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List of Fellows

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., *Chigny, près Morges, Switzerland.*
1912 FREY-GESSNER, Dr. Emile, *La Roseaie, Genève, Switzerland.*
1898 GRASSI, Professor Battista, *The University, Rome.*
1915 HOWARD, Dr. L. O., *National Museum, Washington, U.S.A.*
1914 LAMEERE, Professor A., *Brucelles.*
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.

*Marked * have died during the year.*

Marked † have compounded for their Annual Subscriptions.

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., 50, *Ashley-gardens, Victoria street, S.W. 1.*
1902 ADKIN, Benaiah Whitley, *Trenoweth, Hope-park, Bromley, Kent.*

- 1885 ADKIN, Robert, (COUNCIL, 1901-2, 1911-13), *Wellfield, Lingards-road, Lewisham, S.E.*
- 1904 AGAR, E. A., *La Haut, Dominica, B. W. Indies.*
- 1915 AIYAR, K. S. Padmanabha, *Trivandrum, Travancore, India.*
- 1914 AIYAR, T. V. Ramakrishna, B.A., F.Z.S., *The Agricultural College, Coimbatore, S. India.*
- 1912 ALLEN, T. W., M.A., 266, *Willesden-lane, London, N.W. 2.*
- 1911 ANDERSON, T. J., *Entomological Laboratory, Kabeti, Brit. E. Africa.*
- 1910 † ANDREWES, H. E., 8, *North Grove, Highgate, N.*
- 1899 ANDREWS, Henry W., *Shirley, Welling S.O., Kent.*
- 1901 ANNING, William, 39, *Lime Street, E.C. 3.*
- 1908 † ANTRAM, Charles B., *Somerdale Estate, Ootacamund, Nilgiri Hills, S. India.*
- 1913 ARMYTAGE, Edward O., *Geelong, 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, *Brooklands, 36, Bulstrode-road, Hounslow, Middlesex.*
- 1907 † ASHBY, Sidney R., *Edith Villa, Yiewsley, 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-), *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 W., *The Bungalow, Escombe, Natal, South Africa.*
- 1902 BARRAUD, Philip J., *Chester Cottage, Benhill-road, Sutton, Surrey.*
- 1911 * BARRETT, J. Platt, *Westcroft, South-road, Forest Hill, S.E.*
- 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, *Red Lodge, Porchester-road, Bournemouth.*
- 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, 11th Hampshire Regt., B.E.F., and *Church Felles, Horley.*
- 1899 BEDWELL, Ernest C., *Bruggen, Brighton-road, Coulsdon, Surrey.*
- 1914 BENDERITTER, Eugène, 11, *Rue St. Jacques, Le Mans, France.*
- 1904 BENGTSOON, 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), 19, *Clarendon-road, Edgbaston, Birmingham.*
- 1895 BEVAN, Lieutenant H. G. R., R.N., 38, *The Common, Woolwich.*
- 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., 23, *West Hill, Highgate, N. 6.*
- 1885 BLATHWAYT, Lt.-Col. Linley, F.L.S., *Eagle House, Batheaston, Bath.*
- 1904 BLISS, Maurice Frederick, M.R.C.S., L.R.C.P., *Coningsburgh, Montpellier-road, Ealing, W. 5.*
- 1916 BOCOCK, Charles Hanslopé, *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.*
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- 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.*
- 1916 BOX, Leonard Charles, F.R.H.S., *Dominion Experimental Station, Fredericton, New Brunswick.*
- 1910 BOYD, A. Whitworth, *The Allon, Altrincham, Cheshire.*
- 1905 BRACKEN, Charles W., B.A., 5, *Carfrae Terrace, Lipson, Plymouth.*
- 1904 BRIDGEMAN, Commander The Hon. Richard O. B., R.N., 44, *Lowndes-square, S. W. 1*; and c/o Commander-in-Chief, *Cape of Good Hope Station, c/o G.P.O.*

- 1877 * BRIGGS, Charles Adolphus, *Rock House, Lyntonmouth S.O., N. Devon.*
 1912 BRIGGS, Miss Margery II., B.Sc., 7, *Winterstoke-gardens, Mill Hill, N.W. 7.*
 1870 BRIGGS, Thomas Henry, M.A., *Rock House, Lyntonmouth S.O., N. Devon.*
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 1904 BROWN, Henry H., *Tower House, 8, Bruntsfield-terrace, Edinburgh.*
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- 1915 CARR, William, B.Sc., *Station-road, Bentham, Lancaster.*
- 1911 CARSON, George Moffatt, Entomologist to the Government of New Guinea, *Port Moresby, Papua, via Australia.*
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- 1906 CARTER, H. J., B.A., *Ascham, Darling Point, Sydney, N.S.W.*
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- 1914 CHAMPION, Harry George, B.A., Assistant Conservator of Forests, *W. Almora, U.P., India.*
- 1891 CHAPMAN, Thomas Algernon, M.D., F.Z.S., VICE-PRESIDENT, (V.-PRES., 1900, 1904-5, 1908, 1916; COUNCIL, 1898-1900, 1903-5, 1907-9, 1916-), *Betula, Reigate.*
- 1910 CHARNLEY, J. R.
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- 1913 CHEAVIN, Harold S., F.R.M.S., F.N.P.S., *The Glenroy Hotel, 22, Woburn Place, Russell-square, W.C.*
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- 1914 CHRYSTAL, R. Neil, B.Sc., *Birk's Buildings, Ottawa, Canada.*
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- 1908 CLARK, Edgar L., *Laureston, Ridge Road, Overport, Durban, Natal.*
- 1914 CLEAVE, I. D., Dept. of Science and Agriculture, *Georgetown, British Guiana.*
- 1914 CLEGHORN, Miss Maude Lina West, F.L.S., 5, *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., (COUNCIL, 1915-), 16, *Cambridge-square, London, W. 2.*
- 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., M.Sc., F.L.S., Research Fellow of the University of St. Andrews, *The Gatty Marine Laboratory, St. Andrews, Scotland.*
- 1913 CONEY, Miss Blanche A., *The Poplars, Pucklechurch, Gloucestershire.*
- 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, *Cringle Lodge, Levenshulme, Manchester.*
 1913 CRAGG, Capt. F. W., M.D., I.M.S., *King Institute of Preventive Medicine, Saidapet, Madras, India.*
 1909 CRAWLEY, W. C., B.A., 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., 28, *Clarendon-road, Leeds.*
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 1900 DALGLISH, Andrew Adie, 7, *Keir-street, Pollokshields, Glasgow.*
 1907 DAMES, Felix L., 10, *Lortzingstrasse, Berlin-Lichterfelde.*
 1886 DANNATT, Walter, *St. Lawrence, Guobal-road, Lee, S.E.*
 1911 DAVEY, H. W., Inspector of Department of Agriculture, *Geelong, Victoria, Australia.*
 1913 DAVIDSON, James, M.Sc., *Imperial College of Science and Technology, South Kensington, S.W.*
 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, *Manor House, Upper Wick, Worcester.*
 1903 DAY, F. H., 26, *Currock-terrace, Carlisle.*
 1898 DAY, G. O., *Sahlatston, Duncan's Station, Vancouver Island, British Columbia.*
 1912 DEWITZ, Dr. John, Director German Govt. Experimental Station, *Devant-les-Ponts, Metz, Lorraine.*
 1913 DICKINSON, Barnard Ormiston, B.A., *Beech Hill, Newport, Salop.*
 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.*
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 1906 DOLLMAN, Hereward, *Hove House, Newton-grove, Bedford-park, W. 4.*
 1903 DOLLMAN, J. C., *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.*
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- 1884 DRUCE, Hamilton H. C. J., F.Z.S., (COUNCIL, 1903-5), *Trefusis Lodge, 3, Norfolk-road, N.W. 8.*
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- 1894 DUDGEON, G. C., Director General of the Dept. of Agriculture, *Mead, Cairo.*
- 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), *Merton, 17, Burstock-road, Putney, S.W. 15; and British Museum (Natural History), Cromwell-road, South Kensington, S.W. 7.*
- 1910 EALES-WHITE, J. Cushny, 47, *Chester-terrace, Eaton-square, 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.*
- 1911 EDWARDS, F. W., *Kingswear, Cornwall-road, Harrow.*
- 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, *Choubruh-avenue, Cairo, Egypt, and S.E. Agricultural College, Wye, Kent.*
- 1900 ELLIOTT, E. A., 16, *Belsize Grove, Hampstead, N.W.*
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- 1903 ELTRINGHAM, Harry, M.A., D.Sc., F.Z.S., (V.-PRES., 1914 ; COUNCIL, 1913-15), *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.*
- 1914 EMMETT, Lieut. Charles P., c/o Messrs. Cox & Co., 16, *Charing Cross, W.C. 2.*
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- 1900 FLEMYNG, The Rev. Canon W. Westropp, M.A., *Coolfin, Portlaw, co. Waterford.*
- 1898 FLETCHER, 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., *The Villa, Bubwith, Selby, Yorks.*
- 1913 FOSTER, Arthur H., M.R.C.S., L.R.C.P.(Eng.), M.B.O.U., *Sussex House, Hitchin, Herts.*
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- 1908 FRASER, Frederick C., Capt., M.D., I.M.S., c/o The Ent. Soc. of London.
- 1896 FREKE, Percy Evans, *Southpoint, Limes-road, Folkestone.*
- 1888 FREMLIN, H. Stuart, M.R.C.S., L.R.C.P., 1st London Sanitary Co., Duke of York's Headquarters, *Chelsea*, and *The Elms, Kingsbury, N.W. 9.*
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- 1906 † FRY, Harold Armstrong, P.O. Box 46, *Johannesburg, Transvaal Colony.*
- 1900 FRYER, H. Fortescue, *The Priory, Chatteris, Cambs.*
- 1907 FRYER, John Claud Fortescue, M.A., (COUNCIL, 1916-), *Board of Agriculture and Fisheries, Craven House, Northumberland-avenue, W.C. 2.*
- 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, (SEC., 1899-1900; COUNCIL, 1893-5, 1901, 1914-), 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.*
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- 1906 † GIBBS, Arthur Ernest, F.L.S., F.Z.S., (COUNCIL, 1912-14), *Hounds-path, Upper Marlborough-road, St. Albans.*
- 1915 GIBSON, Arthur, *Entomological Branch, Dept. of Agriculture, Ottawa, Canada.*
- 1908 GIFFARD, Walter M., *P.O. Box 308, Honolulu, Hawaii.*
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- 1904 GILLIAT, Francis, B.A., *Combe House, Balcombe, Sussex.*
- 1914 GODFREY, E. J., Education Dept., *Bangkok, Siam.*
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- 1898 GORDON, R. S. G. McH., *Corsemalzie, Whauphill S.O., Wigtonshire.*
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- 1911 GRAVES, P. P., *Turf Club, Cairo, Egypt.*
- 1891 † GREEN, E. Ernest, F.Z.S., (V.-PRES., 1915; COUNCIL, 1914-), *Way's End, Beech-avenue, Camberley.*
- 1910 GREEN, Herbert A., *The Central Fire Station, Durban, Natal.*
- 1894 GREEN, J. F., F.Z.S., 38, *Pont-street, London, S.W. 1.*
- 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., *Elgin House, Knockholt, Sevenouks.*
- 1906 GURNEY, Gerard H., *Keswick Hall, Norwich.*
- 1910 GURNEY, William B., Asst. Govt. Entomologist, *Department of Agriculture, Sydney, Australia.*
- 1912 HACKER, Henry, *Bowen Bridge-road, Brisbane, Queensland.*
- 1906 HALL, Arthur, 7, *Park-lane-mansions, Croydon.*
- 1890 † HALL, Albert Ernest, c/o *City Librarian, Surrey-street, Sheffield.*
- 1885 HALL, Thomas William, *Stanhope, The Crescent, Croydon.*

- 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.*
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- 1891 HAMPSON, Sir George Francis, Bart., B.A., F.Z.S., (V.-PRES., 1898 ; COUNCIL, 1896-8), 62, *Stanhope-gardens, S.W. 7.*
- 1891 HANBURY, Frederick J., F.L.S., *Brockhurst, E. Grinstead.*
- 1905 † HANCOCK, Joseph L., 5454, *University-avenue, Chicago, U.S.A.*
- 1916 HANNYNGTON, Frank, *Mercara, Coorg, S. India.*
- 1903 HARE, E. J., 4, *New-square, Lincoln's Inn, W.C. 2.*
- 1904 HARRIS, Edward, *St. Conan's, Chingford, Essex.*
- 1910 HARWOOD, Philip, 2, *Fern Villas, Melford-road, Sudbury.*
- 1910 HAWKSHAW, J. C., *Hollycombe, Sussex.*
- 1913 † HAWKSHAW, Oliver, 3, *Hill-street, Mayfair, W. 1.*
- 1910 HEDGES, Alfred van der, *Stoke House, Stoke Mandeville, Bucks.*
- 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.*
- 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., Govt. Entomologist, *Port Darwin, Northern Territory, South Australia.*
- 1876 † HILLMAN, Thomas Stanton, *Eastgate-street, Lewes.*
- 1907 HOAR, Thomas Frank Partridge, *Mercia, Albany-road, Leighton Buzzard.*
- 1914 HODGE, The Rev. Prebendary Edward Grose, *The Vicarage, Paddington, W. 2.*
- 1912 HODGE, Harold, *St. James' Mansions, 54, Piccadilly, W.*
- 1888 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., 5th Avenue, *Pittsburgh, Penn., U.S.A.*
- 1898 HOLMAN-HUNT, C. B., Asst. Entomologist, Department of Agriculture, *Kuala Lumpur, Federated Malay States.*
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- 1901 HOPSON, Montagu F., L.D.S., R.C.S.Eng., F.L.S., 7, *Harley-street, W. 1.*
- 1897 HORNE, Arthur, 60, *Gladstone-place, Aberdeen.*
- 1903 HOUGHTON, J. T., 1, *Portland-place, Worksop.*
- 1907 † HOWARD, C. W., Entomological Division, *College of Agriculture, St. Anthony Park, Minn., U.S.A.*

- 1900 HOWES, W. George, 432, *George-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.*
- 1914 * HUDSON, H. Baldwin, *The Ferns, Upper Highway, Kings Langley, Herts.*
- 1907 HUGHES, C. N., 178, *Clarence Gate-gardens, Regent's Park, N.W. 1.*
- 1912 HUIE, Miss Lily, *Hollywood, Colinton-road, Edinburgh.*
- 1897 IMAGE, Prof. Selwyn, M.A., (COUNCIL, 1909-11), 78, *Parkhurst-road, Camden-road, N. 7.*
- 1912 † IMMS, A. D., D.Sc., B.A., F.L.S., *Entomological Dept., The University, Manchester.*
- 1908 IRBY, Major Leonard Paul, *Evington-place, Ashford, Kent.*
- 1891 ISABELL, The Rev. John, *Sunnycroft, St. Sennen S.O., Cornwall.*
- 1907 JACK, Rupert Wellstood, Government Entomologist, Department of Agriculture, *Salisbury, Rhodesia.*
- 1907 JACKSON, P. H., 112, *Balham-park-road, S.W. 12.*
- 1907 JACOBI, Professor A., Ph.D., Director of the R. Zoological and Anthropol.-Ethnographical Museum, *Dresden, Saxony.*
- 1911 JACOBS, Capt. J. J., R.E., *Framsden, Tring, Herts.*
- 1910 JACOBS, Lionel L., c/o Algoma Steel Corporation, *Sault Ste. Marie, Ontario, Canada.*
- 1914 JANNINGS, Rev. Frederic S. F., *Warmisworth Rectory, Doncaster.*
- 1914 JANSE, A. J. T., *1st-street, Gezina, Pretoria, S. Africa.*
- 1869 JANSON, Oliver E., 44, *Great Russell-street, Bloomsbury, W.C. 1. ;*
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- 1898 JANSON, Oliver J., *Cestria, Claremont-road, Highgate, N. 6.*
- 1912 JARDINE, Nigel K., *The Glenan, Helensburgh, Dumbartonshire.*
- 1912 JEMMETT, C., *Withersdane House, Wye, Kent.*
- 1886 JENNER, James Herbert Augustus, *East Gate House, Lewes.*
- 1899 JENNINGS, F. B., 152, *Silver-street, Upper Edmonton, N. 18.*
- 1909 JEPSON, Frank P., *Department of Agriculture, Suva, Fiji Islands.*
- 1886 JOHN, Evan, *Llantrisant S.O., Glamorganshire.*
- 1907 JOHNSON, Charles Fielding, *West Bank, Didsbury-road, Heaton Mersey.*
- 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., TREASURER, 1904- , (V.-PRES., 1912, COUNCIL, 1898-1900), *Shrublands, Eltham, S.E.*
- 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., *Bradfield, Reading.*

