda, Blue Nile, Lake Baringo, and Bahr-el-Ghazal, but not as yet from the Lado Enclave." Dr. Jordan added: "I do not know whether collectors have actually caught *viola* ♀ and *epijasius* in the same spot; both came in a small collection from Meridi, Bahr-el-Ghazal."

This doubt could be now dismissed, for the Hope Department had received both, taken in the same localities in the Nuba Hills by Col. R. S. Wilson, and still more recently from Torit, Mongalla Province, S. Sudan, captured by Capt. A. L. Kent Lemon. A beautiful slide, kindly coloured by Dr. H. Eltringham, showed *epijasius* and the ♀ *viola* taken at Torit on May 25, 1919, and the ♂ of *viola* on May 29.

Lord Rothschild and Drs. Jordan, Marshall, Gahan and Neave commented on Prof. Poulton's exhibit.

Paper.

The following paper was read :—

"New *Staphylinidae* from Singapore, pt. iii.," by Malcolm Cameron, M.B., R.N.

The House-fly in Winter.—Dr. Longstaff inquired whether anything could be added to Dr. Gahan's letters in the "Times" calling attention to the statement that larvae of the House-fly had been found living in snails in mid-winter, and Dr. Gahan said that although he had no reason to doubt the statement, yet, in view of the fact that other species of fly were known to live parasitically in snails, he thought there might possibly be a mis-identification, and for that reason he was anxious to receive snails for investigation in order to find out how far the statement of M. E. Séguy held true; nothing definite was yet known as to how the House-fly normally passed through the winter; there was no evidence to support the old idea that it hibernated in the adult state; and the probability was that it went through the winter either as a larva or a pupa; but proof here again was wanting, and much further investigation in various directions was badly needed.

ANNUAL MEETING.

Wednesday, January 21st, 1920.

Comm. J. J. WALKER, M.A., R.N., F.L.S., President, in the Chair.

The Rev. GEORGE WHEELER, one of the Secretaries, read the following

Report of the Council.

During the past year the Society has sustained an unusual number of losses by death, fifteen in all, two being those of former Presidents, Dr. F. DU CANE GODMAN and Lord WALSINGHAM; five Fellows also have resigned, and eight have been removed for non-payment of subscriptions. Our total losses therefore amount to twenty-eight, but in spite of this fact our numbers are at this moment at the highest point they have ever reached, no less than fifty-seven new Fellows having been elected since the last Annual Meeting. The Society now consists of twelve Honorary Fellows, two Special Life Fellows, six hundred and eighteen Ordinary Fellows, making a total of six hundred and thirty-two.

The Vacancy among the Trustees of the Society, caused by the death of Dr. GODMAN, was filled by the appointment of the Honble. N. CHARLES ROTHSCHILD.

The Council has voted a donation of five guineas towards the Godman Memorial in the Natural History Museum.

The continued rise in the price of paper and even more the large increase in the cost of labour have made it impossible for the Business Committee to sanction the publication of quite so large a body of matter as has been customary for some years past; the Transactions, however, contain 467 pages and consist of nineteen papers by the following authors:—H. E. ANDREWES (2); Prof. J. CHESTER BRADLEY, M.S., Ph.D.; T. A. CHAPMAN, M.D., F.R.S., etc. (3); G. CHESTER

Crampton, Ph.D.; F. A. Dixey, M.A., M.D., F.R.S.; Alan P. Dodd; H. Eltringham, M.A., D.Sc., F.Z.S. (2); Sir George Hampson, Bart., B.A., F.Z.S.; Martin E. Mosley (2); F. Muir (2); R. C. L. Perkins, M.A., D.Sc., etc.; A. Jefferies Turner, M.D., and C. B. Williams, M.A. Of these eight refer to the Lepidoptera, five to the Coleoptera, three to the Trichoptera, two to the Hymenoptera, and one to Insect Phylogeny, but of those on the Lepidoptera Dr. Eltringham's on Butterfly Vision, and Mr. Williams's on Migration are really of much wider interest. The papers are illustrated by two chromo-lithographs, one 3-colour plate, eight collotypes, one copper line-block, fourteen half-tone plates, twelve line-blocks and a large number of text figures; Dr. Chapman bears the cost of the two chromo-lithographs and half the cost of twelve half-tones, and Mr. C. B. Williams half the cost of five of the line-blocks. Nine of these plates are provided from the Westwood Bequest.

The Proceedings consist of 78 pages, and are illustrated by one collotype and one half-tone plate, the cost of the block of the latter being defrayed by Mr. H. M. Edelsten.

The attendance at the meetings has been generally good, except at the first meeting in October, when owing to the strike on the Railways and Tubes only four Fellows and one Visitor succeeded in putting in an appearance. The exhibits have also come well up to the average in number and interest.

In February a Sub-Committee was formed, consisting of Dr. Neave, the Honble. N. C. Rothschild and the Treasurer to enquire into the question of better accommodation for the Society, which has now, especially with regard to Library space, far outgrown its present quarters. This Sub-Committee has during the past year been making enquiries with a view to obtaining Government accommodation, but this having proved impossible, it is now engaged in the preparation of alternative schemes.

The Librarian reports:—

That 357 volumes have been issued for home use as against 330 for the previous year. The Library has been largely used for the purposes of reference. Thirty volumes and a large quantity of separata have been presented to the Library.

The Report was adopted on the motion of Dr. Hugh Scott, seconded by Mr. H. J. Turner, and the Treasurer then read the following Report:—

The dominant factor affecting the Finance in 1919 has been, as it was in 1918, the cost of publishing. This has been about double the price that obtained previous to the War, whereas the income has remained almost stationary. Under these circumstances the only way to make both ends meet was to reduce the amount of the publications, which has had to be done. Apart from this question the financial position is satisfactory.

A year ago I ventured to make two forecasts, one of which was that I hoped to record as large a number of subscriptions paid in 1919 as in 1914, until then the high-water mark. The other was that I hoped the amount of arrears of subscriptions would be reduced during the past year. The actual position on the 31st of December last was, that in 1919, 488 current year subscriptions had been received in place of 472 in 1914, an increase of 16. The amount of subscriptions in arrears at the end of last year was £84 3*s*. 0*d*. due from 47 Subscribers as against £147 10*s*. 11*d*. due from 69 Subscribers at the end of 1918, a reduction of £63 7*s*. 11*d*.

The total Income in 1919 was £885 15*s*. 11*d*., a reduction on that of the previous year of £40 7*s*. 2*d*. This reduction is very much more than accounted for by a reduction of receipts from arrears of subscriptions of £109 4*s*. 6*d*. The reason of this reduction of course is, that the arrears out of which this source of income arose, were in 1919 only about one-half of what they amounted to the previous year.

Admission Fees amounted to £48 6*s*. 0*d*. more than in 1918. Four Fellows have compounded for their subscriptions as against one in 1918. The sale of Publications is rather unaccountably down by nearly £30. Donations in aid of the Publications are very small, amounting to only £4 2*s*. 6*d*. Donations in aid of the Tea Fund have been sufficient to place it on a sound footing. There has been during the year a large and welcome addition to the number of Fellows, now about 200 in number, who have adopted the method of paying their subscriptions direct to Messrs. Coutts & Co. through their Bankers. This method results in a saving of expense to the Society, of expense and trouble to those who adopt it, and a considerable amount of trouble to myself. In thanking these Fellows I should like to express the hope that there will be during the present year a further large addition to their ranks.

With respect to the disposal of the Admission Fees, which are not strictly speaking income, a new departure has been taken. There has been up to the present nothing in the nature of a fund for the purchase of new books for the Library. It has been decided that in 1919 and in future, one-half the amount arising out of Admission Fees shall be devoted to this purpose, the other half being invested annually to assist what I propose to call the Compounding Fund.

An explanation of the meaning and necessity of this Fund seems necessary.

From the date of its formation in 1833, until the year 1862, the Society did not possess any money invested, but used everything in current expenditure. In the latter year, however, the Council having funds in hand, invested in consols the sum of £109 14*s.* 0*d.* What amounts practically to an apology was given for taking this step instead of spending the money on the Publications.

Bearing in mind that at this date no fewer than 22 out of the 143 members had compounded for their subscriptions, leaving the 121 who had not compounded to carry on the entire financial burden of the Society, an apology hardly seemed necessary.

The next investment, of £38 6*s.* 5*d.*, took place in 1869; and various sums were invested between this date and 1876, when the principle of investing the compounding fees seems first to have commended itself to the Council. In this year six were received, and four of them were invested. Between the years 1876 and 1894 a few more Fees were invested; apparently when the Council considered they could afford to do so.