- 1913 JUNK, Wilhelm, 68, *Sachsische-strasse, Berlin*, W. 15.
- 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*.
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- 1912 KING, Harold H., Govt. Entomologist, *Gordon College, Khartoum, Sudan*.
- 1889 KING, James J. F.-X., 1, *Athole Gardens-terrace, Kelvinside, Glasgow*.
- 1913 KIRBY, W. Egmont, M.D., *Hilden, 46, Sutton Court-road, Chiswick, W. 4*.
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- 1910 LAKIN, C. Ernest, M.D., F.R.C.S., 2, *Park-crescent, Portland-place, W. 1*.
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- 1916 LATA, 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*.
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- 1909 LEIGH-CLARE, Reginald L., *Golf Club, Hadley, Barnet*.
- 1900 LEIGH-PHILLIPS, Rev. W. J., *Burtle Vicarage, Bridgwater*.
- 1903 † LEVETT, The Rev. Thomas Prinsep, *Frenchgate, Richmond, Yorks*.
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- 1885 † LLOYD, Robert Wylie, (COUNCIL, 1900-1), I, 5 and 6, *Albany, Piccadilly, W. 1.*
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- 1895 MASSEY, Herbert, *Ivy-Lea, Burnage, Didsbury, Manchester.*

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- 1900 MAXWELL-LEFROY, H., *Imperial College of Science and Technology, South Kensington, S.W.*
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- 1913 MILLER, F. V. Bruce, *Livingston, N. Rhodesia, Africa.*
- 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 Alecrim, Lisbon.*
- 1902 MONTGOMERY, Arthur Meadows, 34, *Shalimar Gardens, Pembroke-road, North Acton, W. 11.*
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- 1916 MOORE, Ralph Headley, B.A., *Heathfield, Plymstock, Devon.*
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- 1912 * MORRELL, R. D'A., *Authors' Club, 1, Whitehall-court, S.W. 1.*
- 1907 MORTIMER, Charles H., *Royton Chase, Byfleet, Surrey.*
- 1893 MORTON, Kenneth J., 13, *Blackford-road, Edinburgh.*
- 1910 MOSELY, Martin E., 21, *Alexandra-court, Queen's-gate, S.W. 7.*
- 1900 MOSER, Julius, 59, *Bulow-strasse, Berlin.*
- 1882 MOSLEY, S. L., *The Museum and Technical College, Huddersfield.*
- 1911 MOSS, Rev. A. Miles, *Helm, Windermere.*
- 1907 † MOULTON, John C., *Saravak Museum, Saravak.*
- 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.*
- 1914 MURRAY, George H., *Dirimu Estate, Binaturi River, Daru, Papua.*
- 1909 MUSHAM, John F., 48, *Brook-street, Selby, Yorks.*
- 1903 NEAVE, S. A., M.A., B.Sc., F.Z.S., (COUNCIL, 1916-), 24, *de Vere-gardens, Kensington, W. 8.*
- 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, Robert, M.Sc., 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.*
- 1906 NIX, John Ashburner, *Tilgate, Crawley, Sussex.*
- 1916 NOHIRA, Akio, *Tchijoji, Ottagigun, 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., *Timworth Hall, Bury St. Edmunds.*
- 1877 OBERTHÜR, René, *Rennes (Ile-et-Vilaine), France.*
- 1893 † OGLE, Bertram S., *Steeple Aston, Oxfordshire.*
- 1910 OLDAKER, Francis A., M.A., *The Red House, Haslemere.*
- 1913 ORMISTON, Walter, *Kalupahani, Haldumulle, Ceylon.*
- 1895 PAGE, Herbert E., *Bertrose, Gellatly-road, St. Catherine's Park, S.E. 15.*
- 1916 PALMER, Arthur Raymond, *Ingleholme, Norton Way, Letchworth, Herts.*
- 1912 PATERSON, Edward J., *Fairholme, Crowborough.*
- 1907 PEAD, Clement H., *Box 252, Bulawayo, South Africa.*
- 1911 PEARSON, Douglas, *Chilwell House, Chilwell, Notts.*
- 1916 PEBBLES, Howard M., 13, *Chesham-street, S.W. 1.*
- 1915 PEILE, Major Harry Diamond, I.M.S., *Bannu, N.W.F.P., India.*
- 1914 PENDLEBURY, 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.*
- 1879 PERKINS, Vincent Robert, *Wotton-under-Edge.*

- 1907 † PERRINS, J. A. D., 3rd Seaforth Highlanders, *Davenham, Malvern*.
- 1897 PHILLIPS, Capt. Hubert C., M.R.C.S., L.S.A., 37, *Princes-square, Buyswater, W. 2*.
- 1903 † PHILLIPS, Montagu A., F.R.G.S., F.Z.S., *Deronshire House Preparatory School, Reigate*.
- 1891 PIERCE, Frank Nelson, 1, *The Elms, Dingle, Liverpool*.
- 1903 PILCHER, Colonel Jesse George, I.M.S., F.R.C.S., 133, *Gloucester-road, Kensington, S.W. 7*.
- 1913 PLATT, Ernest Edward, 403, *Essenwood-road, Durban, Natal*.
- 1885 POLL, J. R. H. Neerwort van der, *Driebergen, Netherlands*.
- 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 Mircille, Hyères (Var), France*.
- 1908 PRATT, William B., 10, *Lion Gate Gardens, Richmond, Surrey*.
- 1878 PRICE, David, 48, *West-street, Horsham*.
- 1908 PRIDEAUX, Robert M., *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., *Cuius College, Cambridge*.
- 1900 RAINBOW, William J., *The Australian Museum, Sydney, N.S.W.*
- 1912 RAIT-SMITH, W., *Hollybrook, Rose Heyworth-road, Abertillery, Monmouthshire*.
- 1913 RAO, H. Ananthaswamy, *Curator of the Government Museum, Bangalore, India*.
- 1916 RAO, Yelseti Ramachandra, M.A., Asst. Govt. Entomologist, *Agricultural College, Coimbatore, India*.
- 1907 RAYWARD, Arthur Leslie, *Rockford, Beechwood-road, Sanderstead*.
- 1898 * RELTON, R. H., c/o Perkins and Co., Ltd., *Brisbane, Queensland*.
- 1898 REUTER, Professor Enzo, *Helsingfors, Finland*.
- 1910 DE RHÉ-PHILIPPE, G. W. V., c/o Grindlay & Co., *Hastings-street, Calcutta*.
- 1912 RILEY, 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*.
- 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*.

- 1886 ROSE, Arthur J., 1, *Harewood-road, S. Croydon.*
- 1912 ROSEN, Kurt, Baron, *Zoologische Staatssammlung, Munich.*
- 1907 ROSENBERG, W. F. H., 57, *Haverstock-hill, N.W. 3.*
- 1868 ROTHNEY, George Alexander James, *Pembury, Tudor-road, Upper Norwood, S.E.*
- 1894 † ROTHSCHILD, The Honble. Nathaniel Charles, M.A., F.L.S., F.Z.S., PRESIDENT, (V.-PRES., 1914; COUNCIL, 1904, 1913-), *Arundel-house, Kensington Palace Gardens, W. 8.*
- 1888 † ROTHSCHILD, The Right Honble. Lord, D.Sc., F.R.S., F.L.S., F.Z.S., (COUNCIL, 1900), *Zoological Museum, Tring.*
- 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-), *Oskey-grove, Harrow Weald.*
- 1910 RUDGE, Charles Henry.
- 1892 RUSSELL, S. G. C., 19, *Lombard-street, E.C. 3.*
- 1905 ST. QUINTIN, W. H., *Scampton Hall, Rillington, York.*
- 1906 SAMPSON, Colonel F. Winn, 74, *Vineyard Hill-road, Wimbledon Park.*
- 1910 SAUNDERS, H. A., *Brookfield-house, Swanage.*
- 1901 SCHAUS, W., F.Z.S., *U.S. National Museum, Washington, D.C., U.S.A.*
- 1907 SCHMASSMANN, W., *Benlah Lodge, London-road, Enfield, N.*
- 1912 SCHUNCK, Charles A., *Ewelme, Wallingford.*
- 1881 SCOLLICK, A. J., *Elmswood, 8, Malden-road, New Malden.*
- 1911 SCORER, Alfred George, *Hill Crest, Chilworth, Guildford.*
- 1909 SCOTT, Hugh, M.A., F.L.S., Curator in Entomology, *University Museum of Zoology, Cambridge.*
- 1911 SCOTT, Percy William Affleck, Chinese Imperial Customs Service, *Hangchow, China.*
- 1912 SEITZ, Dr. Adalbert, 59, *Bismarckstrasse, Darmstadt, Germany.*
- 1911 SELOUS, Cuthbert F., M.D., M.R.C.S., L.R.C.P., *Agra, Barton-on-Sea, New Milton, Hants.*
- 1911 † SENNETT, Noel Stanton, 32, *Bolton-gardens, S. Kensington, S.W.*
- 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, Crowthorne, 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, *Youlgreave, South Croydon.*
- 1900 † SHEPHEARD-WALWYN, H. W., M.A., *Dalchinnie, Kenley, Surrey.*
- 1887 † SICH, Alfred, (COUNCIL, 1910-12), *Corney House, Chiswick, W. 4.*
- 1911 SIMES, James A., *Mon Repos, Monkham's-lane, Woodford-green, Essex.*

- 1904 SIMMONDS, Hubert W., 12, *Grey's Chambers, Court House-lane, Auckland, New Zealand.*
- 1913 SITWELL, Capt. F., *Wooler, Northumberland.*
- 1902 SLADEN, Frederick William Lambart, *Dept. of Agriculture, Central Experimental Farm, Ottawa, Canada.*
- 1902 SLOPER, Gerard Orby, F.Z.S., J.P., *Badminton Club, Piccadilly, W. 1.*
- 1907 SLY, Harold Baker, *Mapledean, Ringley-avenue, Horley.*
- 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., *Edgehill, Warlingham, Surrey.*
- 1912 SMITH, Roland T., 131, *Queen's-road, Wimbledon, S.W. 19.*
- 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., *Cleethorpes, Lincolnshire.*
- 1908 SPEYER, Edward R., *Ridgehurst, Shenley, Herts.*
- 1889 STANDEN, Richard S., F.L.S., (COUNCIL, 1906), *Newlyn, Romsey, Hants.*
- 1910 STANLEY, The Rev. Hubert George, *Marshfield Vicarage, Cardiff.*
- 1898 STARES, C. L. B., M.R.C.S., L.R.C.P., *The Limes, Swanley Junction, Kent.*
- 1898 STEBBING, Henry, *Chasewood, Round Oak-road, Weybridge.*
- 1910 STENTON, Rupert, *St. Edward's, St. Mary Church, Torquay.*
- 1910 STONEHAM, Hugh Frederick, Capt. 1st Batt. E. Surrey Regt., *Stoneleigh, Reigate.*
- 1913 STOREY, Gilbert, *Dept. of Agriculture, Cairo, Egypt.*
- 1915 STOTT, Charles Ernest, *Woodcroft, Eglington-road, Chingford, Essex.*
- 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), 6, *Gunterstone-road, Kensington, W.*
- 1894 SWINHOE, Ernest, 6, *Gunterstone-road, Kensington, W.*
- 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., *Mon plaisir, Wormley, Surrey.*
- 1916 TACHELL, Leonard Spencer, *Heathwood-road, Bournemouth.*
- 1911 TAUTZ, P. H., *Cranleigh, Pinner, Middlesex.*
- 1893 TAYLOR, Charles B., *Gap, Lancaster County, Penn., U.S.A.*
- 1911 TAYLOR, Frank H., *Australian Institute of Tropical Medicine, P.O. Box 207, Townsville, Queensland.*

- 1903 TAYLOR, Thomas Harold, M.A., *Yorkshire College, Leeds.*
- 1914 TEMPERLEY, Reginald, *Trevena, Harlow Oval, Harrogate, and L'Aurore, Vevey-la-Tour, Vaud, Switzerland.*
- 1909 * TETLEY, Alfred, M.A., 22, *Avenue-road, Scarborough.*
- 1910 THEOBALD, Prof. F. V., M.A., *Wye Court, Wye.*
- 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., B.Sc., F.L.S., Linnean Macleay Fellow in Zoology, *Kuranda, Mount Errington, Hornsby, New South Wales.*
- 1911 TODD, R. G., *The Limes, Hadley Green, N.*
- 1897 TOMLIN, J. R. le B., M.A., (COUNCIL 1911-3), *Lakefoot, Hamilton-road, Reading.*
- 1907 TONGE, Alfred Ernest, (COUNCIL, 1915-), *Aircraft, 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.*
- 1859*† TRIMEN, Roland, M.A., F.R.S., F.L.S., (PRES., 1897-8; V.-PRES., 1896, 1899; COUNCIL, 1868, 1881, 1890), 33, *Croftdown-road, Highgate-road, N.W.*
- 1906 TULLOCH, Col. B., *The King's Own Yorkshire Light Infantry, c/o Messrs. Cox & Co., 16, Charing Cross, S.W.*
- 1895 TUNALEY, Henry, *Castleton, Seavle-road, Farnham.*
- 1910 TURATI, Conte Emilio, 4, *Piazza S. Alessandro, Milan, Italy.*
- 1898 TURNER, A. J., M.D., *Wickham Terrace, Brisbane, Australia.*
- 1893 TURNER, Henry Jerome, (COUNCIL, 1910-12), 98, *Drakefell-road, Brockley, S.E. 4.*
- 1906 TURNER, Rowland E., (COUNCIL, 1909-10).
- 1915 TYTLER, Lt.-Col. H. C., *Vacoas, Mauritius.*
- 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 Colonial Sugar Refining Co., *Rarawai Mill, Fiji Islands.*
- 1909 VIDLER, Leopold A., *The Cedars, Little Holland, Clacton-on-Sea.*
- 1911 VITALIS DE SALVAZA, R., *Vientiane, Laos, Indo-China.*
- 1895 WACHER, Sidney, F.R.C.S., *Dane John, Canterbury.*
- 1897 WAINWRIGHT, Colbran J., (COUNCIL, 1901, 1912-14), 45, *Handsworth Wood-road, Handsworth, Birmingham.*
- 1878 WALKER, James J., M.A., R.N., F.L.S., VICE-PRESIDENT, SECRETARY, 1905- (COUNCIL, 1894; SEC. 1899), *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, (PRES., 1889-90 ; V.-PRES., 1882, 1888, 1891-2, 1894-5 ; COUNCIL, 1896), *British Museum (Natural History)*, *Cromwell-road*, S.W. 7.
- 1910 WARD, John J., *Rusinurbe House, Somerset-road, Coventry*.
- 1908 WARREN, Brisbane C. S., *le Chatagny, Territet, Switzerland*.
- 1869 * WATERHOUSE, Charles O., I.S.O., (PRES., 1907-8 ; V.-PRES., 1900, 1909 ; COUNCIL, 1873, 1882-3 ; 1898-1900), *Ingleside, Avenue-gardens, Acton*, W. 3.
- 1901 † WATERHOUSE, Gustavus A.; B.Sc., F.C.S., *Allonrie, Stanhope-road, Killara, New South Wales, Australia*.
- 1914 WATERSTON, Rev. James, B.D., B.Sc., 32, *Blandford-road, Bedford Park*, W. 4.
- 1914 WATT, MORRIS N., *St. John's Hill, Wangenui, New Zealand*.
- 1893 WEBB, John Cooper, 218, *Uplund-road, Dulwich*, S.E. 22.
- 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, Edward Barton, M.R.C.S., *Cardiff City Mental Hospital, Cardiff*.
- 1913 † WHITLEY, Percival N., *Brantwood, Halifax* ; and *New College, Oxford*.
- 1913 † WHITAKER, Oscar, *Ormidale, Ashlands, Ashton-upon-Mersey*.
- 1911 WHITTINGHAM, Rev. W. G., *Knighton Rectory, Leicester*.
- 1906 WICKWAR, Oswin S., *Charlemont, Gregory-road, Colombo, Ceylon*.
- 1903 WIGGINS, Clare A., M.R.C.S., *Entebbe, Uganda*.
- 1896 WILEMAN, A. E., *Thatched House Club, St. James'-street*, S.W. 1.
- 1910 WILLCOCKS, Frank C., Entomologist to the Khedivial Agricultural Society, *Cairo, Egypt*.
- 1911 WILLIAMS, C. B., M.A., *Port of Spain, Trinidad*, and 20, *Slatery-road, Birkenhead*.
- 1915 WILLIAMS, Harold Beck, 82, *Filey-avenue, Stoke Newington*, N. 16.
- 1915 WINN, Albert F., 32, *Springfield-avenue, Westmount, Montreal, Canada*.
- 1894 WOLLEY-DOD, F. H., *Millarville P. O., Alberta, N.W.T., Canada*.
- 1881 WOOD, The Rev. Theodore, *The Vicarage, Lyford-road, Wandsworth Common*, S.W. 18.
- 1905 WOODBRIDGE, Francis Charles, *South Mead, The Common, Gerrard's Cross S.O., Bucks*.
- 1914 WOODFORDE, Francis Cardew, B.A., 2, *Isis-street, Oxford*.
- 1912 WOODRUFFE-PEACOCK, Rev. E. Adrian, F.L.S., F.G.S., *Cadney Vicarage, Briyg, Lincolnshire*.
- 1892 YOUNDALE, William Henry, F.R.M.S., 21, *Belle Isle-street, Workington*.

ADDITIONS TO THE LIBRARY

DURING THE YEAR 1916.

- ALEXANDER (C. P.). New Neotropical *Tipulinae* (Tipulidae, Diptera).
[Ann. Entom. Soc. Amer., Vol. V, No. 4, 1912.]
- The American species of *Adelphomyia* Bergroth (Tipulidae, Diptera),
[Pomona Coll. Journ., Entom., Vol. IV, No. 3, 1912.]
- A Revision of the genus *Brachypremna*, Osten Sacken (Tipulidae,
Diptera).
[Journ. New York Entom. Soc., Vol. XX, No. 4, 1912.]
- Report on a collection of Crane-flies (Tipulidae, Diptera) from the
Colombian Andes, taken by Mr. J. T. Lloyd.
[Journ. New York Entom. Soc., Vol. XXI, No. 3, 1913.]
- The Neotropical Tipulidae in the Hungarian National Museum
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* [Entom. News, Vol. XXIV, 1913.]
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[Insector Inscitiae Menstruus, Vol. I, No. 9, 1913.]
- and LLOYD (J. T.). Biology of the North American Crane-flies
(Tipulidae, Diptera), I. The genus *Eriocera*, Macquart.
[Pomona Journ. Entom. and Zool., Vol. VI, No. 1, 1914.]
Entom. Lab., Cornell Univ.
- ARNOLD (G.). Monograph of the Formicidae of South Africa (Myrmecinae
pars).
[Ann. South African Mus., Vol. XIV, Part II, 1916.]
The Author.
- BACK (E. A.) and PEMBERTON (C. E.). Effect of cold storage temperatures
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capitata*).
[Journ. Agric. Research, Vol. VI, No. 7, 1916.]
- Effect of cold storage temperatures upon the Mediter-
ranean Fruit Fly (*Ceratitis capitata*, Wied.).
- Banana as a host fruit of the Mediterranean Fruit Fly.
[Journ. Agric. Research, Vol. V, No. 17, 1916.]
U. S. Dept. Agric.
- BACOT (A. W.). Report of the Entomological Investigation undertaken for
the Yellow Fever (West African) Commission for year August
1914 to July 1915.
[Research concerning Bionomics of *Stegomyia fasciata*.]
- The temperature necessary for the destruction of lice and their
eggs.
[Brit. Med. Journ., Jan. 29, 1916.]
- Notes on *Pediculus humanus (vestimenti)* and *Pediculus capitis*.
[Brit. Med. Journ., June 1916.]
- Use of Insecticides against Lice.
[Brit. Med. Journ., Sept. 30, 1916.]
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- BAKER (A. C.). Identity of *Eriosoma pyri*.
[Journ. Agric. Research, Vol. V, 1916.]
——— [See QUAINANCE (A. L.).]
——— and DAVIDSON (W. M.). Woolly Pear Aphis.
[Journ. Agric. Research, Vol. VI, No. 10, 1916.]
——— and TURNER (W. F.). Morphology and Biology of the Green
Apple Aphis.
[Journ. Agric. Research, Vol. V, No. 21, 1916.]
——— Rose Apple Aphis.
[Journ. Agric. Research, Vol. VII, 1916.] *U. S. Dept. Agric.*
- BALLARD (E.). *Calocoris angustatus*, Leth.
[Agric. Research Inst. Pusa, Bull. No. 58, 1916.] *The Institute.*
- BALLINGAR (A. M.). [See JOHNSON (P. M.).]
- BANKS (N.). The Acarina or Mites. A review of the group for the use of
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- BARBER (E. R.). The Argentine Ant. Distribution and control in the
United States (*Iridomyrmex humilis*, Mayr.).
[U. S. Dept. Agric., Bureau Entom., Bull. No. 377, 1916.]
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The Martorell Museum, Barcelona.
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Torino, 1848.
Mrs. Meldola.
- BEESON (C. F.). [See TROUP (R. S.).]
- BELT (T.). Naturalist in Nicaragua.
[1st edition. London, 1874.] *E. B. Poulton.*
- BERGROTH (E.). New and little-known Heteropterous Hemiptera in the
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[Proc. U. S. Nat. Mus., Vol. LI, 1916.]
The Smithsonian Institution.
- BERLESE (A.). Centuria prima di Acari nuovi.
[Redia, Vol. XII, 1916.]
——— Centuria seconda di Acari nuovi.
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——— e PAOLI (G.). Un Endofago esotico efficace contro il *Chrysom-*
phalus dictyospermi, Morg.
[Redia, Vol. XI, 1916.] *The Authors.*
- BETHUNE (C. J. S.). Bibliography of Canadian Entomology for the year
1914.
[Trans. Roy. Soc. Canada, Ser. 3, Vol. IX, 1916.] *The Society.*
- BLACKMAN (M. W.). [See SWAINE (J. M.).]
- BOISDUVAL (J. A.), RAMBUR (P.) et GRASLIN (A.). Collection Iconographique
et Historique des Chenilles ou description et figures des
Chenilles d'Europe. Texte et Plates. Paris, 1832-37.
Mrs. Meldola.
- BOLIVAR (J.) [See WYTSMAN (P.).]
- BOTKE (J.). A contribution to the knowledge of the phylogeny of the wing
markings in Lepidoptera.
[Kon. Akad. Wet. Amsterdam. Vol. XVIII, 1916.]
The Author.

- BRADLEY (J. C.). The Siricidae of North America.
[Journ. Entom. and Zool., Vol. V, 1913.]
Entom. Lab., Cornell Univ.
- BRAIN (C. K.). Fowl Tick (*Argas persicus*, Oken).
Union S. Africa, Pretoria.
- BRITAIN (W. H.). [See SANDERS (G. E.).]
- BUGNION (E.). Le *Termes horni*, Wasm. de Ceylan.
[Revue Suisse Zool., Vol. XXI, No. 10, 1913.]
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TRANSACTIONS
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FOR THE YEAR 1916.

I. *On new or little-known Xylophilidae.* By GEORGE
CHARLES CHAMPION, F.Z.S.

[Read November 3rd, 1915.]

PLATES I, II.

THIS paper contains descriptions of the numerous unnamed Xylophilidae in the British Museum, some remarks on various known species, and a few corrections in synonymy. The Asiatic forms * are mainly from the collections of Doherty (two only of these having been previously described) and Mr. Andrewes, supplemented by two recently received from Bengal; those from South America are from various sources, some of them from the Fry collection. So far as I am aware no Xylophilid has hitherto been recorded from Siam, the Andaman Islands, or China. Since the publication of my monograph of the Central American forms (1890-1893), supplemented subsequently by other papers on certain Antillean, Australian and Japanese members of the family, upwards of 200 Xylophilidae have been named by Pic. Extremely few of these latter, however, appear to be represented in the collections before me; but this is not surprising, taking into account the general rarity and restricted habitat of these fragile insects,

* Exclusive of those from Ceylon, Borneo and Penang enumerated by myself in Ann. and Mag. Nat. Hist. (8) xvi, pp. 215-226 (Sept. 1915), and Ent. Monthly Mag. li, pp. 278-288, 310 (Oct. and Nov. 1915), respectively.

so many of which are unique in collections. If the specimen is a male, there is little risk of adding to the synonymy in describing new species from a single example,* the characters to be found in the legs or antennae being often particularly well marked in this sex, sometimes, indeed, of an extraordinary or unexpected nature. No new genera or subgenera are added in the present paper, and dichotomous tables of species are of little or no value unless both sexes are known. *Xylophilus* doubtless requires splitting up, but to do it on the characters used by Casey a very large number of "genera" would be required.† The Xylophilidae are constantly confused in collections with the much more abundant and more widely distributed Anthicidae, which they may perhaps be said to mimic; they are, however, always recognisable by their tarsal structure ‡ (the tarsi having each a minute, short, nodiform, penultimate joint preceded by a very much longer, inferiorly produced, lobed joint), the fusion of the first and second ventral segments of the abdomen, and the broad apical joint of the labial palpi.

The new species described are from the following regions: India (including Burma), 31, 4 of them also occurring in Siam, about a dozen others having been previously recorded from the same region; Siam, 8, including three found in Tenasserim and one in Ceylon; Perak, 3; Sumatra, 1; Selangor, 1; Larat, 1; China, 5; Australia, 4; New Zealand, 1; S. Africa, 3; South America (including Trinidad), 11; Lesser Antilles, 2.

Mr. Andrewes has kindly lent me the co-types of two Indian species of *Xylophilus* described long ago by Fairmaire; and Mr. Bryant the types of two remarkable forms from Trinidad and two from Ceylon, all four recently named by Pic; figures of these latter are appended to the

* Out of 17 species captured by Mr. Bryant during his recent expedition to Borneo and Penang, 12 occurred singly.

† This author, in 1895, placed the 37 recognised N.-American species under 13 genera, but all his new generic names (including *Axylophilus*, which is doubtless valid) have been sunk as subgenera in Pic's Catalogue (1910).

‡ Misunderstood by the artist employed by Mulsant, whose figures of the tarsi of *X. pygmaeus*, de Geer (cf. Colligères, pl. 1, figs. 1, 2), appear to have been taken from an Anthicid! Pic's illustrations, too, in Wytzman's "Genera Insectorum" are all incorrect in this respect, including those copied (wrongly) from the "Biologia." Lewis's figure, too, of *X. distortus*, Champ., is inaccurate.

present paper. Mr. Hugh Scott found three *Xylophili* in the Seychelles, which will be dealt with elsewhere. Amongst a few forms detected in the Oxford Museum subsequent to the publication of my notes on the species of the group occurring in Ceylon (Ann. and Mag. Nat. Hist., Sept. 1915), the following may be mentioned: *Euxylophilus principalis*, Champ., ♂; *Xylophilus palliditarsis*, Pic; *X. orientalis*, Champ., and an insect here described under the name *X. bigeminatus*: all these were received from Thwaites, in 1873, from the same island.

NEW SPECIES DESCRIBED.

1. <i>Hylobaenus fracticornis</i> , Assam.	36. <i>Xylophilus andrevesi</i> , Nilgiri Hills.
2. " <i>raricornis</i> , Siam and Tenasserim.	37. " <i>parvicollis</i> , Assam.
3. <i>Xylophilus podagricus</i> , Siam and Tenasserim.	38. " <i>siamensis</i> , Siam.
4. " <i>arthriticus</i> , Assam.	39. " <i>annulicornis</i> , Tenasserim.
5. " <i>pulvinatus</i> , Siam and Tenasserim.	40. " <i>fuscototatus</i> , Bengal.
6. " <i>cylindricornis</i> , Assam.	41. " <i>megalocephalus</i> , Larat.
7. " <i>tavoyanus</i> , Tenasserim.	42. " <i>bigeminatus</i> , Siam and Ceylon.
8. " <i>perakensis</i> , Perak.	43. " <i>pectinatus</i> , Hong Kong.
9. " <i>axillaris</i> , Assam.	44. " <i>spinimanus</i> , Hong Kong.
10. " <i>melanotus</i> , Assam.	45. " <i>parvidens</i> , China.
11. " <i>patkainus</i> , Assam.	46. " <i>chinensis</i> , China.
12. " <i>meranganus</i> , Sumatra.	47. " <i>quadratipennis</i> , China.
13. " <i>latericius</i> , Siam.	48. " <i>darwinensis</i> , Port Darwin.
14. " <i>clavipes</i> , Tenasserim.	49. " <i>luniger</i> , Moko Hinou Isl., New Zealand.
15. " <i>trinotatus</i> , Tenasserim.	50. " <i>albopilosus</i> , Natal.
16. " <i>flavofasciatus</i> , Assam.	51. " <i>macrocephalus</i> , Natal.
17. " <i>ephippiatus</i> , Tenasserim.	52. " <i>ovatis</i> , Mashonaland.
18. " <i>denticollis</i> , Belgauim.	53. " <i>ingens</i> , Brazil.
19. " <i>nilgiriensis</i> , Nilgiri Hills.	54. " <i>triguttatus</i> , Brazil.
20. " <i>linearis</i> , Burma.	55. " <i>prochensus</i> , Amazons.
21. " <i>barbicornis</i> , Nilgiri Hills.	56. " <i>rectifasciatus</i> , Brazil.
22. " <i>glauca</i> , Perak.	57. " <i>insularis</i> , Brazil.
23. " <i>claviger</i> , Siam.	58. " <i>latefasciatus</i> , Brazil.
24. " <i>penicillatus</i> , Manipur.	59. " <i>amazonicus</i> , Amazons.
25. " <i>rufonotatus</i> , Perak.	60. " <i>dryophiloides</i> , Brazil.
26. " <i>furcatimanus</i> , Tenasserim.	61. " <i>flavipes</i> , Brazil.
27. " <i>andamanensis</i> , Andaman Is.	62. " <i>fuscifasciatus</i> , Brazil.
28. " <i>curtus</i> , Assam.	63. " <i>trinitatis</i> , Trinidad.
29. " <i>holosericeus</i> , Punjab.	64. " <i>hulticoides</i> , Grenada, W.I.
30. " <i>sellatus</i> , Nilgiri Hills.	65. " <i>atomarioides</i> , St. Vincent, W.I.
31. " <i>troglodytes</i> , Selangor.	66. " <i>duplocinctus</i> , Queensland.
32. " <i>plumbeus</i> , Kanara.	67. " <i>fergusoni</i> , New South Wales.
33. " <i>uncifer</i> , Bombay.	68. " <i>fracticolis</i> , New South Wales.
34. " <i>tumidiceps</i> , Bengal.	
35. " <i>tortipes</i> , Siam.	