During the Treasurership of Robert McLachlan it was recognised that the Society should in future invest all sums arising from compounding to provide a fund the interest of which would defray the expenditure the Society must incur to those Fellows who had compounded for their subscriptions, and for many years, including the whole period of the Treasurership of Mr. A. H. Jones, all the compounding fees were invested in Consols.

The result at the beginning of 1919 was that there were in the Society 65 Fellows who had compounded, and the interest on the money provided to pay their expenses to the Society amounted to £33 17*s.* 0*d.* per annum, or about 10*s.* 5*d.* per Fellow.

As the publications supplied to each Fellow cost the Society considerably more than this sum, and there are in addition what might be called Establishment charges, which work out at several shillings per Fellow, it is obvious that at the present moment compounding is, from an income point of view, a distinct burden upon the Society.

To gradually reduce this burden, the Council will in future, in addition to investing the money arising out of the compositions, invest also half the amount received from Admittance Fees. The Investment chosen for this purpose is the 5 % War Loan of 1928, which must be redeemed at par in that year, whereas the old investment stock, consols, is not redeemable at par, the result being unfortunately that to-day it is only worth very little more than half the original cost.

The General Balance, after allowing for the estimated Liabilities at the end of 1919, amounts to £207 3*s.* 0*d.* I think this sum should be held as a reserve against the cost of moving and installing the Library in the new quarters, when these are found.

I regret to have to point out that the Society's Investments show a further large depreciation in value. The Stocks, Consols, and Birmingham 3 %, mark a decline during the year of £122 17*s.* 6*d.*

The TREASURER then read the Balance Sheet, which was adopted on the motion of Mr. E. E. GREEN, seconded by Mr. STANLEY EDWARDS.

The PRESIDENT then declared the following Fellows to have been duly appointed to serve as Officers and Council for the ensuing session :—

President, Comm. JAMES J. WALKER, M.A., R.N., F.L.S.; *Treasurer*, W. G. SHELDON, F.Z.S.; *Secretaries*, the Rev. GEORGE WHEELER, M.A., F.Z.S., and S. A. NEAVE, M.A., D.Sc., F.Z.S.; *Librarian*, G. C. CHAMPION, A.L.S., F.Z.S.; *Other Members of Council*, H. E. ANDREWES; G. T. BETHUNE-BAKER, F.L.S., F.Z.S.; K. G. BLAIR, B.Sc.; Surgeon-Comm. M. CAMERON, M.B., R.N.; J. HARTLEY DURRANT; H. ELTRINGHAM, M.A., D.Sc.; A. D. IMMS, M.A., D.Sc., F.L.S.; G. A. K. MARSHALL, D.Sc., F.Z.S.; the Rev. F. D. MORICE, M.A., F.Z.S.; H. E. PAGE; the Rt. Honble. Lord ROTHSCHILD, M.A., F.R.S., etc., Capt. the Rev. J. B. WATERSTON, B.D., B.Sc.

The PRESIDENT also read a letter from Lady Walsingham expressing her thanks for the letter of condolence voted by the Society.

He then read an Address, after which a Vote of Thanks to him was passed on the motion of Mr. HAROLD HODGE, seconded by Lord ROTHSCHILD, to which he replied.

A Vote of Thanks to the Officers was then proposed by Prof. SELWYN IMAGE, and seconded by Mr. W. J. KAYE, to which the Treasurer and the two Secretaries replied.

THE ENTOMOLOGICAL SOCIETY OF LONDON.

TREASURER'S ACCOUNTS for the Year ended December 31, 1919.

(Presented at the Annual Meeting, January 21, 1920.)

RECEIPTS AND PAYMENTS ACCOUNT.

RECEIPTS.		£ s. d.	£ s. d.
To Cash at Bank as per last Account—			
Tea Fund Account		11 0	
General Account	£725 16 7		
Less Transferred to Compounding Fund	81 10 0		
		694 6 7	
Compounding Fund Account		31 10 0	
Westwood Bequest Fund Account ...		95 2 10	
			821 10 5
„ Cash in Treasurer's hands on Tea Fund Account			5 0
„ Interest on Investments—			
Dividend on Consols		33 17 0	
Interest on Deposit		17 11 7	
Interest on Birmingham 3 % Stock (Westwood Bequest)		7 3 8	
			58 12 3
„ Admission Fees			79 16 0
„ Annual Contributions 1919		491 5 0	
Arrears		77 14 0	
In Advance		32 11 0	
			601 10 0
(Subscriptions in respect of year 1919 received in 1918, £21)			
„ Compositions			63 0 0
„ Sales of Publications			125 7 5
„ Donations—			
In aid of Publications		4 2 9	
In aid of Tea Fund		16 7 6	
			20 10 3
„ Miscellaneous Receipts			16 19 10
			£1,787 11 2

W. G. SHELDON, *Treasurer.*

PAYMENTS.		£ s. d.	£ s. d.
By Rent			70 7 6
„ Salaries			53 18 0
„ Library—			
New Books		6 10 6	
Binding, Repairs and Insurance... ...		11 1 5	
			17 11 11
„ Cost of Publications—			
Printing		661 5 0	
Illustrations—			
General	£21 17 5		
Westwood Bequest ...	37 2 10		
		59 0 3	
Distribution		102 19 1	
			823 4 4
„ Sundry Printing and Stationery			41 11 10
„ Postage			9 8 11
„ Tea and Light Refreshments			14 2 6
„ Audit Fee			5 5 0
„ Compounding Fund—			
Purchase of £47 1s., 5 % National War Bonds—Cost			47 5 0
„ Miscellaneous Payments...			18 18 0
„ Cash at Bankers, on Deposit and Current Accounts—			
On General Account		497 3 0	
On Westwood Bequest Fund Account		65 3 8	
On Compounding Fund Account ...		87 3 0	
On Library Fund Account		33 7 6	
On Tea Fund Account		3 1 0	
			685 18 2
			£1,787 11 2

We have examined the above Account of Receipts and Payments with the Books and Vouchers and certify it to be in accordance therewith. Vouchers for all payments have been produced to us.

The Bankers have certified the correctness of the Cash Balance and that they hold the Securities for the Investments.

23, *Queen Victoria Street, London, E.C.* 4.
January 13, 1920.

W. B. KEEN & Co., *Chartered Accountants.*

WESTWOOD BEQUEST FUND.

	£	s.	d.		£	s.	d.
To Balance at Bank, January 1, 1919	95	2	10	By Expenditure on Illustrations	37	2	10
,, Interest on Birmingham 3% Stock	7	3	8	,, Cash at Bank, December 31, 1919	65	3	8
	£102	6	6		£102	6	6

COMPOUNDING FUND.

	£	s.	d.		£	s.	d.
To Balance at Bank, January 1, 1919	31	10	0	By Investment, £47 1*s*., 5 % National War Bonds 1928 (3rd Series)—Cost	47	5	0
,, One-half of Admission Fees received in 1919	39	18	0	,, Cash at Bank, December 31, 1919	87	3	0
,, Compositions, 1919	63	0	0				
	£134	8	0		£134	8	0

LIBRARY FUND (NEW BOOKS).

	£	s.	d.		£	s.	d.
To One-half of Admission Fees received in 1919 ...	39	18	0	By Expenditure on New Books	6	10	6
				,, Cash at Bank, December 31, 1919	33	7	6
	£39	18	0		£39	18	0

TEA FUND.

	s.	d.	£	s.	d.		£	s.	d.
To Balance at Bank, January 1, 1919	11	0				By Caterer's Account	14	2	6
,, Cash in Treasurer's hands, January 1, 1919	5	0				,, Cash at Bank, December 31, 1919	3	1	0
				16	0				
,, Contributions			16	7	6				
			£17	3	6		£17	3	6

W. G. SHELDON, *Treasurer*.

MEMORANDUM

AS TO ASSETS AND LIABILITIES AT DECEMBER 31, 1919.

Assets.

	£ s. d.	£ s. d.	£ s. d.
To Arrears of Annual Contributions	£84 3 0		
,, Arrears of Admission Fees ...	6 6 0		
,, Arrears of Contributions to Publications	3 19 6		
		94 8 6	
Less Amount not considered good ...		39 18 0	
			54 10 6
,, Present value of—			
£1,354 2*s.* 2*d.* Consols 2½ % at 51 (Cost £1,233 3*s.*), Compounding Fund		690 11 11	
£239 12*s.* 4*d.* Birmingham Corporation 3 % Stock at 56 (Cost £250)		134 3 9	
£47 1*s.*, 5 % National War Bonds 1928 (3rd Series) at 98 (Cost £47 5*s.*) Compounding Fund		46 2 2	
			870 17 10
,, Balance at Bankers, December 31, 1919—			
On Deposit Account		400 0 0	
On Current Account		285 18 2	
			685 18 2

W. G. Sheldon, *Treasurer.*

Liabilities.