HYLOBAENUS, Pic.

1. *Hylobaenus fasciatus*. (Plate I, fig. 1.)

Hylobaenus fasciatus, Pic. Ann. Soc. Ent. Fr. 1912, p. 272; Champ. Ann. and Mag. Nat. Hist. (8) xvi, p. 215.

Hab. CEYLON, Galle [type] (*Bryant*); TENASSERIM, Tavoy (*Doherty*).

The Ceylon type is figured, the Tenasserim example recently recorded by myself having darker legs.

2. *Hylobaenus fracticornis*, n. sp. (Plate I, fig. 2,
antenna, ♂.)

♂. Moderately elongate, shining; piceous, the palpi and legs (the infusate posterior femora excepted), an elongate-triangular patch on the disc of the elytra before the middle (extending forwards to near the base), and a small spot near the suture before the tip, testaceous, the antennae with joints 1 and 2 and 8-11 rufescent, the others almost black; clothed with fine, sericeous, cinereous pubescence; head and prothorax densely, finely, the elytra a little more coarsely, punctate. Head strongly deflexed; eyes very large, contiguous; antennae moderately long, stout, joint 2 shorter than 1, subcylindrical, about as long as broad, 3 triangular, about as long as 2, 4-7 abruptly wider and very strongly transverse, 8 nearly as long as 5-7 united, sublunate (narrow at the base and arcuately dilated at the apex within, the concave inner portion pilose), 9 and 10 subquadrate, 11 ovate. Prothorax broader than long, convex, somewhat uneven, subparallel-sided, and feebly constricted at the base. Elytra much wider than the head and prothorax, subparallel, broadly and obliquely depressed on the disc below the base, and somewhat tumid near the suture anteriorly. Legs moderately long, slender, the posterior femora strongly clavate; anterior tibiae and basal joint of posterior tarsi almost straight; posterior tibiae bowed, slender.

Length $1\frac{1}{2}$ mm.

Hab. ASSAM, Patkai Mts. (*Doherty*).

One male. The extraordinary structure of the ♂ antenna is unique, so far as I am aware, amongst the Xylophilids, though there is a minute New Zealand form (*X. luniger*, Ch.) with the seventh antennal joint somewhat similarly shaped in the same sex.

3. *Hylobaenus varicornis*, n. sp.

Moderately elongate, robust, shining; piceous, the palpi, legs (the infusate posterior femora excepted), and apex of abdomen testaceous, the basal and apical margins of the prothorax, and joints 1, 2, and 11 of the antennae, rufous; densely, finely punctate, thickly clothed with greyish, sericeous pubescence. Head strongly deflexed; eyes very large, contiguous; antennae stout, moderately long, joints 1 and 2 much thickened, 3 scarcely longer than 2, 3-10 gradually becoming a little wider and more angular, 11 ovate. Prothorax convex, about as wide as the head (including the eyes),

broader than long, subparallel-sided. Elytra broader than the head and prothorax, moderately long, subparallel, obliquely depressed on the disc below the base. Legs long; posterior femora feebly incrassate; posterior tibiae slightly curved in ♂; basal joint of posterior tarsi strongly arcuate.

Length 2 mm.

Hab. SIAM, Renong [type]; TENASSERIM, Tavoy.

Two specimens, assumed to be sexes, the one from Siam having the posterior tibiae distinctly curved, both taken by Doherty. It is quite probable that these insects should be referred to *H. (Phytobaenus) indicus*, Pic, from Mahé, Malabar; but as the latter is described as having the prothorax longer than broad, and the antennae reddish (a character relied upon by Pic in his comparative remarks under *H. notaticollis*, from New Guinea), the identification is too doubtful to be accepted. The normal antennae, immaculate elytra, more slender posterior femora, and arcuate basal joint of the posterior tarsi, readily separate the present species from *H. fracticornis*.

NOTOXEUGLENES.

Notoxeuglenes, Pic, Ann. Soc. Ent. Fr. 1912, p. 281.

Mr. Bryant has been kind enough to lend me for examination the type of this genus, *N. impressithorax*, Pic, found by himself in Trinidad, in Feb. 1903. It is certainly a male, and the broadly rostrate head (which is flattened in front and produced beyond the labrum) may be peculiar to this sex. The posterior femora are exceedingly stout, clavate, arched in front, and armed with a small tooth at about the middle beneath. The posterior tibiae are short, and subarcuately dilated externally.

The genus was described in a paper on Anthicidae and Hylophilidae, and the particular family to which the insect belonged was not indicated by the author. The type (♂) is figured on Plate I, figs. 3, 3a.

EUXYLOPHILUS.

Euxylophilus. Champion, Ann. and Mag. Nat. Hist. (8) xvi, p. 215 (Sept. 1915).

1. **Euxylophilus principalis.** (Plate I, figs. 4, ♀; 4a, hind leg, ♂.)

♀. *Euxylophilus principalis*, Champ., loc. cit. p. 216.

♂. Antennae with the serrated joints 5–10 less widened and more strongly serrate than in ♀; the short anterior tibiae slightly curved, unarmed at the tip (as in ♀); basal joint of anterior tarsi thickened; posterior tibiae armed with a short curved spur at the inner apical angle; basal joint of posterior tarsi more strongly curved than in ♀.

Hab. CEYLON (*Lewis*, in *Mus. Brit.*, ♀, type; *Thwaites*, in *Mus. Oxon.*, ♂).

Since the description of *E. principalis* was published, a ♂ has been detected in the Oxford Museum, showing that the type was a ♀. It is considerably smaller than the latter, and has the testaceous markings on the elytra more extended. The apical armature of the tibiae in the ♂ of this insect is transferred to the posterior pair, and the anterior pair are feebly developed, the spur, when present in the ♂, arising from the anterior tibiae in all the other species of the group known to me. The terminal dorsal segment of the abdomen is not covered by the elytra in either sex. The type is figured, also the hind leg of the ♂.

XYLOPHILUS, Latr.

*Asiatic Species.**

1. **Xylophilus podagricus**, n. sp. (Plate I, fig. 5, ♂.)

♂. Moderately elongate, rather broad, shining; nigro-piceous or piceous, the palpi, prothorax, elytral humeri, anterior legs, intermediate and posterior tarsi, and the intermediate femora and tibiae in part, testaceous, the antennae infuscate, with the joints 9–11 testaceous; the head and prothorax densely, finely, the elytra more coarsely, punctate; clothed with long, cinereous pubescence. Head short, narrowly, subangularly extended on each side behind the eyes, the latter very large, deeply emarginate, and subapproximate in front; antennae long, moderately stout, joint 1 curved, about as long as 2 and 3 united, 3 short, 4 about twice as long as 3, 4–10 subcylindrical, gradually decreasing in length, 11 as long as 9 and 10 together, stout, obliquely acuminate. Prothorax rather small, transversely subquadrate, obliquely narrowed anteriorly, the disc

* Those from China are placed under a separate heading.

without definite impression. Elytra comparatively short, much broader than the head, narrowing from a little below the base, the usual depression on the disc almost obsolete. Legs long; anterior tibiae almost straight on their outer edge, hollowed towards the apex (and thus appearing sinuous) within; intermediate femora curved; intermediate tibiae broadly, triangularly dilated externally; posterior femora curved, strongly incrassate, furnished with a broad, pallid, setose pad along their lower face, and with a long slender tooth at the inner apical angle; posterior tibiae strongly dilated, sinuous; basal joint of posterior tarsi feebly curved.

Length (with head extended) $2\frac{1}{3}$ – $2\frac{1}{4}$, breadth 1 mm.

Hab. TENASSERIM, Tavoy [type]; SIAM, Renong.

Three specimens, captured by Doherty. The peculiar form of the legs in this species will enable it to be readily identified, at least in the male sex. The posterior femora appear to be ciliate as seen from above, the slender straight tooth at the tip being about as long as the setae.

2. *Xylophilus arthriticus*, n. sp. (Plate I, figs. 6, 6a, b, ♂, legs.)

♂. Moderately elongate, broad, robust, shining; black, the trochanters and tarsi testaceous; the head and prothorax densely, the elytra coarsely, punctate; clothed with long, decumbent, cinereous hairs. Head short, broad, narrowly extended on each side behind the eyes, the latter large, deeply emarginate, and separated by about one-third of their width; antennae moderately stout, joint 2 short, 3 nearly twice as long as 2 (the other joints missing). Prothorax convex, broader than long, subquadrate, narrowed in front, unimpressed on the disc. Elytra moderately long, wider than the head, gradually narrowing from a little below the base, the disc with a deep oblique depression, the space between it and the suture appearing tumid. Abdomen clothed with long hairs, broadly excavate and bare down the middle. Legs long; anterior and intermediate femora moderately thickened, the posterior pair strongly incrassate and furnished with a broad, pallid, spongy pubescent pad along their lower face; anterior tibiae (fig. 6) sinuate, dilated towards the base, mucronate at the tip; intermediate tibiae (fig. 6a) sinuate, broadly foliaceous, deeply, obliquely emarginate externally; posterior tibiae (fig. 6b) bowed at the base, and widened and almost straight thence to the apex; tarsi rather stout, the basal joint of the posterior pair feebly curved.

Length $2\frac{2}{3}$, breadth $1\frac{1}{10}$ mm.

Hab. ASSAM, Patkai Mts. (*Doherty*).

One specimen. This species is related to *X. podagricus*, differing from it in the less curved intermediate and posterior femora, the deeply, obliquely emarginate outer edge of the still broader intermediate tibiae, the non-dentate posterior femora, the broadly excavate ventral surface, etc., of the male. *X. oedipus*, Pic, from the Island of Banguay, near Borneo, seems to have similar tibiae in the same sex, but it differs in various respects from *X. arthriticus*. The Japanese *X. distortus*, Champ. (1890), figured by Lewis in 1895, also approaches *X. arthriticus*.

3. *Xylophilus pulvinatus*, n. sp.

Moderately elongate, rather broad, robust, shining; ferruginous, the palpi and tarsi (the infuseate basal joint of the intermediate and posterior pairs excepted) testaceous, the eyes, antennae (the base and tip excepted), and femora and tibiae in part, nigro-piceous or piceous; the head and prothorax closely, finely, the elytra more coarsely, punctate; clothed with rather long, pallid, decumbent hairs. Head short, moderately broad, very narrowly, subangularly extended on each side behind the eyes, the latter large, deeply emarginate, and separated by about half their width; antennae (♂) stout, long, joint 2 short, half the length of 3, 3-10 subcylindrical, almost equal in length, and gradually becoming slightly wider, 11 ovate, obliquely acuminate, (♀) shorter, and with joint 3 less than twice the length of 2. Prothorax large, convex, transversely subquadrate, broader in ♀, obliquely narrowed in front, unimpressed. Elytra much wider than the head, comparatively short, narrowing from the basal third, with a deep, oblique depression on the disc below the base. Legs long. ♂. Anterior tibiae slender, almost straight, armed with a long, fine spur at the inner apical angle; intermediate tibiae distinctly sinuate, slightly widened outward; posterior femora strongly clavate, furnished with a broad spongy-pubescent pad along their lower face (appearing closely ciliate as seen from above), the other femora rather slender; posterior tibiae deeply sinuate, moderately broad; basal joint of posterior tarsi areuate.

Length $2\frac{1}{2}$ - $2\frac{4}{5}$, breadth $1-1\frac{1}{5}$ mm. (♂ ♀)

Hab. SIAM, Renong [type, ♂]; TENASSERIM, Tavoy [♀].

Described from two specimens found by Doherty. A broken third example (♀?) from the Patkai Mts., Assam, with a much broader head may also belong here. The

ferruginous, shining, sparsely pilose body, the stout, infusate antennae, the partly infusate legs, and the sexual peculiarities of the ♂, sufficiently distinguish *X. pulvinatus*. The pad on the posterior femora is conspicuous.

4. *Xylophilus cylindricornis*, n. sp. (Plate I, fig. 7,
anterior leg, ♂.)

♂. Moderately elongate, broad, robust, shining; nigro-piceous, the palpi, mouth-parts, tip of antennae, prothorax, base of elytra, under surface in part, anterior legs, intermediate and posterior femora at base, and the tarsi of the same legs in part, ferruginous; head and prothorax closely, finely, the elytra a little more coarsely, punctate; clothed with rather long, decumbent, pallid pubescence, the antennae closely set with short, stiff, bristly hairs. Head short, broad, narrowly, subangularly extended on each side behind the eyes, the latter extremely large, feebly emarginate, and separated by about half their width; antennae long, very stout, joint 2 short, 3 twice as long as 2, 3-10 subcylindrical, subequal in length, 11 large, about as long as 9 and 10 united, strongly acuminate. Prothorax convex, transverse, subquadrate, obliquely narrowed anteriorly, much narrower than the head, unimpressed. Elytra broad, rather short, parallel at the base, the oblique post-humeral depression deep. Legs long; posterior femora strongly clavate, the others stout; anterior tibiae much widened outwards, sinuous within, armed with a stout curved spur at the apex, and also with a short triangular tooth just before the tip beneath (fig. 7); tarsi rather stout, first joint of posterior pair feebly curved, more than half the length of the tibia.

Length 3, breadth $1\frac{1}{5}$ mm.

Hab. ASSAM VALLEY (*Doherty*).

One male. In this insect the antennae are nearly as stout as in the American *X. forticornis* and its allies. The ferruginous prothorax and base of elytra, the black antennae, the strongly clavate posterior femora, and the peculiarly shaped anterior tibiae (♂) are its chief characters. The general coloration is not unlike that of the cosmopolitan *Anthicus floralis*.

5. *Xylophilus tavoyanus*, n. sp. (Plate I, fig. 8,
anterior leg, ♂.)

♂. Moderately elongate, robust, shining; nigro-piceous, the palpi, base of elytra, tip of abdomen, anterior legs (the knees

excepted), base of intermediate femora, and intermediate tarsi, flavo-testaceous; head and prothorax closely, finely, the elytra more coarsely, punctate; clothed with long, fine, pallid pubescence. Head very large, short, narrowly, angularly extended on each side behind the eyes, the latter extremely large, deeply emarginate, and separated by about half their width; antennae long, moderately stout, joint 2 much shorter than 3, 3 very gradually decreasing in length, 10 transverse, 11 stout, longer than 9 and 10 united, strongly acuminate. Prothorax rather narrow, broader than long, subquadrate, convex, narrowed in front, unimpressed. Elytra a little wider than the head, comparatively short, subparallel at the base, the usual oblique depression long and deep (the space near the suture thus appearing strongly tumid). Legs long [the posterior pair wanting]; anterior and intermediate femora stout; anterior tibiae broadly, subangularly at the middle within, and produced into a curved tooth at the tip (fig. 8), the tarsus inserted a little before the apex.

Length $2\frac{1}{2}$, breadth $\frac{9}{10}$ mm.

Hab. TENASSERIM, Tavoy (*Doherty*).

One male, now wanting the posterior legs, but nevertheless easily recognisable by the powerful, subangularly dilated anterior tibiae, the long, dark antennae, with elongate, stout, apical joint, the large head and eyes, and the abruptly flavous base of the elytra. *X. tavoyanus* is related to *X. pulvinatus*; but it is much smaller and narrower, the antennae are more slender, the prothorax is infusate, and the anterior tibiae (δ) are differently shaped.

6. *Xylophilus perakensis*, n. sp.

δ . Oblong, broad, robust, shining; nigro-piceous, the humeri, the anterior femora, and the anterior tibiae and intermediate femora in part, ferruginous, the palpi and tarsi testaceous [the hind legs missing], the antennae black, with the base and tip reddish; densely, the elytra a little more coarsely, punctate; finely pubescent. Head short, broad, extended outwards on each side behind the eyes, the latter large, depressed, deeply emarginate, and separated by about half their own width; antennae stout, moderately long, joint 2 short, 3 longer, 3-10 gradually decreasing in length, 3-7 nearly as long as broad, 8-10 transverse, 11 stout, obliquely acuminate. Prothorax rather convex, large, transverse, a little narrower than the head, subquadrate, narrowed in front, unimpressed. Elytra considerably wider than the head, oblong, narrowing from a little below the base, with an oblique intra-humeral depression.

Legs stout [posterior pair wanting], the femora clavate; anterior tibiae short, moderately thickened, mucronate at the apex. Penis-sheath stout, acuminate.

Length $2\frac{3}{4}$, breadth 1 mm.

Hab. PERAK (*Doherty*).

One specimen. This insect is coloured like *X. axillaris*, from Assam, but it is more nearly related to *X. tavoyanus*, from Tenasserim, which has the entire base of the elytra testaceous, the legs and antennae longer and not so stout, and the anterior tibiae of the ♂ strongly dilated at the middle within. The posterior legs are unfortunately wanting in the unique types of these two insects; these legs doubtless have the femora strongly clavate. *X. axillaris*, known from a single ♀, has shorter and much more slender limbs, and it is scarcely likely to be the sexual complement of the Perak insect.

7. *Xylophilus axillaris*, n. sp.

♀. Moderately elongate, broad, robust, shining; nigro-piceous. the palpi, humeri, anterior legs (the knees excepted), intermediate femora in part, and the intermediate and posterior tarsi testaceous; head and prothorax densely, finely, the elytra more coarsely, punctate; clothed with rather long, pallid pubescence. Head broad, short, narrowly, subangularly extended on each side behind the eyes, the latter large, deeply emarginate, and separated by about half their width; antennae short, rather stout, joint 2 slightly shorter than 3, 3-10 very gradually decreasing in length, 3-5 about as long as broad, 6-10 transverse, 11 short-ovate, acuminate. Prothorax transverse, subquadrate, narrowed in front, convex, obsolete canaliculate down the middle behind. Elytra broad, much wider than the head, rather short, subparallel in their basal half, without definite depression. Legs rather short, posterior femora a little thicker than the others, basal joint of posterior tarsi curved.

Length $2\frac{1}{2}$, breadth 1 mm.

Hab. ASSAM, Patkai Mts. (*Doherty*).

One female, in poor condition. Not unlike *X. bryanti*, Pic, from Ceylon, differing from that species in its larger size, the stouter, nigro-piceous antennae, the unimpressed elytra, with the humeri only testaceous, and the less thickened posterior femora and tibiae. *X. scapularis*, Fairm. (re-named *fairmairei* by Pic), from Belgaum, may be an allied form.

8. *Xylophilus melanotus*, n. sp.

♀. Moderately elongate; broad, robust, shining; nigro-piceous, the mouth-parts, palpi, the anterior legs in great part, and the intermediate and posterior legs with the tarsi and the bases of the femora, testaceous or rufo-testaceous; head and prothorax closely, finely, the elytra a little more coarsely, punctate; clothed with long, fine, decumbent, cinereous pubescence. Head short, broad, narrowly, subangularly extended on each side behind the eyes, the latter large, deeply emarginate, and separated by about half their own width; antennae rather short, moderately stout, joint 2 short, 3 a little longer, 3-10 very gradually decreasing in length, 8-10 transverse, 11 acuminate-ovate. Prothorax convex, transversely-subquadrate, obliquely narrowed in front, narrower than the head, unimpressed. Elytra moderately long, much wider than the head, subparallel in their basal half, feebly, transversely depressed below the base. Legs long, the posterior pair with the femora stout, clavate, the tibiae rather broad, and the basal joint of the tarsi arcuate.

Length $2\frac{1}{3}$, breadth $1\frac{1}{10}$ mm.

Hab. ASSAM, Patkai Mts. (*Doherty*).

One specimen. This insect approaches *X. arthriticus*, from the same locality, the male only of which is known, but differs from it, apart from the shorter antennae, in having the anterior legs almost entirely testaceous, the basal joint of the posterior tarsi strongly curved, and the elytra less coarsely punctate, without the deep oblique depression below the base. Compared with the allied *X. axillaris* (♀), also from the same locality, it is more elongate, the legs and antennae are longer, the posterior femora are more strongly clavate, the posterior tibiae are broader, and the elytra want the humeral spot.

9. *Xylophilus patkainus*, n. sp.

♂. Moderately elongate, narrow, robust, shining; piceous, the head black, the antennae ferruginous at the tip, the palpi and tarsi testaceous, the anterior femora and tibiae, and the intermediate femora at the base, rufo-piceous; closely, rather finely punctate, the punctures very little coarser on the elytra; clothed with moderately long, greyish pubescence. Head large, broad, narrowly extended on each side behind the eyes, the latter large, deeply emarginate, and separated by about half their own width; antennae stout, short, joint 2 shorter than 3, 3-7 subquadrate, about equal,

8-10 transverse, 11 stout, longer than 9 and 10 united, obliquely acuminate. Prothorax convex, narrow, nearly as long as broad, slightly rounded at the sides, unimpressed. Elytra a little wider than the head, rather short, gradually narrowing from just below the base, the oblique intra-humeral depression well-defined. Legs moderately long; anterior tibiae bowed inwards from about the middle, subangulate externally; posterior femora a little stouter than the others; posterior tibiae somewhat dilated, feebly rounded externally; basal joint of posterior tarsi feebly arcuate.

Length (with head extended) 2, breadth $\frac{2}{3}$ mm.

Hab. ASSAM, Patkai Mts. (*Doherty*).

One male. Near *X. clavipes*, from Tenasserim, but with the legs and antennae much shorter and darker, the posterior femora not nearly so stout, the body piceous, the anterior tibiae bent in the ♂, etc. The dark body, short antennae, narrower and more finely punctured elytra, and less abruptly bent, non-mucronate anterior tibiae of the ♂, separate *X. patkainus* from *X. cribricollis* (= *mucronatus*), Pic, from Ceylon. *X. melanotus*, from the same locality, the ♀ only of which is known, is a much larger, broader, and more robust insect, with longer limbs, a shorter apical joint to the antennae, etc., and it cannot be the sexual complement of the present species. *X. patkainus* is also very like the Brazilian insect here identified as *X. obscuricolor*, Pic, which has differently formed antennae and stouter posterior femora.

10. *Xylophilus meranganus*, n. sp.

Oblong, robust, convex, shining; ferruginous, the head black, the palpi, antennae, elytra, and legs (the partially infusate intermediate and posterior femora and tibiae excepted) testaceous; densely, the elytra rather coarsely, punctate; clothed with rather long, pallid hairs. Head short, broad, narrowly, subangularly extended on each side behind the eyes, the latter large, deeply emarginate, and separated by about half their own width; antennae short, stout, joint 2 short, 3 longer, 3-10 gradually decreasing in length, 3-6 about as long as broad, 7-10 transverse, 11 acuminate-ovate. Prothorax large, a little narrower than the head, transversely subquadrate, narrowed in front, unimpressed. Elytra rather short, convex, wider than the head, somewhat rounded at the sides, narrowing from the basal third, without definite impression on the disc. Legs comparatively short and stout; posterior

femora clavate, simple; basal joint of posterior tarsi feebly curved.

Length 2, breadth 1 mm. (♀?)

Hab. SUMATRA, Merang (*Doherty*).

One specimen. A robust, convex, somewhat oval insect, with short, stout limbs, a broad black head, and the prothorax, elytra, antennae, and tarsi ferruginous or testaceous, the prothorax and elytra without depression, the posterior femora clavate. This is the only representative of the genus from Sumatra in the British Museum collection, and it is apparently different from all the numerous species described from that island.

11. *Xylophilus latericius*, n. sp.

Oblong, robust, shining; rufo-testaceous, the eyes black, the posterior tibiae and the sides of the elytra slightly infuscate; densely punctate, the punctures on the elytra very little coarser than those on the prothorax; clothed with long, fine, pallid hairs. Head very broad, narrowly extended on each side behind the eyes, the latter large, deeply emarginate, and separated by a little more than half their own width; antennae short, moderately stout, joint 3 slightly longer than 2, 3-10 gradually decreasing in length, 7-10 transverse, 11 rather stout, obliquely acuminate. Prothorax large, strongly transverse, a little narrower than the head, subquadrate, narrowed in front, obsoletely canaliculate down the middle behind. Elytra broader than the head, moderately long, subparallel in their basal third, rounded at the apex, transversely depressed below the base. Legs rather stout, moderately long; posterior femora clavate, simple; posterior tibiae widened and compressed; basal joint of posterior tarsi curved.

Length 2½, breadth 1 mm. (♂?)

Hab. SIAM, Renong (*Doherty*).

One specimen, apparently a male. Near *X. ceylonicus*, from Kandy, Ceylon, and *X. lentus* and *X. matangensis*, from Borneo, all of which have the anterior tibiae more or less bent and mucronate in ♂. Larger and broader than the first-named, the antennae shorter and not so stout, the elytra more finely punctate. More elongate and broader than *X. lentus*, ♂, the legs and antennae not quite so stout, the prothorax broader, etc. Much larger and broader than *X. matangensis*, the antennae shorter and stouter,

the elytral punctuation not nearly so coarse. *X. erythroderus*, from Borneo, *X. acuminatus*, from Penang, and *X. meranganus*, from Sumatra, again, are allied forms, but they have the head black and differ in other respects.

12. *Xylophilus clavipes*, n. sp.

♂. Oblong, robust, shining; testaceous, the head, prothorax, and under surface reddish, the eyes black, the posterior femora and tibiae in great part piceous, the intermediate femora infuscate near the tip; head and prothorax closely, finely, the elytra more coarsely and diffusely, punctate; finely pubescent. Head short, broad, narrowly, subangularly extended on each side behind the eyes, the latter very large, deeply emarginate, and separated by less than half their own width; antennae rather stout, long, joint 2 much shorter than 3, 3-10 subcylindrical, about equal in length, 11 nearly as long as 9 and 10 united, acuminate-ovate. Prothorax rather convex, narrow, broader than long, quadrate, but little narrowed in front, unimpressed. Elytra comparatively short, a little wider than the head, narrowing from just below the base, broadly, obliquely depressed on the disc anteriorly, appearing subcostate from the humeri downward. Legs stout, moderately long; anterior tibiae feebly sinuate within, mucronate at the inner apical angle; posterior femora very stout, strongly clavate; posterior tibiae widening from a little below the base; basal joint of posterior tarsi feebly curved, stouter than the following joints.

Length 2, breadth $\frac{1}{2}$ mm.

Hab. TENASSERIM, Tavoy (*Doherty*).

One male. More elongate than *X. ceylonicus*, Pic, ♂, the antennae much longer, with joints 3-10 oblongo-cylindric, the anterior tibiae more slender and without a long bent hook at the apex beneath, the prothorax less transverse. The legs longer and stouter, the posterior femora strongly clavate.

13. *Xylophilus trinotatus*, n. sp. (Plate I, fig. 9, ♀.)

♀. Short, broad, shining; piceous, the antennae, palpi, legs, prothorax, a large humeral spot on the elytra, and the apex of the latter broadly, testaceous; densely, finely, the elytra more coarsely, punctate; clothed with long, pallid pubescence. Head short, broad, narrowly, subangularly extended on each side behind the eyes, the latter large, deeply emarginate, and separated by about half their own width; antennae short, rather slender, joint 2 much

shorter than 3, 3-10 subcylindrical, gradually decreasing in length, 10 transverse, 11 acuminate-ovate. Prothorax strongly transverse, convex, very little narrower than the head, unimpressed. Elytra short, much broader than the head, somewhat rounded at the sides, rather convex, the post-basal depression wanting. Legs comparatively short, the posterior femora a little stouter than the others.

Length $2\frac{1}{10}$, breadth 1 mm.

Hab. TENASSERIM, Tavoy (*Doherty*).

One female, at first provisionally placed by me under *X. podagricus*, the male only of which is known; but the differences are much too great for these insects to be the sexual complements of the same species. *X. trinotatus* is not unlike the Palaearctic *X. neglectus*, Duval, except that it is larger and more robust, etc.

14. *Xylophilus flavofasciatus*, n. sp.

♂. Oblong, rather convex, shining; piceous, the head (the eyes excepted) and prothorax ferruginous, the antennae and palpi, the elytra with a rather broad basal fascia and an indeterminate oval spot near the suture beyond the middle, and the legs (the posterior femora in part excepted), testaceous; densely, finely, the elytra rather coarsely, punctate, finely pubescent. Head convex, short, moderately broad, the eyes depressed, deeply emarginate, not reaching the base; antennae rather stout, subfiliform, joint 2 short, 3 and 4 a little longer, equal, 5-10 slightly shorter and wider, 10 transverse, 11 stout, as long as 9 and 10 united, acuminate-ovate. Prothorax transverse, rounded at the sides, rather convex, unimpressed. Elytra short, much wider than the head, somewhat rounded at the sides, the post-basal depression wanting. Legs comparatively short, rather stout; anterior tibiae armed with a minute triangular tooth on the inner edge about the middle; posterior femora stout, clavate, simple; posterior tibiae curved, rather broad; basal joint of posterior tarsi feebly curved.

Length $1\frac{3}{4}$, breadth $\frac{3}{4}$ mm.

Hab. ASSAM, Patkai Mts. (*Doherty*).

One male, somewhat crushed. Smaller than *X. ceylonicus* and *X. nigronotatus*, Pic, and *X. clavipes*, Ch.; the elytra less parallel, piceous, and testaceo-maculate; the eyes rather small and depressed; the male with the anterior tibiae armed with a minute tooth at the middle, the posterior femora simply clavate, and the posterior tibiae curved.

15. *Xylophilus ehippiatus*, n. sp.

♂. Short, shining; testaceous, the head black, the elytra with a transverse mark at the base near the scutellum and a common interrupted median fascia (formed by a triangular patch at the sides and a broader subtriangular patch across the suture) piceous, the posterior femora and tibiae slightly infuscate; head and prothorax closely, finely, the elytra a little more coarsely, punctate; finely pubescent. Head short, broad, very narrowly extended on each side behind the eyes, the latter large, deeply emarginate, and narrowly separated; antennae rather slender, joint 2 short, half the length of 3, 3 and 4 about equal, cylindrical [5-11 broken off]. Prothorax transversely subquadrate, obliquely narrowed in front, narrower than the head, with a faint, shallow, arcuate depression before the base. Elytra a little wider than the head, gradually narrowing from near the base, with a shallow, oblique, post-basal depression. Legs rather short; anterior tibiae slightly widened, simply arcuate, the intermediate pair feebly curved; posterior femora stout, with a slender, sharp tooth near the tip, and furnished with a narrow, setulose pad along their lower face.