	£ s. d.
By Cost of Printing Transactions Parts III—V, 1919; Cost of Plates and Sundry Unpaid Accounts ...	290 0 0


0
20
40
60
Schubert B.
Maldives
Seychelles
Chag
Rodrigue
Tropic of
Crozets
Kerg

THE PRESIDENT'S ADDRESS

Ladies and Gentlemen,

From the Report of the Council which has just been read, it is I think fairly evident that the past year has been one of more than usual prosperity for our Society. Not only do our finances—thanks in large measure to our energetic Treasurer—show a balance in our favour that may be regarded as highly satisfactory, but the steady increase in the numerical strength of the Society during the past session is most encouraging, and the number of new Fellows elected on December 3rd has only once been exceeded, I believe, at any previous meeting.

With one exception of recent date, due to causes entirely beyond our control, in which the number of Fellows present reached probably the lowest point in our entire history, our meetings have been very fully attended, and the exhibits and discussions have been quite up to their usual high standard. Notwithstanding the fact that the cost of printing, and even more that of illustration, continues to grow by leaps and bounds, the Transactions and Proceedings of the Society for the past year, though they may not attain the bulk of some of our former annual volumes, are not a whit behind any of their predecessors in scientific value and interest. Among so many meritorious papers it is perhaps invidious to draw special attention to any one of them; but we may congratulate ourselves on being enabled to publish in our Transactions a memoir on so suggestive and interesting a subject as the paper by Dr. Eltringham on "Butterfly Vision."

Our Library continues to increase steadily, and the difficulties arising from the inadequate space in which we are compelled to house it become more painfully evident year by year. The necessity of seeking more ample accommodation is thus in a measure forced upon us; and although some, including myself,

MAP TO ILLUSTRATE THE PRESIDENTIAL ADDRESS.

may regret having sooner or later to leave our present quarters, with their advantages of central situation and ready accessibility, and their associations with the memories of forty-five years of the Society's history, we can only trust that our efforts in that direction may be crowned with success in the near future.

The honour you have conferred upon me by my election to the office of President has involved the choice of a new Secretary in my place, and the Society may be congratulated in having found in Dr. S. A. Neave a Fellow who has proved himself so highly qualified in all respects for this somewhat onerous but highly interesting and enjoyable office—I speak from experience. To Dr. Neave and his colleague the Rev. G. Wheeler, as well as to the other Officers and Members of Council, my best thanks are due for their steady and unfailing support and assistance during the past session.

I regret to say that our losses by death have been more numerous than usual, and two of our Fellows who have gone from us were in the very front rank of Entomological Science, and in former years were among the most distinguished occupants of the Presidential Chair. On February 19th Dr. F. Du Cane Godman passed away, full of years and honours, and the generous appreciation by Lord Walsingham of his life-work and personality, read by me from the Chair at the meeting immediately after his death, is still fresh in the recollection of all of us. We may, I think, agree that this noble tribute to the memory of our late valued colleague applies in very large measure to its own writer, whose unexpected decease on December 3rd it was my painful duty to announce to the Society at our meeting on the same evening. I fear it will be long indeed before the places of these two great masters of our Science can be adequately filled.

We have also to regret the loss of the veteran Major Thomas Broun, whose great work on the beetles of New Zealand, continued through many years, has revealed to us the marvellous Coleopterous fauna of those most interesting islands in the far South; of Hereward Dollman, a young and highly promising Entomologist and an accomplished artist, whose premature death was the result of a fell disease contracted in the course of duty in Tropical Africa, and of W. E. Sharp, one of the most able and energetic students of British *Coleoptera*, until quite lately a familiar figure at our meetings, and whose genial and sympathetic nature endeared him to all of us. We rarely saw Sir Frank Crisp, who joined the Society as long ago as 1880, and who was perhaps best known as an eminent microscopist and botanist, as well as a tower of strength to the Linnean Society. Other Fellows who have passed from among us are Lt.-Col. L. Blaythwayt, G. M. Carson, H. A. Fry, F. Hannyngton, T. Nottidge, E. J. Patterson, S. Wacher, and F. H. Wolley-Dod, the last-named being distinguished for his researches and observations on the Lepidoptera of the western regions of British North America.

It is perhaps a natural result of my career in the Royal Navy, in which I had the good fortune to observe and to study insect life, however superficially at times, in many remote and rarely visited parts of the world, that the subject of Geographical Distribution has always appealed to me more strongly than has any other aspect of our Science. On the present occasion it has occurred to me that a useful purpose may be served, by bringing together as many as possible of the available records of those hardy and adventurous butterflies which have penetrated northward and southward to the extreme limits of terrestrial life, and to the most remote islands in mid-ocean. I therefore venture to suggest, as the title of my Address—

" The Fringes of Butterfly Life."

Commencing our circuit of the shores of the North Polar Ocean with Norwegian Lapland, we find here a butterfly fauna of unexpected richness and variety for so high a latitude. Our enterprising Fellows, Messrs. Rowland-Brown and Sheldon, have in recent years visited this very interesting region, and we are greatly indebted to them for their delightful and valuable papers on Lapland butterflies in the volumes of the " Entomologist " for 1906 and 1912. Herr J. Sparre-Schneider enumerates no fewer than forty-six species which extend their range beyond the Arctic Circle, and of these such familiar forms as *Papilio machaon*, *Pieris brassicae* and *napi*, *Callophrys rubi*, *Vanessa antiopa* and *urticae*, the almost world-wide *Pyrameis* *cardui*, *Argynnis aglaia*, *Brenthis euphrosyne* and *B. selene*, are found as far north as the 70th parallel of latitude. Still more characteristic of the Arctic fauna are *Colias hecla*, Lef., *Erebia disa*, Thunb., *Oeneis norna*, Thunb., *Melitaea iduna*, Dalm., *Brenthis chariclea*, Schneid.—perhaps the rarest of European butterflies—*B. frigga*, Thunb., and *B. polaris*, Boisd., most of which we shall frequently encounter again as we proceed eastward round the Polar basin. Another of our Fellows, Dr. Cockayne, has by the fortune of war been enabled to gather some experience of the butterflies of the Murman coast, and we may, I hope, look forward to an account of his observations in that practically unknown region. Dr. B. Poppius records six species, all well-known Lapland forms, from the Kanin Peninsula east of the White Sea; and on August 4th, 1879, on the east coast of Novaya Zemlya, facing the inhospitable Kara Sea, the late Admiral Sir A. H. Markham met with *Colias nastes* var. *werdandi*, Zett., *Brenthis chariclea*, and the remarkable *B. improba*, Butl., which is probably a melanic form of *B. frigga* and was previously known only from Arctic America. Concerning these butterflies he writes—" The land at the head of Schubert Bay was the only place where I saw butterflies; and here I was fortunately able to secure several different specimens. They are, I believe, the first captured and brought home from Novaya Zemlya. They were excessively wild, flew very fast, and rarely alighted, so that they were exceedingly difficult to catch. . . . It is a curious fact that, although I landed several times during the month of August with the express purpose of obtaining specimens, it was only on the day above referred to that I saw any."

Records from the northern shores of Siberia are nearly or quite wanting, but the adventurous German explorer Middendorff gives a vivid and graphic description of the summer aspect of the tundra in the Taimur peninsula, gay with innumerable flowers and alive with insects, of which unfortunately the vast majority are the notorious Siberian mosquito. Middendorff tells us that on August 3rd, 1845, in the very middle of the short Taimurian summer, in 74° 15′ north latitude, he hunted butterflies under the shelter of a hill, barefooted and in light underclothes. The thermometer rose in the sun to + 68° F., and close to the ground to + 84°, while at a short distance on a spot exposed to the north-eastern air-current, it fell at once to + 27°. Further he states that "the more vigorous vegetation on the sheltered declivities of the Taimur provides food for a greater number of insects than is found on the coasts of Novaya Zemlya. Bees, hornets, and three species of butterflies, buzzed or hovered round the flowers, and caterpillars could be gathered by dozens on the tundra; but their mortal enemies had pursued them even here, and ichneumon flies crept out of most of them."