Length (with head extended) $1\frac{2}{3}$, breadth $\frac{3}{4}$ mm.

Hab. TENASSERIM, Tavoy (*Doherty*).

One male. Smaller and narrower than *X. diversiceps*, Pic, from Ceylon (the female only of which is known); the elytra less coarsely punctate, the dark basal markings not extending down the suture, and the common median fascia divided into two triangular patches on each elytron; the posterior femora very much stouter. Unless these insects were obtained at the same locality, it would be unsafe to treat them as the sexual complements of one species.

16. *Xylophilus rufinus*.

Xylophilus rufinus, Fairm., Ann. Soc. Ent. Belg. xl, p. 45 (1896) (part.).

♂. Oblong, shining; rufo-testaceous, the eyes black, the posterior femora slightly infuscate; the entire upper surface densely punctate, the punctures on the elytra rather coarse; finely pubescent. Head short, broad, the eyes small, not reaching the base, feebly emarginate; antennae subfiliform, moderately long, rather stout, joints 2 and 3 about equal, 4 longer than 3, 4-10 very gradually decreasing in length, 11 rather stout, acuminate-ovate. Prothorax not quite so wide as the head, short, transversely quadrate, abruptly, obliquely

narrowed in front. Elytra considerably wider than the head, oblong, without definite depression. Legs slender, moderately long; anterior tibiae curved, armed with a minute triangular tooth at about one-third from the apex, and mucronate at the inner apical angle; posterior femora clavate, stout; posterior tibiae straight; basal joint of posterior tarsi very slender, almost straight.

Length $1\frac{2}{3}$, breadth $\frac{2}{3}$ mm.

Hab. INDIA, Belgaum (*Andrewes*).

Fairmaire appears to have confused three species under this name. Two co-types, ♂ ♀, lent me by Mr. Andrewes, cannot possibly be conspecific, and the ♂ mentioned by the author, and retained by him, with a dark head, larger and more approximate eyes, and stouter antennae, is clearly a third species. The general description, especially as regards the rather stout antennae, the densely punctured prothorax and elytra, and the infusate posterior femora, applies to the male before me, which can be taken as typical *X. rufinus*. An allied form, *X. chinensis*, Ch. (infra), occurs in China.

17. *Xylophilus denticollis*, n. sp.

Xylophilus rufinus, Fairm., Ann. Soc. Ent. Belg. xl, p. 45 (1896) (part.).

Oblong, moderately shining; testaceous, the eyes black; sparsely, minutely, the elytra more closely and distinctly, punctate; finely pubescent. Head short, not very broad, very narrowly extended on each side behind the eyes, the latter moderately large, distant, entire; antennae rather short, joints 1 and 2 stout, 3 and 4 slender, equal, 3 longer than 2, 5-10 rapidly becoming shorter and wider, 9 and 10 transverse, 11 acuminate-ovate. Prothorax as wide as the head, strongly transverse, trapezoidal, abruptly, obliquely narrowed anteriorly, the anterior angles tumid and subdentiform, the disc with two shallow oblique foveae before the base. Elytra broad, nearly twice as wide as the prothorax, oblong, narrowing from about the basal third, the oblique post-basal depression rather deep, the humeri somewhat prominent. Legs slender, rather long, the posterior femora moderately incrassate, clavate, the tibiae narrow; basal joint of posterior tarsi very slender, long, almost straight.

Length 2, breadth 1 mm. (♀?).

Hab. INDIA, Belgaum (*Andrewes*).

One specimen. This species has the head and prothorax

equal in width; the prothorax short and trapezoidal, with the anterior angles subdentiform and the disc comparatively smooth; the elytra broad; the third and fourth joints of the antennae slender; and the body wholly testaceous, the eyes excepted. The antennae are very different from those of *X. rufinus*, being more like those of *X. orientalis*, Ch.* The puncturing of the surface also is very much finer and more scattered than in *X. rufinus*, and the eyes are larger and entire.

18. *Xylophilus nilgiriensis*, n. sp. (Plate I, figs. 10, ♂;
10a, anterior leg.)

♂. Short, depressed, opaque; rufo-testaceous or testaceous, the elytra slightly infuscate along the suture from a little below the base to near the tip, the eyes black; head and prothorax minutely, the elytra more distinctly, punctate; very finely sericeo-pubescent. Head short, broad, very narrowly extended on each side behind the eyes, the latter large, unemarginate, distant; antennae short, not very slender, joints 2 and 4 rather stout, subequal, 3 narrower and scarcely longer, 4-10 gradually becoming shorter, 8-10 transverse, 11 ovate. Prothorax transverse, trapezoidal, the anterior angles somewhat dentiform, the disc shallowly, obliquely bi-impressed before the base. Elytra wider than the head, narrowing from about the basal third, the post-basal depression oblique and rather broad. Legs very slender, long; anterior tibiae slightly curved; anterior tarsi with the basal joint much thickened, as broad as the tibiae (fig. 10a); posterior femora incrassate, much stouter than the others.

Length $1\frac{1}{2}$, breadth $\frac{2}{3}$ mm.

Hab. INDIA, Nilgiri Hills (*H. L. Andrewes*).

Three males. A minute, delicate, pallid form, with finely punctate surface, unemarginate, widely separated eyes, long, slender legs, incrassate posterior femora, and a greatly thickened basal joint to the anterior tarsi in ♂, much as in many *Macratræ*. The infuscation of the suture may be due to discoloration. This species bears some relationship to *X. scutatus*, Ch., from Borneo,† which is a much broader insect, with stouter posterior femora, a larger head, non-unicolorous antennae, etc.

* Ann. and Mag. Nat. Hist. (8) xvi, p. 223.

† Ent. Mo. Mag. li, p. 284.

19. *Xylophilus brunneomaculatus*.

Hylophilus brunneomaculatus, Pic, L'Échange, xxiii, p. 182 (1907).

Moderately elongate, broad, attenuate posteriorly, shining; testaceous, the head in part or almost entirely piceous, the eyes black, the elytra with a large, brownish, indeterminate patch on the disc before the middle; head almost smooth, prothorax and elytra densely punctate, the punctures on the prothorax very fine, those on the elytra moderately coarse; finely pubescent. Head small, transverse, broadly, subangularly extended on each side behind the eyes, the latter small and feebly emarginate; antennae moderately long, very slender, thickened towards the apex, joint 2 about as long as 4, 3 and 5 more elongate, 5-10 becoming gradually wider, 10 about as broad as long, 11 longer and stouter, arcuato-acuminate. Prothorax nearly as wide as the head, transversely quadrate, the sides constricted behind the middle, tumid in front of this, and abruptly convergent in front, the disc with two deep oblique foveae before the base. Elytra rather long, somewhat inflated, more than twice the width of the prothorax, rapidly narrowed posteriorly, transversely depressed below the base. Legs slender, rather long; posterior femora thickened towards the tip.

Length $2\frac{1}{3}$ - $2\frac{1}{2}$, breadth $1\frac{1}{10}$ - $1\frac{1}{3}$ mm. (♀?).

Hab. INDIA, Kasauli, Himalayas (*H. J. W. Barrow*, 21. vi. '05), Simla (vi. 1912, on *Mus decumanus*), Murree [type].

Two specimens from Kasauli and Simla respectively are perhaps referable to *X. brunneomaculatus*, Pic, the type of which was from Murree. There is, however, some doubt about the identification, and a description is given from the examples in the British Museum: the Murree insect is said to have the elytra more coarsely punctate at the base than at the apex, the prothorax longer than broad, and the abdomen black. *X. rosti*, Pic (1909), from Kulu, may also be an allied form, but it is described as having the prothorax "presque carré."

20. *Xylophilus linearis*, n. sp.

Elongate, narrow, shining; fuscous, the humeri and palpi testaceous, the antennae piceous with the tip ferruginous, the legs obscure testaceous; densely, minutely, the elytra a little more coarsely punctate; closely, finely pubescent. Head short, convex, moderately broad, the eyes small, distant, feebly emarginate, not reaching

the base; antennae slender, widening outwards, joint 2 short, 3 longer and narrower, 4-10 gradually becoming shorter and wider, 9 and 10 transverse, 11 ovate, obliquely acuminate. Prothorax narrower than the head, broader than long, quadrate, the anterior angles dilated into a prominent obtuse tooth, the sides abruptly and obliquely convergent thence to the apex, the disc with a deep, transverse, arcuate impression before the base and a shallow transverse groove in front of this. Elytra long, much wider than the head, subparallel in their basal half, the post-basal depression oblique and deep. Legs very slender [intermediate and posterior pairs wanting].

Length 2, breadth $\frac{1}{3}$ mm.

Hab. BURMA, Ruby Mines (*Doherty*).

One specimen, in a sufficiently good state of preservation for naming. The laterally dentate, uneven, subquadrate prothorax, the small eyes, and the long, subparallel elytra are characteristic. Two species of the genus (*robustior* and *nigricolor*, Pic) have been described from Burma, but they must be different from the present insect.

21. *Xylophilus barbicornis*, n. sp. (Plate I, fig. 11,
antenna, ♂.)

♂. Elongate, narrow, depressed, dull (till denuded); obscure testaceous, the long apical joint of the antennae to near the tip, and a common, broad, post-median fascia on the elytra, fuscous, the eyes black, the tarsi flavous; the head and prothorax densely, finely, the elytra coarsely, punctate; finely pubescent. Head transverse, rather convex, narrowly extended on each side behind the eyes, the latter moderately large, separated by about their own width, and very feebly emarginate in front; antennae (fig. 11) moderately long, joints 1 and 2 much thickened, 2 short, 3-6 gradually decreasing in length, 3 obconic, narrower and much longer than 2, 7-10 a little wider and strongly transverse, 11 stout, greatly elongated, as long as 3-10 united, subcylindrical, acuminate at the tip, becoming thicker towards the base and apex, and closely set with stiff dark setae. Prothorax nearly as long as broad, narrow, with the sides constricted behind the middle, somewhat tumid in front of this, and obliquely convergent in front, the disc almost unimpressed. Elytra long, wider than the head, parallel in their basal half, with a broad, oblique, deep post-basal depression. Legs long; anterior tibiae armed, with a triangular tooth beyond the middle; anterior tarsi with the basal joint thickened; posterior femora a little thicker than the others, furnished with a narrow, densely

ciliate pad along their lower face; basal joint of posterior tarsi elongate, very slender, almost straight.

Length $2\frac{1}{2}$, breadth $\frac{3}{4}$ mm.

Hab. INDIA, Nilgiri Hills (*H. L. Andrewes*).

One male. This remarkable insect, which might easily be mistaken for an Anthicid till the tarsal structure was examined, has the apical joint of the antennae stout and greatly elongated as in many Lagriids, this joint being probably normal in the female. It is a narrow, elongate, depressed, pallid form, with a broad, faint, darker post-median fascia on the elytra. The very long, curved, acuminate, penis-sheath is extruded in the type. *X. claviger*, Ch. (infra), from Siam, is a somewhat similar insect.

22. *Xylophilus glaucus*, n. sp.

♂. Moderately elongate, depressed, opaque (till denuded); nigropiceous, the head rufo-piceous, the mouth-parts, palpi, joints 1-3 and 11 of the antennae, the prothorax, a small humeral spot on the elytra, the anterior and intermediate legs (the slightly infusate outer halves of the intermediate femora and tibiae excepted), and the posterior tarsi, rufous or testaceous; densely, finely, the elytra a little more coarsely, punctate; the upper surface uniformly clothed with fine, sericeous, grey pubescence. Head short, moderately broad, extended on each side behind the eyes, the latter not very large, feebly emarginate, and separated by about their own width; antennae slender, comparatively short, joint 3 nearly twice as long as 2, 3-10 gradually decreasing in length, 4-10 subtriangular, 11 stout, acuminate-ovate. Prothorax transverse, scarcely narrower than the head, subtrapezoidal, abruptly, obliquely narrowed in front, the anterior angles somewhat dentiform, the disc arcuately impressed before the base. Elytra moderately long, subparallel, flattened, wider than the head, with a shallow, oblique, post-basal depression. Legs rather long, slender; posterior femora moderately inerrassate, with a long, narrow, flavous, densely ciliate pad towards the apex beneath; basal joint of posterior tarsi feebly curved, barely half the length of the tibia.

Length $2\frac{1}{16}$, breadth $\frac{4}{5}$ mm.

Hab. PERAK (*Doherty*).

One male. Less elongate and more depressed than *X. malaccanus*, Pic; the head smaller and darker; the antennae short; the prothorax scarcely sinuate at the

sides, the dorsal depressions shallow, the anterior one faintly indicated; the ♂-characters wholly different. The colour of the elytra is considerably modified by the close, fine, grey pubescence. The narrow, ciliate, flavous pad on the posterior femora (which is wholly wanting in the same sex of *X. malaccanus*) extends for about one-third their length.

23. *Xylophilus malaccanus*.

? *Hylophilus malaccanus*, Pic, Ann. Soc. Ent. Fr. 1911, p. 108.

♂. Elongate, subparallel, shining (when denuded); nigro-piceous, the head, prothorax, a large humeral spot on the elytra, and the femora and tibiae (the posterior pair in part excepted), rufous or rufo-testaceous, the palpi and tarsi testaceous, the antennae rufo-piceous, with joints 1, 2, and 11 testaceous; closely, finely, the elytra more coarsely, punctate; clothed with fine, grey, sericeous pubescence. Head short, broad, convex, considerably developed on each side behind the eyes, the latter moderately large, feebly emarginate, and separated by a little less than their own width; antennae long, rather slender, joint 2 short, 3 much longer, 3-10 subequal in length, subtriangular, 11 acuminate-ovate. Prothorax much narrower than the head, subquadrate, abruptly, obliquely narrowed in front, strongly constricted on each side behind the tumid anterior angles, the disc with a deep, transverse, arcuate fovea near the base and a transverse groove in front of it, the latter extending outward to the lateral constriction. Elytra long, subparallel, wider than the prothorax, somewhat convex, the post-basal depression deep. Legs long, not very slender; anterior tibiae thickened, feebly sinuate, slightly curved; basal joint of anterior tarsi elongated, stout; intermediate tibiae sinuate, somewhat curved; posterior femora moderately incrassate, distinctly curved, simple; posterior tibiae dilated in their outer half within; basal joint of posterior tarsi long, a little curved, more than half the length of the tibia.

Length $2\frac{1}{2}$, breadth $\frac{1}{2}$ mm.

Hab. PERAK (*Doherty*).

The male described seems to be a variety of *X. malaccanus*, Pic (the type of which was found by Doherty at the same locality), with a ferruginous humeral patch. To judge from the description, the sinuate sides of the prothorax and the strong transverse depression on the anterior portion of the latter agree better with the present insect than with *X. glaucus*, which is from the same source.

The antennae are simply said to be "assez grêles," a definition fitting either insect. The type may be a female. *X. nilgiriensis* has a similar front foot in ♂.

24. *Xylophilus claviger*, n. sp. (Plate I, fig. 12, antenna, ♂.)

♂. Elongate, narrow, depressed, shining; obscure testaceous, the eyes black, the elytra gradually becoming infusate towards the sides from a little below the base; densely, finely, the elytra more coarsely, punctate; finely pubescent. Head convex, broad, short, very narrowly extended on each side behind the eyes, the latter large, feebly emarginate, subapproximate in front; antennae (fig. 12) rather short, not very slender, joints 2 and 4 short, subequal in length, 3 longer, 4-10 gradually decreasing in length, 8-10 transverse, 11 produced into a long, acuminate club, about as long as 6-10 united. Prothorax rather small, transverse, subquadrate, constricted behind the rather prominent anterior angles, the disc arcuately impressed near the base and transversely grooved in front of this, the groove extending outwards to the lateral constriction. Elytra a little wider than the head, moderately elongate, subparallel, transversely depressed below the base. Legs long, rather slender; anterior tibiae armed with a small tooth towards the apex within; anterior tarsi with the basal joint slightly thickened; posterior femora moderately incrassate, furnished with a narrow, flavous, densely ciliate pad beneath which extends nearly the whole length of the femur; basal joint of posterior tarsi slender, about half the length of the tibia.

Length 2, breadth $\frac{3}{4}$ mm.

Hab. SIAM, Renong (*Doherty*).

One male. Near *X. glaucus*, Ch., ♂, from Perak, obscure testaceous in colour, the prothorax shaped as in *X. malaccanus*, Pic, the eyes large and subapproximate in front, the antennae with a very elongate apical joint, the anterior tibiae toothed, the ciliate pad on the posterior femora extending for nearly their whole length. *X. barbicornis*, Ch., from the Nilgiri Hills, is an allied form with a still longer, but much stouter apical joint to the antennae in ♂; but in the Indian insect the eyes are much smaller, the elytra are longer and coarsely punctate, and the prothoracic depressions are shallow.

25. *Xylophilus penicillatus*, n. sp. (Plate I, fig. 13, ♂.)

♂. Elongate, depressed, shining; nigro-piceous, the elytra with the humeral callus and an indistinct spot on the disc before the

apex rufescent, the palpi, tarsi, and anterior coxae testaceous, the antennae piceous, with the apical joint reddish; head and prothorax densely, finely, the elytra more coarsely, punctate; finely pubescent, the minute hairs on the elytral spots flavescent. Head comparatively small, considerably developed on each side behind the eyes, the latter moderately large, emarginate, and separated by about their own width; antennae rather slender, joint 2 short, 3 longer and narrower than 2, 4-10 subserrate, longer than broad, subequal, 4 larger than 3, 11 acuminate-ovate. Prothorax slightly broader than long, narrow, quadrate, obliquely narrowed in front, transversely grooved before the middle, and with an areuate excavation before the base. Elytra elongate, slightly narrowed anteriorly, at the middle about twice as wide as the prothorax, transversely depressed below the base. Legs [anterior pair missing] long, the tarsi slender; intermediate femora much widened towards the apex beneath (appearing sinuous as seen from behind); posterior femora moderately incrassate, and furnished with a dense, compressed brush of fulvous hairs beneath, the brush extending from about the basal third to near the tip; posterior tibiae slightly dilated on the inner side beyond the middle, appearing sinuous within; basal joint of posterior tarsi feebly curved.

Length 3, breadth 1 mm.

Hab. INDIA, Manipur (*Doherty*).

One male, in bad condition and wanting the anterior legs, but with such a remarkable brush to the posterior femur that there can be no difficulty in identifying the species. *X. penicillatus* is not unlike *X. planipennis*, Motsch., ♂, from Ceylon,* but it has a much narrower head and prothorax, and differently formed legs.

26. *Xylophilus rufonotatus*, n. sp.

♀. Elongate-oval, robust, opaque (till denuded); nigro-piceous, the mouth-parts, the antennae with joints 1, 2, and 11, and the elytra with an elongate-triangular patch on the outer part of the disc below the base (extending forward to the humeri) and a large, indeterminate, oblong space towards the apex (visible only in certain lights), rufous or obscure ferruginous, the palpi, knees, and tarsi testaceous; the entire upper surface densely, minutely punctate, thickly clothed with very fine ashy pubescence, the elytra with a common, broad, brown median fascia. Head short, the eyes convex, very large, occupying the whole of the sides of the head, emarginate, well separated; antennae moderately long, very stout, becoming

* Cf. Ann. and Mag. Nat. Hist. (8) xvi. p. 217.

more slender towards the base, joint 2 short, 3 and 4 a little longer, 5 subtriangular, 6-10 broad, strongly transverse, 11 acuminate-ovate. Prothorax slightly broader than long, rather narrow, the sides arcuately converging anteriorly, the disc with an arcuate depression before the base. Elytra moderately long, much wider than the head, somewhat rounded at the sides, strongly, transversely depressed below the base. Legs moderately long; posterior femora feebly clavate; basal joint of posterior tarsi curved.

Length $2\frac{1}{2}$, breadth 1 mm.

Hab. PERAK (*Doherty*).

One specimen, in good condition. A robust, elongate-oval, nigro-piceous insect, with very stout, outwardly widened antennae, joints 6-10 of which are strongly transverse; the elytra rufo-maculate on the outer part of the disc anteriorly, and also variegated with cinereous and brown pubescence; the entire upper surface densely, minutely punctate; the knees and tarsi testaceous. In certain lights the cinereous pubescence on the elytra appears to be condensed into a triangular patch in the post-basal depression. An isolated form.

27. *Xylophilus fureatimanus*, n. sp. (Plate I, figs. 14, ♂; 14a, anterior tibia and tarsus.)

♂. Moderately elongate, opaque (till denuded); piceous, the antennae, palpi, legs, and apex of abdomen, and the elytra with an oblique, elongate humeral patch and a smaller patch on the disc at about one-third from the apex, testaceous; the upper surface very finely punctate and clothed with fine pruinose pubescence. Head broad, short, with a flattened, slightly concave, triangular prominence in the middle at the base (conspicuous when seen in profile), the eyes large, occupying the whole of the sides, distant, feebly emarginate; antennae long, joint 2 short, 3 nearly twice as long as 2, 4 a little shorter than 3 or 5, 5-10 subequal in length, subserrate, 11 acuminate-ovate. Prothorax transverse, large, convex, rounded-subquadrate, with a deep, transverse, bifoveate impression before the base. Elytra moderately long, somewhat rounded at the sides, at the base not much wider than the head, the disc obliquely depressed anteriorly. Legs moderately long, comparatively stout; anterior tibiae dilated outwards into a very broad, obliquely bifurcate, subtriangular plate, the tarsus inserted beneath the apical portion of the plate (fig. 14a); posterior femora a little stouter than the others; posterior tibiae rather broad; basal joint of posterior tarsi somewhat curved.

Length $2\frac{1}{4}$, breadth $\frac{9}{10}$ mm.

Hab. TENASSERIM, Tavoy (*Doherty*).

One male. The extraordinary form of the anterior tibiae of this insect is unique, I believe, amongst the known *Xylophilids*. The basal impression of the prothorax is unusually deep, and bifoveate within. The dull, finely punctured surface, the quadrimaculate elytra, and the pruinose vestiture distinguish the present species from the allied Indian forms known to me. The head is shaped as in *X. rufonotatus*.

28. *Xylophilus andamanensis*, n. sp. (Plate I, fig. 15, ♂.)

Moderately elongate, shining (when denuded); testaceous or rufo-testaceous, the eyes black, the elytra with a common, broad, angulate fascia at about one-third from the base and a narrower one beyond the middle, the anterior one extending forwards along the suture and outer margin, piceous or nigro-piceous, the posterior femora infusate in one example; head and prothorax closely, finely, the elytra more coarsely, punctured; clothed with very fine sericeous pubescence. Head short, broad; eyes very large, feebly emarginate, occupying almost the whole of the sides of the head, and separated by about half their own width; antennae slender, moderately long, similar in the two sexes, joints 2 and 3 short, equal, 4 twice as long as 3, 4-10 obovate, subequal in length, 11 much stouter than 10, acuminate-ovate. Prothorax transverse, rather narrow, rounded at the sides anteriorly, the disc with a shallow transverse depression before the base. Elytra long, subparallel in their basal half, a little wider than the head, somewhat convex, flattened towards the base, without definite depression. Legs long, slender, the posterior femora a little stouter than the others, the basal joint of the posterior tarsi distinctly curved; anterior tibiae of ♂ curved towards the apex, and feebly mucronate at the inner apical angle.

Length $2\frac{1}{4}$ - $2\frac{1}{2}$, breadth 1 mm. (♂ ♀.)

Hab. ANDAMAN ISLANDS (*Capt. Wimberley*).

One pair, found placed amongst the Anthicids in the Fry collection. Recognisable by its elongate shape, the angulato-bifasciate elytra, the rather slender, pallid antennae, with short second and third joints, the large eyes, the moderately thickened posterior femora, and the feebly curved anterior tibiae of the male. The female is larger than the male.

29. *Xylophilus curtus*, n. sp.

Short, shining (when denuded); brown, the head piceous, the antennae obscure testaceous, the palpi and legs testaceous; densely, finely punctate, finely pubescent. Head short, broad, the post-ocular portion extremely narrow; eyes large, occupying nearly the whole of the sides of the head, feebly emarginate, moderately distant; antennae extremely short, rather stout, widening a little outwards, joints 2 and 3 subequal in length, 4-10 transverse and gradually becoming wider, 11 stout, short-ovate. Prothorax transverse, not so wide as the head, obliquely narrowed in front, with a sinuous, transverse groove before the base. Elytra short, a little wider than the head, subparallel at the base, feebly transversely depressed below the base. Legs short, slender [posterior pair wanting].

Length $1\frac{1}{2}$, breadth $\frac{2}{3}$ mm. (♀.)

Hab. ASSAM, Patkai Mts. (*Doherty*).

One specimen, somewhat crushed. A minute brown insect, with the antennae and legs paler and the head piceous, the antennae extremely short and comparatively stout, the eyes large, the elytra short and densely punctate. An isolated form.

30. *Xylophilus holosericeus*, n. sp.

Elongate-oval, robust, shining (when denuded); fusco-ferruginous, the head piceous, the legs ferruginous; densely, finely, the elytra more coarsely and diffusely, subuniformly punctate; clothed with a fine, greyish, sericeous pubescence. Head short, moderately broad, arcuately gibbose at the base (as seen from behind), very narrowly extended on each side behind the eyes, the latter large, deeply emarginate, and separated by rather more than half their own width; antennae moderately stout, joint 2 short, 3 nearly twice as long as 2, 3-8 subequal, 9 and 10 a little shorter and wider, 11 ovate, obliquely acuminate. Prothorax narrower than the head, slightly broader than long, rounded-subquadrate, moderately convex, unimpressed. Elytra long, much wider than the head, gradually widened to the middle and narrowed thence to the apex, the oblique intra-humeral depression moderately deep. Legs long; posterior femora very little thicker than the others, feebly, subangularly dilated at a little beyond the middle beneath.

Length (with head deflexed) 3, breadth $1\frac{1}{4}$ mm. (♀?).

Hab. INDIA, Kangra Valley, Punjab, alt. 4500 ft. (*Dudgeon*).

One specimen, found in June 1899. Very like *X. armipes*, Fairm., ♀, from Belgaum; but with the head arcuately swollen in the middle at the base, the antennae not so stout, the prothoracic angles more obtuse, the elytra a little wider at the middle and closely, conspicuously punctate throughout, the punctures (as in *X. troglodytes* from Selangor) very little coarser at the base. *X. dentatifemur*, Pic, from Ceylon, the ♂ only of which is known, is not unlike *X. holosericeus*; but the latter is a much larger insect, with longer legs, broader elytra, etc.

31. *Xylophilus sellatus*, n. sp. (Plate II, figs. 16, 16a, ♂.)

♂. Moderately elongate, rather narrow, dull (till denuded); ferruginous, the head, a very broad, common, post-median fascia on the elytra (narrowing outwards and not quite reaching the margin), and the posterior femora (except at the base) black, the posterior tibiae slightly infusate; above closely, minutely, the elytra more sparsely, punctate; clothed with very fine, greyish, sericeous pubescence. Head large, arcuate at the base above (fig. 16a); eyes extremely large, occupying almost the whole of the sides of the head, feebly emarginate, distant; antennae setulose, long, slender, joint 2 short, 3 twice as long as 2, 3-10 gradually decreasing in length, obconic, 10 about as broad as long, 11 ovate, obliquely acuminate. Prothorax convex, narrow, oblongo-subquadrate, the sides slightly constricted at the middle. Elytra moderately long, a little wider than the head, parallel in their basal third, with a rather deep, post-basal depression. Legs long, slender; anterior tibiae feebly curved, sharply toothed at the inner apical angle above (the apex appearing bidentate as seen from in front); anterior tarsi with joint 1 elongate, stout; intermediate femora angulato-lamellate at the apex beneath; posterior femora a little stouter than the others, distinctly clavate; posterior tarsi very slender, the basal joint almost straight.

Length 2, breadth $\frac{3}{4}$ mm.

Hab. INDIA, Nilgiri Hills (*H. L. Andrewes*).

One male, in very good condition. Near *X. palliditarsis*, Pic, from Ceylon; but differently coloured, the antennae less elongate, the basal joint of the anterior tarsi much thickened and the anterior tibiae sharply toothed at the tip above in ♂, the head not binodose at the base and the intermediate femora simply angulato-lamellate at the apex in this sex. A figure of the head of *X. palliditarsis*, ♂, is shown for comparison (Plate II, fig. 17).

32. *Xylophilus troglodytes*, n. sp. (Plate II, fig. 18, ♂.)

Elongate, rather convex, dull; nigro-piceous, the outer joints of the antennae and the basal portions of the femora ferruginous, the palpi and tarsi testaceous; closely, minutely, the elytra more sparsely and distinctly, punctate, the interspaces alutaceous throughout; clothed with very fine, sericeous, greyish pubescence, the upper surface appearing plumbeo-pruinose. Head moderately large, a little smaller in ♀, narrowly extended on each side behind the eyes, the latter very large in ♂, smaller in ♀, deeply emarginate, occupying nearly the whole of the sides of the head; antennae (♂) pilose, slender, filiform, extremely elongate, longer than the body, joint 2 short, 3 twice as long as 2, 4-10 nearly equal, 4 longer than 3, 11 strongly, obliquely acuminate, (♀) a little shorter and more slender; apical joint of maxillary palpi extremely broad, that of the labial palpi stout, securiform. Prothorax convex, about as long as broad, the sides obliquely convergent anteriorly and parallel thence to the base. Elytra elongate, subparallel in their basal half, in ♀ nearly twice as wide as the head and somewhat inflated, in ♂ a little narrower, flatter, and with a rather deep, transverse, post-basal depression. Beneath cinereo-pubescent, densely, minutely punctulate, with some scattered fine punctures intermixed; ventral segment 5 broadly depressed down the middle in ♂. Legs very elongate, slender; posterior femora subangularly dilated at about the apical third beneath, stouter in ♂ than in ♀; basal joint of posterior tarsi almost straight, very elongate in ♂.

Length $2\frac{1}{2}$ -3, breadth 1 mm. (♂ ♀.)

Hab. MALAY PENINSULA, Batu Cave, Selangor (*H. N. Ridley*).

Three specimens, received by the British Museum in 1897, two in good condition and assumed to be ♂ and ♀, the third fragmentary and apparently ♂. They are labelled as having been found in total darkness, in the Batu Cave, a strange habitat for a *Xylophilid* and possibly accidental. This species is allied to the Indian *X. armipes* and *X. plumbeus*, but it is at once separable from them by the very elongate, slender, filiform antennae, the still longer legs, the more finely, evenly punctured elytra, etc. *X. troglodytes* bears a certain resemblance to the Scydmaenid genus *Mastigus*. These insects have an extremely broad apical joint to the maxillary palpus, and they may have to be removed from the present genus, with *X. palliditarsis*, Pic, and *X. sellatus*, Ch., and others.