Many degrees of longitude to the eastward, the naturalists of the "Vega" expedition, during their memorable "North-east Passage" in 1878–9, found at their winter quarters, about 100 miles west of Behring's Strait, "larvae of an *Argynnis*" at the end of June; and they met with *Oeneis crambis*, Freyer, and *Erebia rossii*, Curtis, at St. Lawrence Bay in Chukchi Land, a little to the southward of these Straits. The swampy meadows of the desolate Pribyloff Islands, in the middle of Behring's Sea, are, according to H. W. Elliott, enlivened in summer by myriads of yellow butterflies, in all probability one of the North American species of *Colias*. Alaska appears to possess a fairly rich butterfly fauna, two Papilios, *aliaska*, Scudd., and *turnus*, L., even extending to the valley of the Yukon, from whence thirteen species of butterflies are recorded by Dr. S. H. Scudder. I can find no records, however, from beyond the Arctic Circle in this region, except that of *Erebia fasciata*, Butl., which appears to be not rare at Kotzebue Sound. This remarkable species was first obtained at Cambridge Bay (lat. 69° N., long. 107° W.) by Capt. Collinson in H.M.S. "Enterprise," during the prolonged search for Sir John Franklin's lost expedition. Mr. D. Hanbury, in the summer of 1902, made a large collection of butterflies on the Arctic coast near Cape Barrow (lat. 68° 30′ N., long. 111° W.), which is described by our former President Mr. H. J. Elwes in our Transactions for 1903, and illustrated by a very fine coloured plate. This collection, probably the most interesting and representative series of Arctic butterflies ever obtained from any one locality, consists of no fewer than fifteen species, including three *Erebias* (*fasciata*, Butl., *disa*, Thunb., and *rossii*, Curt.); two *Oeneis* (*bore* var. *taygete*, Hübn., and *semidea*, Say, var.); a variety (*mixturata*, Alph.) of our *Coenonympha typhon*; four species of *Brenthis* (*pales*, W. V., *polaris*, Boisd., *chariclea*, Schn., and *frigga* var. *improba*, Butl.); *Lycaena orbitulus* var. *franklinii*, Curt.; and four species of *Colias* (*hecla*, Lef., *boothii*, Curt., *pelidne*, Boisd., and *nastes*, Boisd.). From a little farther to the north-east, on the shores of Prince Regent's Inlet, we have the insects collected and preserved under the most trying conditions by the expedition under Capt. Sir John Ross, in the "Victory" during its sojourn of four years (1829–1833), in this desolate region; the second officer in command, afterwards Sir James Clark Ross of Antarctic renown, being in most cases the actual collector. Five species of butterflies are described and figured by John Curtis in his inimitable style, in the Appendix to Sir John Ross's Narrative of this voyage. These are *Colias boothii*, which "appears in mid-July on *Oxytropis*;" *C. chione*, probably a variety of the preceding; *Hipparchia* (*Erebia*) *rossii*, "five only, they were scarce and frequented the precipitous faces of dark-coloured rocks and loose stones; I never found any of them on flowers of any kind" (J. C. Ross, 1830); *H.* (*Oeneis*) *subhyalina*, one only, probably with the preceding; *Melitaea tarquinius*, in all probability the widely ranging *Brenthis chariclea*, "an abundant species, like the *Coliades* found feeding on the flowers of *Oxytropis*, June and July 1830"; and *Polyommatus franklinii* (= *orbitulus*, Esp. var.), "only two taken, feeding on *Astragalus alpinus*, end of July."

Another British Arctic expedition of more than forty years later date, that under Sir George Nares in the "Alert" and "Discovery" in 1875–6, brought back an important little collection of insects from nearly the highest latitude attained on that occasion, and the butterflies included in it may be regarded as probably the most northern representatives of their race in the world. Our former President, Mr. R. McLachlan, writes of these insects as follows—"Thirty-five specimens of gaily-coloured butterflies were procured, belonging to certainly five distinct species. It may safely be asserted that there are desert regions in the tropics that would not furnish an equal number. I have used the term 'desolate';

but the desolation is not of that extreme nature one would expect. I am informed by Prof. Oliver that over sixty species of flowering plants have been determined in the collections formed by the naturalists of the expedition between the already given parallels of latitude (78° — 83° N.). This fact, at first sight, reads like romance . . . Captain Feilden informed me that during the short period when there is practically no night, butterflies are continuously on the wing, supposing the sun's face not to be obscured by clouds or passing snow-showers." The species found in the vicinity of the "Discovery's" winter quarters, between 81° 42′ and 81° 52′ N. latitude, were *Colias hecla* (var. *glacialis*, McL.), *Brenthis polaris* (also from Disko Island in lat. 70° N.), *B. chariclea*, *Lycaena orbitulus* var. *aquilo*, Boisd., and, strange to say, a slight aberration (*feildeni*, McL.) of our familiar "Small Copper," *Chrysophanus phlaeas*, L.

Some very interesting observations on the butterflies of this remote region were also made by Lieut. A. W. Greeley, the leader of the ill-fated American Polar expedition of 1881–4. At Lake Hazen, in the interior of Grant Land, on June 28th 1882, "a large number of butterflies were seen, of which there were apparently three different species. They were so active and distrustful, however, that I succeeded in capturing but one during the day." On the 29th, one of the party saw "a bumble-bee and a devil's darning needle"—a highly interesting record, showing that the range of the *Hymenoptera* and the *Odonata* extends as far to the northward as that of the *Lepidoptera*—and "butterflies were very numerous, as many as fifty being seen during the day," which was one of unprecedented high temperature in the Far North.

The intrepid American explorer R. E. Peary also contributes his quota to the records of these Hyperborean butterflies. In June 1892, after he had crossed the appalling ice desert of North Greenland to bare land on the north-east coast, elevated 3800 feet above the sea, in lat. 81° 37′ N., long. 34° 5′ W., a fair amount of vegetation and "two bumble-bees, several butterflies, and innumerable flies" were noted by him. Another American Arctic voyager, Dr. I. I. Hayes, records the capture of a "yellow-winged butterfly" on July 9th, 1861, at his winter quarters at Port Foulke (lat. 78° 17′ N., long.

73° W.); and a few days later, at Barden Bay in Whale Sound (lat. 77° N.) "myriads of butterflies fluttered among the flowers," the day being calm and sunny, with the high temperature for that latitude of 51° F.

The entomologists of the Danish expedition to North-east Greenland in 1910, at the winter quarters of their ship on the east coast in lat. 76° 46′ N., long. 18° 14′ W., met with *Colias hecla*, *Brenthis chariclea* var. *arctica*, Zett., and *B. polaris* in numbers, and *Lycaena orbitulus* var. *aquilo* less commonly. One of them, Fritz Johansen, gives such a graphic and pleasing account of these butterflies in their almost inaccessible home, that I cannot refrain from quoting it *in extenso*. "Most marked of all the insects, however, are the butterflies, as it is only in the height of summer that all are out and can be said to be common. It is remarkable that with but few exceptions the North-east Greenland butterflies are not found on the most fertile places. On mossy ground, for example, the only common butterfly is the yellow *Colias hecla*, but this is also so much bound to such localities, that if there is a fertile slope round a larger or smaller water-course, we may be almost sure of seeing a *Colias* flitting about, and be able to follow with the eye how it keeps to the windings of the slope. On large grassy plots (for example at the foot of the fells) we see several of these beautifully coloured insects flitting about; when two come nearer together, they playfully cross and recross in the air before separating; the one perhaps settles on a *Dryas* blossom, whilst the other seeks rest on a blade of grass, the colour of which it resembles so much. The commonest day butterflies are, however, the *Argynnis*, but like the following they are not met with on boggy ground (nor in fact on the bare clay or stone plains). Yet we may be surprised by these butterflies flying up from ground where the dry grass, *Cassiope*, and other plants are only growing in hollows here and there, until we observe that it is just these places which afford the butterfly the most shelter. When this settles, for example, on a stone or a *Cassiope* tuft, the reddish-brown lichen covering the former, like the purple-black leaf of the latter, blends so perfectly in colour with the butterfly that this cannot be seen before it starts up. It is very shy, flying often far before it again settles, and as it ' doubles ' a great deal in its flight, it is more difficult to catch than *Colias*. These butterflies are sometimes seen together, however, in which case it is *Argynnis* that has come on to the grounds of *Colias*, and they playfully cross one another before proceeding on their way. More rarely and more singly we meet with the day-butterfly *Lycaena orbitulus* on localities similar to those of *Argynnis*. It is quite impossible to see this butterfly when sitting on the ground; the gray underside of the folded wings blends so perfectly with the surrounding small stones. It does not fly far each time, but irregularly and fairly quickly."

A much earlier record of butterflies from the same coast, but in a considerably lower latitude, is that of the veteran whaling captain William Scoresby, junior. At the end of July 1822, in the region now known as Scoresby Sound (lat. 70° 30′ N., long. 22° W.), he found on landing that " the insects were numerous, consisting of mosquitoes, and several species of butterflies." These latter are named in the appendix to Scoresby's narrative of his voyage, as " *Papilio palaeno*, L., and *P. dia*, L.," by Prof. Jameson of Edinburgh. Many years afterwards (1899–1900) this part of the Greenland coast was visited by Prof. A. G. Nathorst, who there collected specimens of the four butterflies so characteristic of these high latitudes, *Colias hecla*, *Brenthis chariclea*, *B. polaris*, and *Lycaena orbitulus* var. *aquilo*, to the first two of which Scoresby's insects must in all probability be referred. No butterfly has been as yet recorded from Spitsbergen, though several species of moths are known from this archipelago.

Before finally leaving the North Polar basin, the case of Iceland demands attention. As many as six species of butterflies, belonging to the characteristic Arctic genera *Colias*, *Erebia*, and *Brenthis*, have been stated by various writers to occur in this large island, which from its relatively mild climate and fairly luxuriant vegetation might reasonably be expected to produce some at least of them. But of late years, the visits of several able entomologists to Iceland, notably the long stay of Dr. Staudinger in 1857, have not revealed the presence of even a single resident species. The only authentic record that I can find of the occurrence of any butterfly in Iceland, is that of the late Rev. Francis Walker, who notes in Vol. XXII of the "Entomologist," the capture by Jon Thoroddson in 1888 of a specimen of *Pyrameis cardui* in one of the main streets of Reykjavik, the capital of the island.

When we proceed to the Southern Hemisphere, we find the terminations of the great land-masses lying many degrees farther from the Pole than is the case in the north; and with the exception of the extremity of South America, these southern lands enjoy far more genial conditions of climate. But the scanty butterfly fauna of these regions, as compared with that of corresponding or even far higher latitudes north of the equator, has not failed to impress strongly all Entomologists who have studied the distribution of these insects. The marked contraction southwards of the African continent would appear to have crowded, within narrow limits at its extremity, a Flora unparalleled anywhere in variety and number of species, with the possible exception of South-western Australia, where the geographical and physical conditions are somewhat similar. But when the comparatively low latitude of both these regions is considered, their poverty in butterflies is most remarkable. Lapland, more than thirty degrees nearer the Pole, produces at least as many kinds of butterflies as does Cape Colony, and during a residence of twenty-five years at Cape Town our former President Mr. Roland Trimen could find only forty-seven species in the immediate neighbourhood. A very large proportion of these are inconspicuous forms of *Satyridae*, *Lycaenidae*, and *Hesperidae*, only one *Papilio* (*leonidas*, Fab.) extending its range so far south, and the fine Nymphalid *Meneris tulbaghia*, L., being almost the only showy butterfly. The fauna of Western Australia is even more scanty, as only fifteen species are enumerated as occurring in the district round Perth; and when I was there in the summer of 1890, I was as much impressed by the very small number of butterflies to be seen on the wing, as by the endless variety and beauty of the flowers. Next to nothing is known of the insects of the long range of utterly desert coast facing the great Southern Ocean, and the more fertile regions of South Australia and Victoria are not much richer than Western Australia in species. The beautiful, varied, and luxuriant island of Tasmania, larger in area than Scotland, has fewer than thirty species of butterflies, including two or three remarkable endemic mountain forms of *Satyridae* formerly referred to the characteristic Australian genus *Xenica*, as well as one *Papilio* (*macleayanus*, Leach) which is common near Hobart, and is the most southern representative of its almost world-wide family.

In Patagonia we find, east of the mountain backbone of the country, a barren and treeless land with a limited Flora and a rigorous climate for its latitude, while the densely forested coast facing the Pacific Ocean is one of the wettest and most stormy regions in the whole world. Butterflies are therefore very poorly represented, C. Berg recording only fourteen species as occurring south of the Rio Negro in lat. 40°. In the vicinity of Magellan's Straits some half-dozen species have been found, and *Colias imperialis*, Butl., one of the finest and rarest representatives of its genus, is supposed, though with some doubt, to have been taken by Capt. P. P. King, R.N., at Port Famine about the year 1830. When I was at Punta Arenas on Christmas-day 1880, I found the grassy park-like country near the settlement enlivened by numbers of three pretty butterflies, *Colias vautieri*, Guér. (var. *cunninghami*, Butl.), *Pieris* (*Tatochila*) *argyrodice*, Staud., and *Brenthis cytheris*, Drury; but insect life of any kind was almost absent in the gloomy and saturated forests of the Western Patagonian channels. Mrs. Scoresby Routledge, however, in her adventurous voyage in the yacht " Mana " to Easter Island in 1913, occasionally saw butterflies on the shores of the Messier Channel in lat. 49° S. In Tierra del Fuego, Darwin says that he " saw very few flies, butterflies, or bees," but *Tatochila theodice*, Boisd., *T. xanthodice*, Luc., and *Brenthis cytheris* are recorded by Mabille from Orange Bay in Hoste Island, not far from Cape Horn in lat. 55° 30′ S., and these are almost certainly the most southern of all known butterflies.

Brenthis cytheris is also reported by Mr. R. Vallentin as occurring commonly in the bleak and treeless Falkland Islands, and another " larger and faster flying Fritillary with more pronounced markings," which he says has been seen in West Falkland, is almost certainly *Danaida plexippus* (race *erippus*, Cram.) which has wandered hither from South America, and has been captured in the islands on more than one occasion. The "blue butterfly," stated by Mr. Vallentin to have been frequently observed close to Stanley in the East Island, has not been identified, and thus remains a mystery.

The butterflies of oceanic islands, as defined by Wallace, form the subject of the second part of this Address, and I purposely omit any allusion to those of such island groups as lie near the great continents, and the insects of which are more or less well known. Reference may perhaps be permitted to the Faroe Islands, from which no butterfly is definitely recorded as yet, though there is a strong probability that *Coenonympha typhon* at least may be eventually found there; and to St. Kilda, where *C. pamphilus* is the only species that has been noticed. From the Azores, lying far out in mid-Atlantic, the late Dr. Godman has recorded nine butterflies, all familiar British forms except *Danaida plexippus*, which was first observed there in 1863, and has occurred subsequently on several occasions. To these may be added the little-known *Satyrus azorica*, Strecker, which is perhaps identical with a Satyrid butterfly seen in October 1880 by one of my messmates in H.M.S. "Kingfisher" in some numbers among the rocks on the summit of the Caldera of Fayal, 3300 feet above the sea. I ascended the mountain on the following day, which was unfortunately cloudy, so not a single example of the butterfly could be seen. The one specimen brought to me was in poor condition, but it appeared to be more nearly related to *Oeneis* than to any other genus, and it is well worth looking for by any entomologist who may visit these interesting islands.

Fourteen species of butterflies, according to Prof. A. E. Verrill, have been observed on the coralline group of Bermuda, which is fully 600 miles from the nearest point of the coast of North America. The record of three of these, *Vanessa io*, L., *V. polychloros*, L., and *Debis portlandia*, F., rests on the evidence of single specimens said to have been taken in the islands by Canon Tristram as long ago as 1848; but the first two species, to say the least, are most unlikely to have found their way from Europe to Bermuda. *Vanessa antiopa*, L., *Callidryas eubule*, L., *Colias philodice*, Hübn., *Pieris rapae*, and *Papilio cresphontes*, Cr., are more or less infrequent stragglers from the American mainland, and *Terias lisa*, Boisd., which has on more than one occasion visited Bermuda in great swarms, has perhaps succeeded in establishing itself as a resident species. *Danaida plexippus* has long been known from the islands, and *D. berenice*, F., *Pyrameis atalanta*, *P. cardui*, and *Junonia coenia*, Hübn., are also resident, a fine and strongly marked race of the latter being the commonest Bermudan butterfly.

Fernando Noronha, though barely 200 miles from the nearest point of Brazil, and covered with trees and luxuriant vegetation, has only one little Lycaenid, a form of *Tarucus hanno*, Stoll. From Ascension, 750 miles distant from the coast of Africa, *Pyrameis cardui*, *Hypolimnas misippus*, and *Lampides boeticus* have been recorded by Mr. P. de la Garde, R.N., although the vegetation of the island is of the scantiest, except on the highest summit, where there is a little cultivation and some trees and shrubs have been planted. The more inviting and fertile island of St. Helena has but one species, *Limnas chrysippus*, in addition to those of Ascension, but all the butterflies appear to be tolerably numerous as individuals. Far to the south, and 1550 miles west of the Cape of Good Hope, lies the storm-swept group of Tristan da Cunha and its satellite islands, where Dr. von Willemoes Suhm of the "Challenger" found "the larvae of a *Vanessa*," probably that of *Pyrameis cardui*, which was taken there many years afterwards by Mr. de la Garde; and from the report of the two observant German seal-hunters who were found at Inaccessible Island by the "Challenger," von Willemoes Suhm concluded that there were two butterflies, a *Vanessa* and an *Argynnis*, in that island. When Diego Alvarez or Gough Island, 280 miles south of the Tristan group, was visited by the naturalists of the "Scotia" in 1904, they found "a number of beetles, and several kinds of flies," but apparently no butterfly was present. The last Atlantic island to which I shall allude is South Trinidad, 500 miles distant from Brazil. This remote speck of land, perhaps the weirdest spot on the face of the earth, was visited in 1905 by the Earl of Crawford's yacht "Valhalla," and by the "Terra Nova" in 1912, but no butterflies were seen by the naturalists in either ship, though Mr. E. G. B. Meade-Waldo, in the "Valhalla," found a few species of moths of American type.

In recent years the Fauna and Flora of the numerous small islands scattered over the Indian Ocean have been investigated by successive scientific expeditions in a fairly exhaustive manner, and we now possess a tolerably complete knowledge of their insect productions. I purposely omit any reference to the Comoro Islands, Mauritius, and Bourbon (which may be regarded as satellites to the almost continental island of Madagascar) except to recall to mind the very valuable paper by the late Colonel Manders on the butterflies of the two latter islands, which appeared in our Transactions for 1907. The eleven species recorded from Rodriguez, 300 miles east of Mauritius, are all found commonly in that island and in Bourbon. From the lofty and luxuriantly wooded Seychelles group, which are exceptional among oceanic islands from their granitic formation, twenty-two species of butterflies have been recorded, six of these being, however, somewhat doubtful. These include one *Papilio*, a dwarf form (*nana*, Obth.) of the Mascarene *P. disparilis*, Boisd.; and the handsome and peculiar *Euploea* (*Pramasa*) *mitra*, Moore, and *Atella philiberti*, Joannis, are confined to the Seychelles and to the great atoll of Aldabra, a long way to the south-west. This latter island is the sole locality of a very fine and distinct species of the characteristic African genus *Teracolus* (*aldabrensis*, Holland). The coralline Almirantes have apparently only three butterflies, a small *Pamphila* also found in the Seychelles, and two well-known European "blues," *Zizera lysimon*, Hübn., and *Tarucus telicanus*, Hübn., both also plentiful in the Mascarene Islands. On Glorioso atoll Mr. M. J. Nicoll in the "Valhalla" found butterflies and a day-flying Sphingid in numbers, one of the former being *Hypolimnas misippus*; and in the Chagos group Dr. G. C. Bourne met with the widely ranging *Precis villida*, F., and a very fine and well-marked race of *Hypolimnas bolina*, L. Only two butterflies, also of the most extended distribution, *Limnas chrysippus* and *Pyrameis cardui*, are recorded from the great coral archipelago of the Maldives. The little Cocos-Keeling atoll has produced five species, two of which, *Precis villida* and *Limnas chrysippus* var. *petilia*, Stoll, were observed by me in my flying visit to the island in January 1904. The other three are *Hypolimnas misippus*, *H. bolina*, and *Pyrameis* *cardui* var. *kershawii*, McCoy; and the predominance of the Australian element in the scanty butterfly-fauna of this little island, 1000 miles at least from the nearest point of Australia is very remarkable. Christmas Island, which consists mainly of coralline limestone upheaved to an elevation of more than 1000 feet in its highest part, possesses nine butterflies in spite of its very small area. Three of these, besides a local race (*determinata*, Butl.) of *Melanitis leda*, L., are very distinct and peculiar to the island, viz. *Euploea* (*Vadebra*) *macleari*, Butl., *Terias amplexa*, Butl., and the fine *Charaxes andrewsi*, Butl. The occurrence of the Australian form of *Limnas chrysippus* in Christmas Island is also noteworthy, as it is only 190 miles south of Java, though separated by very deep sea from this island.

The remaining islands in the South Indian Ocean, Marion, the Crozets, Kerguelen, Heard, St. Paul, and Amsterdam, all lie in a tract of the ocean too stormy and inclement for any butterfly life to be possible; and indeed they present the spectacle of a Lepidopterous fauna reduced to its lowest terms. Kerguelen, despite its area of over 1400 square miles, in a latitude nearly corresponding with that of Paris, has only two practically apterous Tineids, a third species, also apterous, having been found in the Crozets; while from St. Paul and Amsterdam, in a somewhat lower latitude, two other moths of the same family, both fully winged, have been recorded. One of these, *Blabophanes ptilophaga*, Enderlein, lives in the nests of penguins at St. Paul and feeds in the larva state on feathers; and it is a curious coincidence, to say the least, that Darwin noted at St. Paul's Rocks in the Atlantic "a small brown moth, belonging to a genus that feeds on feathers," as the sole Lepidopterous resident of that tiny islet in mid-ocean.

For our present purpose New Zealand may be regarded as an oceanic island on a grand scale, and its limited butterfly-fauna is one of the most interesting in the whole world. Of its fourteen resident species, nine are absolutely peculiar, and of these the most conspicuous, as well as perhaps the most plentiful, is the beautiful *Pyrameis gonerilla*, F., which recalls our *P. atalanta* in its appearance and its familiar habits. There are four very remarkable *Satyridae*, of which *Percnodaimon pluto*, Fereday, and *Erebiola butleri*, Fered., are mountain insects confined to the South Island, which in structure and habits exhibit a great affinity with the Erebias of the Palaearctic Region. *Dodonidia helmsi*, Fered., is a very beautiful insect having something of the facies of an Erycinid, and is found sparingly in the wooded regions on both sides of Cook's Strait; and the curious *Argyrophenga antipodum*, Doubl., which probably has its nearest allies in some of the Chilian *Satyridae*, is the characteristic butterfly of the "tussock-grass" country which covers so large an area of New Zealand, especially in the South Island. Two species of *Chrysophanus*, *salustius*, F., and *enysii*, Butl., recall our "Small Copper," and are generally plentiful, while a third species, *C. boldenarum*, White, which is more local than these, reminds one of the European *C. amphidamas* in appearance. A little "Blue," *Lycaena oxleyi*, Feld., completes the list of endemic species. Four others, characteristic of the Australian region, *Precis villida*, *Pyrameis cardui* var. *kershawii*, *P. itea*, F., and *Lycaena phoebe*, Murray, occur more or less commonly, and *Danaida plexippus*, which may have reached New Zealand as long ago as 1840, appears only sporadically, and its permanent tenure in the islands seems to be by no means secure. *Hypolimnas bolina*, *Catopsilia catilla*, Cr., and an *Euploea*, have sometimes wandered hither from their tropical home, and even our *Pyrameis atalanta*, whose nearest authentic locality is 4000 miles distant in the Hawaiian Islands, has on more than one occasion found its way to the shores of New Zealand.

In the Chatham Islands, 400 miles eastward from Cook's Strait, *Pyrameis gonerilla* has developed a well-marked race (*ada*, Alfk.), but I have no record of any other butterfly from thence. Norfolk Island, 450 miles north-west of New Zealand, has five species, the fine *Papilio amphiaraus*, Feld., allied to *P. amyntor*, Boisd., from New Caledonia, being peculiar to the island; the others being well-known Australian forms, with the exception of *Danaida plexippus*. Lord Howe Island is only six square miles in area, and is separated from the coast of New South Wales by 300 miles of deep ocean; but from this small island Mr. G. A. Waterhouse has recorded no fewer than seventeen butterflies, including such conspicuous forms as *Papilio erechtheus*, Don., and *macleayanus*, *Charaxes sempronius*, F., *Hypolimnas bolina*, etc. No butterfly has been observed as yet in the so-called Sub-Antarctic Islands of New Zealand—the Auckland, Campbell, Antipodes, and Macquarie groups—though it is just possible that in the first-named islands, which possess a rich and varied Flora of surpassing interest, one or more indigenous species may be found. This is at any rate the opinion of Mr. G. V. Hudson, who visited the Auckland Islands in November 1906, and who writes as follows: "No butterfly was seen on the islands . . . but it would be an unwarranted assumption that no butterfly exists there . . . I consider that the existence of a Satyrid butterfly on Auckland Island allied to *Erebia* or *Argyrophenga* is probable, but I do not think it likely that any member of the genus *Vanessa* occurs there . . . I always kept a very sharp look-out for butterflies, but none were seen, although on several occasions the weather-conditions for their appearance were highly favourable."

We commence our survey of the islands of the tropical Pacific with the Ladrones, from which, as far as I can ascertain, only four butterflies have been definitely recorded, these being an endemic *Atella* (*egestina*, Godt.), *Danaida plexippus*, and two species of *Euploea*; one of these, *E.* (*Nipara*) *eleutho*, Q. et G., being represented throughout Polynesia by several well-defined races. From the widely scattered Caroline Islands, some at least of which are elevated and bear a most luxuriant vegetation, Semper records a fairly rich butterfly fauna of twenty-three species, nearly all of well-known Indo-Australian forms, and including two *Papilios*, *alphenor*, Cr., and *agamemnon*, L. Mr. G. F. Mathew has also recorded from Ponape Island, a curious dwarf race of *Melanitis leda* under the name *M. ponapensis*. *Danaida plexippus* has also found its way to the Carolines, and Pagenstecher records it from the Marshall Islands; but it has apparently been unable to establish itself on the low coral islands of the Gilbert and Ellice groups, from which the only recorded butterflies are *Euploea distincta*, Butl., and *E. eleutho*, *Precis villida*, and the fine form *rarik*, Esch., of *Hypolimnas bolina*. In the lofty and luxuriant Fiji Islands we again find butterflies in considerable variety. At least twenty resident species are known, the fine *Papilio schmeltzi*, H.-S., and *Charaxes caphontis*, Hew., with the remarkable little Satyrid *Xois sesara*, Hew., and several Euploeas and *Lycaenidae*, being found nowhere else. The *Acraeinae* have here their most easterly extension in *A. andromache*, F.; this insect may possibly reach the Samoa Islands, where we find the most eastern representative of the *Papilionidae* in *P. godeffroyi*, Semper, as well as of the *Danainae* (always excluding *Danaida plexippus*) in the small *Tirumala mellitula*, H.-S. The *Hesperidae* may also find their eastern limit in Samoa, unless a butterfly that I saw once or twice in the Marquesas Islands, but was unable to capture, may belong to that family, as I suspected at the time. *Atella bowdenia*, Butl., is a characteristic species of Samoa, and occurs also in the Tonga group, where about ten species of butterflies were collected during the visit of the "Challenger" in 1874; *Belenois java*, Sparrm., and *Terias hecabe*, L., recorded also from Tonga, are the most eastern known representatives of the *Pierinae*. The Hervey or Cook Islands were visited by me in 1883, and in Rarotonga and Aitutaki I observed, besides the universal *Danaida plexippus* and *Hypolimnas bolina*, *Diadema unicolor*, Godm., *Euploea* (*Nipara*) *unicolor*, H. H. Druce, and *Jamides walkeri*, H. H. Druce, all undescribed species at the time; also *Melanitis leda* and an *Atella*, which last I was not able to catch. Far to the south-east, at the little outlying island of Oparo or Rapa, *Danaida plexippus* was the only butterfly seen by me. In two visits to Tahiti, in April and May 1883, seven species only were collected, a very small number for an island of such luxuriance and beauty. This poverty of Tahiti in butterfly life was noted by the eminent French voyager Capt. Dumont d'Urville in the "Coquille" as long ago as 1823, and the following free translation of his observations is fully in accord with my own experience sixty years later—"The farther I advance in my walk in this country, the more I have occasion to convince myself, that the entomologist who wishes to increase his collections ought not to lose his time in the South Seas. In reality, what land appears to promise a richer harvest of insects than Tahiti? What shades, what forests, are more favourable to the development of these little beings? Everywhere are flowers, humid places, decaying trunks and leaves. But what is the result of these laborious walks, of the assiduous researches of the naturalist? a dozen species of *Lepidoptera*, some *Hymenoptera* and *Hemiptera*, and four or five very small *Coleoptera*. Moreover, except for three species of *Nymphalidae* of which the size, the beauty, and the number of individuals strike the eye of the traveller at every moment, he would willingly believe that these islands nourish no insects whatever —Besides, the sole observation I have to make on Borabora, is that this island has afforded me a Lepidopteron which I have not yet seen in Tahiti; at the same time I have not found again another, occurring in elevated stations near Matavai (Tahiti), where it is very rare. In both islands, a *Melitaea* near *cinxia* frequents the sides of torrents, hillsides, and solitary places; and it settles but rarely, which makes it difficult to capture." This "*Melitaea*" is evidently *Atella gaberti*, Guér., a species peculiar to the Society Islands; I met with it rather commonly in Tahiti, especially in the mountain forests, where it was almost the only butterfly to be seen, and where the brilliantly gilded pupa was sometimes to be found attached to leaves. The other butterflies I observed in the island, mostly in the low ground near the shore, were *Hypolimnas bolina*, fine, large, and abundant, *Danaida plexippus*, an *Euploea*, which Mr. H. H. Druce has named *E.* (*Nipara*) *walkeri*, the finely ocellated form of *Melanitis leda* known as *taitensis*, Feld., a small race of the wide-ranging *Lampides boeticus*, and another little Lycaenid. I did not, however, meet with the brightly coloured form *taitica* of *Precis villida*, which I was informed was at times by no means rare, and here reaches the easternmost limit of this widely spread butterfly. No records are available from the Paumotu or Low Archipelago, though *Hypolimnas* and *Euploea* may extend their range to some of these widely scattered islands. In the Marquesas, which rival Tahiti in beauty and tropical luxuriance, the universal *Danaida* and *Hypolimnas* were the only butterflies that were taken during my visit, though an *Atella*? and the problematical Hesperid previously mentioned, were seen in Nuka-hiva and O-Hiva-oa, two of the larger islands.

In Pitcairn Island, though a good many moths were taken during the day I was on shore there, not a single butterfly was seen; the inhabitants without exception declared that none were found on the island, and did not recognise any of the species that I showed them. Twenty years or more after my visit to this remote spot, Mr. M. J. Nicoll, in the "Valhalla," had the same experience. He remarks ("Three Voyages of a Naturalist," p. 213)—"We saw no butterflies, but there were many small moths, and one species, *Plutella maculipennis*" (which I also noticed on Pitcairn) "was most abundant." The apparent absence of *Hypolimnas bolina* from this beautiful and fertile little island is the more remarkable, as I saw plenty of the Malvaceous undershrub which is the ordinary food-plant of the larva growing there; and the Natural History Museum at South Kensington possesses several specimens of the butterfly from the desolate Elizabeth or Henderson Island, more than 100 miles to the eastward. It has even probably reached the most remote outlier of Polynesia, Easter Island, as a butterfly, captured by Mr. and Mrs. Scoresby Routledge during their visit to that most interesting spot in 1914, can be only that species from their description of the insect, and was entirely unknown to the natives. Unfortunately the single specimen was lost during transmission home. From Caroline Island, a small atoll nearly 500 miles north of Tahiti, the Eclipse expedition of 1883 have recorded *Melanitis leda*, form *taitensis*, and *Hypolimnas bolina*, form *holdeni*, Butl.

Little or nothing is known of the insects of the other small coral islands in the equatorial region of the Pacific, but when we come to the large and lofty islands of Hawaii and its satellites, we find a fairly rich, varied, and isolated Flora and Fauna of the highest interest, which are now almost as well known as those of any region of equal extent in the Tropics. Including our *Pieris rapae*, which has been accidentally brought over from North America, and is now common and sometimes destructive, and two American Lycaenids purposely introduced in order to cope with the plague of that universal tropical shrub *Lantana camara*, the Hawaiian butterflies number nine only. Two of these are endemic species, *Pyrameis tammeamea*, Esch., by far the grandest development of the Vanessid type, and the little

Holochila blackburni, Tuely, so curiously suggestive in its coloration of a mixture of our "Purple" and "Green" Hairstreaks. *Lampides boeticus*, which is common and occurs up to 6000 feet elevation, is probably truly indigenous also, while *Danaida plexippus*, *Pyrameis atalanta*, and *P. huntera*, L., represent the American element of the fauna, and *P. cardui*, which according to Dr. R. C. L. Perkins frequently shows a strong tendency towards the form (*kershawii*) characteristic of Australia, may have been derived from that region. Neither of the two predominant butterflies of the Indo-Pacific region, *Hypolimnas bolina* and *Precis villida*, appear to have reached the Hawaiian Islands up to the present date.

Crossing to the American side of the Pacific Ocean, Clarion Island in the little-visited Revillagigedo group, south of Lower California and separated by 300 miles of deep sea from the mainland, has produced three butterflies, two small *Lycaenidae* and a sub-species of *Papilio troilus*, L. The Galapagos Islands, situated on the Equator 700 miles from the nearest point of South America, are very poor in insect life, though their fauna is otherwise of classical interest. The six known butterflies are all of American type; two of them, *Lycaena parrhasioides*, Wallgr., and *Eudamus galapagensis*, Williams, are peculiar to the islands, and the others are *Callidryas eubule*, L., *Agraulis vanillae*, L., *Pyrameis huntera*, L., and *P. carye*, Hübn. *C. eubule* and *A. vanillae* in the Galapagos are strikingly modified in the direction of small size and dark suffused coloration, being in fact well-marked races of these species. The romantic island of Juan Fernandez, 350 miles from the coast of Chile, is the last that we shall encounter in our circuit of the oceans, and *Pyrameis carye*, Hübn., which I found there in March 1882, appears to be its sole butterfly inhabitant.

We have already seen that the range of butterflies north and south is fully equal to that of flowering plants, and there is little doubt, given continuous land extending as far, that flowers and their attendant insects would be found at the North Pole itself. As it is, we find butterflies of several species maintaining their existence beyond the 80th parallel of latitude under the most rigorous conditions of climate, requiring at least two or three of the brief Hyperborean summers to complete their transformations, and apparently as much exposed to the attacks of the usual enemies of their tribe as in far more genial regions. The large proportion of Lepidopterous larvae in the Far North that are infested with Hymenopterous and Dipterous parasites has been specially noted by more than one observer; and the wariness and rapid flight of the perfect insects, not less than their beautifully protective coloration in repose, indicate with equal certainty the presence of active enemies in this state. It is not easy to say, however, what these enemies can be, unless the numerous small wading birds, and such true land birds as the snow-bunting that occur in the highest North, have developed a taste for butterflies; but on this point observations are almost or quite wanting. Many of these boreal forms have an exceedingly wide distribution; some of the species of *Colias*, *Erebia*, *Oeneis*, and *Brenthis* have been found at all points round the Polar Basin where collections have been made, and representatives of the first and last of these genera reappear at the limits of butterfly life in the Southern Hemisphere. The genus *Brenthis* in particular has the enormous range in latitude of 137°—from 81° 52′ N. to 55° 30′ S.—though with a wide break in the warmer parts of America; and the range of *Colias*, which is continued through the Tropics by the closely allied *Meganostoma*, the genus itself reappearing at high elevations under the Equator, falls short of this by only two degrees of latitude at most. In Southern Patagonia, too, we find a single species of the characteristic Arctic genus *Oeneis*.

Six butterflies stand out as pre-eminently insular forms, these being *Danaida plexippus*, *Melanitis leda*, *Pyrameis cardui*, *Precis villida*, *Hypolimnas bolina*, and *Lampides boeticus*. The range of each of these species covers an enormous area of the earth's surface, and in several cases extends to the smallest and most remote islands in mid-ocean. With regard to *Danaida plexippus*, in the "Entomologist's Monthly Magazine" for 1914 I have discussed in some detail its wanderings to our own shores, and to lands more than half the earth's circumference distant from its American home, so this most interesting butterfly will not require further consideration at present. The various geographical races (or sub-species) of *Melanitis leda* are found over a vast area in the tropical regions of the Old World, and throughout the Pacific islands to Tahiti, but apparently it has not yet reached the Marquesas or the Hawaiian groups. *Pyrameis cardui*, whose migratory habits are so well known, is perhaps the most widely distributed butterfly in the whole world, the only continent from which it is entirely absent being South America, where it is replaced by the closely allied *P. carye*, Hubn. In the Old World it ranges from Arctic Lapland and Siberia to the Cape of Good Hope, and is to be met with in the most desert as well as in the most fertile regions; it has established itself in the remotest islands of the Atlantic, except those, which like Fernando Noronha and South Trinidad, are satellites of South America; and in the Indian Ocean we meet with it even in the Maldive atolls. In the Australian region the distribution of its form *kershawii*, McCoy, extends all over Australia and to New Zealand, the New Hebrides, and New Caledonia, the Loyalty Islands being the most eastern locality in which it has been observed by me; and the same form reappears far to the north-east in the Hawaiian Islands.

Precis villida, which under the name of "Albin's Hampstead Eye," has in some unaccountable manner figured as a British butterfly in the works of our older entomologists, has a wide distribution in the Indo-Pacific region from the Chagos atoll to Tahiti, and from the Caroline Islands to New Zealand; becoming more highly coloured as we go eastward, and its brightest form (*taitica*, Feld.) is found in Samoa and the Society Islands. *Lampides boeticus* has a wider range than any other member of its great family, as it occurs in all the warmer regions of Europe and Asia, throughout Africa, the Malay Archipelago, and Australia. In mid-Atlantic it has reached Ascension and St. Helena, and the Mascarene and Seychelles Islands in the Indian Ocean; and in the Pacific I have found it in the New Hebrides, New Caledonia, and Tahiti, while Dr. Perkins records it as common in the Hawaiian Islands. It is possible that human agency has been a factor in the wide distribution of *L. boeticus*, as its larva feeds on the unripe seeds of cultivated as well as wild leguminous plants, and in some localities, as in Mauritius, it does great damage to garden peas.

I have purposely left *Hypolimnas bolina* to the last, as it is certainly the most interesting of all insular butterflies, and in its wandering propensities and adaptability to new localities, it rivals even the more famous *Danaida plexippus*. In the Indian Ocean its range has quite recently extended to Madagascar, where previous to 1915 it was quite unknown, but since that year the Oxford University Museum has received a good many specimens (of the Indian type) taken on the east coast of that great island by the Ven. Archdeacon (now Bishop) Kestell-Cornish. It probably occurs on nearly every island within the Tropics in the Pacific, with the exception, already noted, of the Hawaiian group; and it is evidently able to adapt itself to the conditions of the smallest and least fertile atolls, where even *Danaida plexippus* fails to establish a footing. Throughout its vast range the male is singularly constant in appearance, and varies only in size, in the amount of white scaling in the centre of the blue spots of both wings, and in the greater or less distinctness of the underside markings, and the subterminal series of white dots above. These dots are very conspicuous in specimens from the Indian region and from the northern and western area of its range, but as we proceed eastward, they become less distinct and finally disappear. The female, on the contrary, is perhaps the most variable of all butterflies, and nearly every fairly extensive group of islands appears to produce its distinctive race. Specific rank has been accorded by various Lepidopterists to many of these forms, but it seems to me nearer the truth to regard them as variations of a single polymorphic species, resulting from different conditions of environment, rainfall, temperature and other modifying influences.

The form of *H. bolina* found by Dr. G. C. Bourne in Diego Garcia (Chagos Islands) is specially remarkable for the great extension of the white markings above and beneath, and a closely similar variation has, curiously enough, been observed in Palawan Island in the Philippines. It is in the Fiji Islands that the variation of the butterfly probably reaches its maximum; the female there ranges from a practically unicolorous fulvous, pale ochreous, or even whitish-ochreous ground-colour in which the distinctive markings are nearly lost, to the large and handsomely marked form *nerina*, F., of Queensland, the

New Hebrides, and New Caledonia, and the still more richly coloured *pulchra*, Butl., of the latter island, and *rarik*, Esch., of the scattered groups to the northward. Nearly all the specimens that I have seen from the Friendly Islands (Tonga) are, on the contrary, smaller and more poorly marked than those from any other locality, but those that I bred from larvae found in Rarotonga and Aitutaki are very handsome, and the females are for the most part intermediate between the fulvous Fijian form and the large dark race occurring in Tahiti. The markings of the females from the Society Islands approximate more nearly to those of the male than is the case with any that I met with elsewhere, except in the Marquesas, where the local race of *H. bolina* differs from that of Tahiti chiefly in its smaller average size and somewhat darker general colouring.

The above instances convey only a faint idea of the marvellous range of variation in the female of this most interesting butterfly, which can be realised only by the inspection of the extensive series from the whole of the area of its distribution, contained in the National Collection, or the almost equally fine series in the Oxford University Museum.

It is not my intention at present to discuss the means by which butterflies have been dispersed over the oceans to the most remote islands, especially as this subject has been treated somewhat fully by me in the case of *Danaida plexippus*, in the volume of the "Entomologist's Monthly Magazine" for 1914. The brief bibliography and sketch-map appended to this Address will, I trust, enable any one who is interested in the geographical distribution of butterflies, to follow these frail creatures to their ultimate limits on the earth's surface, and to travel in imagination to the Fringes of Butterfly Life.

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GENERAL INDEX.

The Arabic figures refer to the pages of the 'Transactions'; the Roman numerals to the pages of the 'Proceedings.'

GENERAL SUBJECTS.

SPECIAL INDEX.

The Arabic figures refer to the pages of the 'Transactions'; the Roman numerals to the pages of the 'Proceedings.'

ERRATA.

TRANSACTIONS.

Page 79, line 8 from top, for *eastern* read *western.*
Page 80, line 27 from top, for *east central* read *west central.*
Page 328, line 7 from top, for *Issorora* read *Issororo.*
Page 341, line 12 from bottom, for *Issorora* read *Issororo.*
Page 353, line 20 from top, for *Ent. M. Mag.* read *Ent. Mag.*
Page 433, line 5 from bottom, for *coeandica* read *cocandica.*
Page 434, line 13 from top, for *rubritinetalis* read *rubritinctalis.*
Page 466, line 9 from bottom, for *acurately* read *accurately.*

PROCEEDINGS.

Page xl, line 11 from bottom, for *larantensis* read *laratensis.*
Page xliv, line 3 from bottom, for *Orchemai* read *Orchemia.*
Page lx, line 17 from bottom, for *Cryptorrynchus* read *Cryptorrhyncus.*
Page lxii, line 14 from bottom, for *Cart.* read *Curt.*

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