33. *Xylophilus armipes*.

Xylophilus armipes, Fairm., Ann. Soc. Ent. Belg. xl, p. 44 (1896).

Hab. INDIA, Belgaum.

Fairmaire described this species from a pair from Belgaum. The type, male, retained by him, is said to have the anterior tibiae acutely angulate at the middle within; the female, lent me by Mr. Andrewes, has the anterior tibiae simple and the posterior femora hollowed at the apex beneath, so as to appear angulate at about one-third from the tip.

34. *Xylophilus plumbeus*, n. sp.

Elongate-obovate, dull; nigro-piceous, the elytral epipleura, the base and tip of the antennae, the coxae, the femora to near the apex, the tibiae in part, and the tarsi, ferruginous, the palpi testaceous; head and prothorax closely, minutely, the elytra more coarsely punctate, the punctures oblong, and becoming much finer and more scattered on the apical half, the interspaces alutaceous throughout; finely sericeo-pubescent. Head transverse, comparatively small, arcuate at the base above, narrowly, subangularly extended on each side behind the eyes, the latter moderately large, distant, and deeply emarginate; antennae long, slender, joint 2 short, 3 a little longer than 2, 4 longer than 3, 4-8 obovate, subequal, 9 and 10 slightly shorter, 11 ovate, obliquely acuminate. Prothorax gibbous, as long as broad, constricted and obliquely narrowed in front. Elytra much wider than the head, long, somewhat inflated, widest at the middle, flattened at the base. Legs long, slender, the posterior femora a little stouter than the others and feebly, subangularly dilated at about the apical third beneath; posterior tarsi comparatively short, the basal joint barely one-third the length of the tibia.

Length $2\frac{1}{4}$, breadth 1 mm. (??.)

Hab. INDIA, Kanara (*H. E. Andrewes*).

One specimen. Near *X. armipes*, Fairm., but smaller, the antennae slender, the head and prothorax narrower, the prothorax gibbous, the elytra more inflated and simply flattened at the base; the puncturing of the latter is very much finer on the apical half and the interspaces alutaceous in both species. The apical joint of the maxillary palpi is extremely broad.

35. *Xylophilus uncifer*, n. sp. (Plate II, fig. 19,
intermediate leg, ♂.)

♂. Oblong, shining; rufo-testaceous, the eyes black, the head, and the posterior femora near the apex, piceous; finely, the elytra more sparsely and distinctly, punctate, the punctures on the latter becoming coarser towards the base; finely pubescent. Head broad, short, very narrowly, subangularly extended on each side behind the eyes, the latter large, rather deeply emarginate, distant; antennae long, not very slender, joint 2 shorter than 3, 3-10 obconic, subequal, 11 much longer than 10, ovate. Prothorax small, transverse, quadrate, obliquely narrowed in front, unimpressed. Elytra a little wider than the head, subparallel in their basal half, the oblique post-basal depression shallow. Legs rather short; intermediate femora armed with a sharp, slender, curved tooth near the apex beneath (fig. 19); posterior femora slightly thickened, feebly, subangularly widened at about the apical third beneath.

Length $1\frac{1}{2}$, breadth $\frac{2}{3}$ mm.

Hab. INDIA, Bombay.

Two males, one in fragments, received by the Museum in 1879. A minute, oblong, rufo-testaceous form, with a very broad, infusate head, long antennae, fusco-annulate, rather slender posterior femora, and the intermediate femora sharply toothed near the tip, as in *X. dentatifemur*, Pic, ♂, from Ceylon. *X. rufotestaceus* and *X. capitalis*, Pic, from Mahé, Malabar, may be allied forms; the descriptions, however, are useless for the purposes of identification. It is just possible that the ♂ with dark head and large eyes referred by Fairmaire to his *X. rufinus*, from Belgaum, may be conspecific with *X. uncifer* (?).

36. *Xylophilus tumidiceps*, n. sp.

Oblong, dull (till denuded); rufo-testaceous, darker beneath, the head and a broad space on the posterior femora before the apex black; densely, minutely, the elytra more sparsely, punctulate, the interspaces on the latter alutaceous; clothed with a very fine, greyish, sericeous pubescence. Head strongly deflexed, arcuato-gibbose at the base (as seen from behind); eyes very large, occupying nearly the whole of the sides of the head, feebly emarginate, somewhat distant; antennae slender, moderately long, joints 2 and 3 rather short, subequal in length, 2 stouter than 3, 4 longer, 4-10 very gradually becoming wider, subequal in length,

10 about as broad as long, 11 acuminate-ovate, rather long. Prothorax narrow, nearly as long as broad, quadrate, unimpressed. Elytra oblong-oval, much wider than the head, faintly, transversely depressed below the base. Legs very slender, long, the posterior femora moderately thickened.

Length $1\frac{3}{8}$, breadth $\frac{3}{4}$ mm. (♀.)

Hab. INDIA, Sarda [Surda], Bengal (*F. W. Champion*).

One specimen, recently received from one of my sons. A graceful little insect, rufo-testaceous in colour, with the head and an annulus on the posterior femora black, the fine silky vestiture hiding the sculpture, the head transversely gibbose in the middle at the base, the antennae slender, with the last three joints perceptibly wider than those preceding and forming a sort of loose club, the legs long and very slender, the posterior femora not much thickened. The head, which is formed as in the female of *X. palliditarsis*, Pic, from Ceylon, is so strongly deflexed that I have not ventured to raise it.

37. *Xylophilus tortipes*, n. sp.

♂. Moderately elongate, robust, shining; nigro-piceous, paler beneath, the head (the eyes excepted) rufous, the palpi, a transverse patch at the base of each elytron (nearly reaching the suture), anterior legs, and intermediate and posterior tarsi, testaceous, the antennae black, with the tip red; the entire upper surface densely, finely punctate, the punctures on the elytra a little coarser; finely cinereo-pubescent. Head comparatively small, a little broader than long, rather broadly developed on each side behind the eyes, the latter moderately large, emarginate, separated by about half their own width; antennae rather stout, moderately long, joint 3 very small, not longer than 2, 4-10 subequal, about as long as broad, 11 obliquely acuminate. Prothorax narrow, nearly as long as broad, subquadrate, obliquely narrowed in front, the disc with a deep, arcuate depression before the base. Elytra broad, about twice as wide as the head, rather short, subparallel at the base, the post-basal depression deep, transverse. Legs long; anterior tibiae feebly sinuate within, distinctly mucronate at the inner apical angle; posterior femora moderately clavate, simple; posterior tibiae strongly sinuate, dilated on the inner side from before the middle to the apex.

Length $2\frac{1}{10}$, breadth (elytra) 1 mm.

Hab. SIAM, Renong (*Doherty*).

One male. This insect has the elytra coloured and shaped as in *X. bryanti*, Pic, from Ceylon, but the head and prothorax are narrow and rufous in colour; the eyes are smaller and do not nearly reach the base of the head; the antennae are black, and stouter, and have a minute third joint, as in *X. subcrassicornis*, Pic, which is also from Ceylon. The very differently coloured *X. andrewesi*, from the Nilgiri Hills, has similar antennae, but in that species the head is broader, the prothorax shorter, the elytra coarsely punctate, etc.

38. *Xylophilus andrewesi*, n. sp.

Moderately elongate, robust, shining; nigro-piceous, the antennae at the tip and a transverse post-humeral patch on the elytra ferruginous, the tarsi and palpi, the anterior and intermediate femora and coxae, and the tibiae at their base, testaceous; the head and prothorax densely, finely, the elytra more coarsely and diffusely, punctate; closely, finely pubescent. Head rather small, greatly developed behind the eyes, the latter small, feebly emarginate, distant; antennae rather short, joints 2 and 3 short, small, 4-10 longer, stouter, subtriangular, about as broad as long, 11 acuminate-ovate. Prothorax narrower than the head, broader than long, quadrate, the sides abruptly, obliquely convergent in front, the disc with two shallow confluent foveae before the base. Elytra moderately long, more than twice the width of the prothorax, subparallel in their basal half, with a deep, oblique, post-humeral depression. Legs long; posterior femora moderately incrassate; posterior tibiae somewhat widened.

Length $2\frac{1}{5}$, breadth (elytra) 1 mm. (♀?).

Hab. INDIA, Nilgiri Hills (*H. L. Andrewes*).

One specimen. Recognisable by the relatively narrow head and prothorax, the broad, subparallel, rather long, faintly rufo-maculate elytra, the small third joint of the antennae, and the comparatively small eyes, the head being developed behind them much as in *X. subcrassicornis*, Pic. *X. andrewesi* approaches *X. taprobanus*, Ch., from Ceylon, from which it differs in the shorter antennae, the narrower prothorax, the testaceous intermediate femora, etc. The stouter antennae, longer legs, more elongate, differently coloured elytra, etc., separate the present species from *X. subcrassicornis*.

39. *Xylophilus parvicollis*, n. sp.

♂. Moderately elongate, depressed, shining; piceous, the head (the eyes excepted), prothorax, and an indeterminate, short, curved streak on the elytra extending from the humeri to the post-basal depression, ferruginous; antennae black, with joints 1-3 testaceous and the tip ferruginous; anterior and intermediate legs (except the tibiae of the intermediate pair in part), and the outer half of the posterior tarsi, testaceous, the rest of the posterior pair piceous; densely, finely, the elytra more coarsely, punctate; closely, finely pubescent. Head convex, moderately broad, rounded at the sides behind, the eyes rather small, convex, distant from the base, feebly emarginate, and separated by nearly their own width; antennae moderately long, rather stout, joints 2 and 3 more slender, 3 small, not longer than 2, 4-10 rapidly decreasing in length, 4 longer than broad, 5-8 about as broad as long, 4-6 distinctly wider than those following, 9 and 10 transverse, 11 acuminate-ovate. Prothorax small, broader than long, quadrate, narrowed in front, transversely grooved before the base. Elytra moderately long, much wider than the head, subparallel, deeply, transversely depressed below the base. Legs long, slender; posterior femora moderately thickened, angularly dilated at a little beyond the middle beneath.

Length $2\frac{1}{10}$, breadth $\frac{4}{5}$ mm.

Hab. ASSAM, Patkai Mts. (*Doherty*).

One specimen, assumed to be a male. The rather long head, small, quadrate prothorax, broad, subparallel, depressed elytra, and peculiarly formed antennae give this insect a distinctive facies. The three basal joints of the latter are clear testaceous and rather slender, and the three infusate joints following are slightly stouter than 7-10. *X. dohertyi*, Pic, from Perak, seems to have similarly formed antennae, but differs in colour, etc. Allied forms are before me from Tenasserim and Siam. They have the general appearance of Anthicids.

40. *Xylophilus siamensis*, n. sp.

♂. Elongate, depressed, shining; ferruginous, the elytra nigropiceous, with the basal third testaceous, the antennae black, reddish at the base and tip, the legs testaceous, the intermediate and posterior tibiae infusate in their outer half; closely, finely, the elytra more coarsely, punctate; finely pubescent. Head transverse, rounded at the sides behind the eyes, the latter moderately large,

deeply emarginate, not reaching the base of the head, and well separated; antennae very long, joints 1-3 rather slender, 3 minute, smaller than 2, 4-11 moderately stout, 4 longer than 2 and 3 united, 4-10 obconic, gradually decreasing in length, 11 obliquely acuminate. Prothorax small, a little broader than long, subquadrate, obliquely narrowed in front, the disc with a transverse depression before the base. Elytra flattened, moderately long, wider than the head, subparallel, blunt at the tip, with an oblique post-basal depression. Legs long; anterior tibiae feebly curved, mucronate at the inner apical angle; posterior femora feebly curved, moderately incrassate, simple.

Length $1\frac{9}{10}$ -2, breadth $\frac{2}{3}$ mm.

Hab. SIAM, Renong (*Doherty*).

Two males—one immature and almost wholly testaceous (the posterior infuscation of the elytra, however, is still visible), the other, from which the description is taken, apparently mature. The very long antennae in ♂, with minute third joint and the small prothorax, bring this species near *X. melanosoma* from Borneo* and *X. parvicollis* from Tenasserim. Compared with the former, the antennae are less serrate, the eyes smaller, the elytra less rounded at the tip and flatter, the body differently coloured, etc. *X. parvicollis*, ♂, has shorter antennae, a longer head, more prominent eyes, differently coloured elytra, angularly dilated posterior femora, etc.

41. *Xylophilus dohertyi*.

Hylophilus dohertyi, Pic, Bull. Soc. Ent. Fr. 1911, p. 109.

Oblong, somewhat depressed, shining (when denuded); rufotestaceous, the elytra with a common, indeterminate, broad, dark brown median fascia, the posterior femora and joints 4-10 of the antennae slightly infuscate, the eyes black; densely, finely, the elytra a little more coarsely, punctate; finely pubescent. Head moderately large, narrowed and considerably developed on each side behind the eyes, the latter rather large, emarginate, and separated by less than their own width; antennae moderately long, joints 2 and 3 narrower than those following, these latter rather stout, 3 very small, shorter than 2, 4-9 about as long as broad, 10 transverse, 11 ovate. Prothorax much narrower than the head, slightly broader than long, subtrapezoidal, abruptly, obliquely narrowed in front, the anterior angles somewhat tumid, the disc

* Ent. Mo. Mag. li, p. 286.

transversely depressed before the base. Elytra oblong, wider than the head, subparallel in their basal half, transversely depressed below the base. Legs rather long, slender; anterior tibiae feebly curved, distinctly sinuate within; posterior femora moderately thickened, hollowed for some distance before the apex, appearing subangulate beneath.

Length 2, breadth $\frac{3}{4}$ mm. (σ ?).

Hab. PERAK (*Doherty*).

One rather immature specimen. The specimen described, to judge from the description, may be a variety of *X. dohertyi*, Pic, the type of which was found by Doherty at the same locality. The latter is said to have long, stout, black antennae, with the three basal joints slender and testaceous in colour (as in the allied *X. parvicollis*, Ch., from Assam), the elytra with more than the posterior half nigro-piceous, etc.

42. *Xylophilus annulicornis*, n. sp. (Plate II, fig. 20, σ .)

σ . Short, robust, shining (when denuded); black, the head (the eyes excepted), the tip of the antennae and the basal margin of the prothorax rufous, the palpi, third antennal joint, anterior legs, intermediate and posterior tarsi, and a common, transverse, post-basal fascia in the elytra (extending forwards along the suture and on each side curving round to the shoulder), testaceous or flavous; the intermediate and posterior femora and tibiae nigro-piceous, testaceous or ferruginous at the base; the entire upper surface densely punctate, the punctures on the elytra rather coarse; finely cinereo-pubescent. Head somewhat oval, convex, the eyes small, prominent, distant from the base, feebly emarginate; antennae moderately stout, rather long, joint 3 small, scarcely longer than 2, 3-10 stouter and longer, 3-9 about as broad as long, 10 transverse, 11 rather stout, acuminate-ovate. Prothorax narrow, broader than long, subquadrate, narrowed in front, obsoletely sulcate down the middle. Elytra short, convex, very broad, somewhat rounded at the sides, faintly, transversely depressed below the base. Legs rather long, slender; anterior tibiae straight, armed with a minute tooth on the inner edge at about one-third from the tip; posterior femora moderately incrassate, simple.

Length (with head extended) 2, breadth (elytra) $\frac{9}{10}$ mm.

Hab. TENASSERIM, TAVOY (*Doherty*).

One male. This insect is so like *X. laticornis*, Pic, from Ceylon and Mergui, Tenasserim, the ♀ only of which is

known to me, that it is not impossible it may prove to belong to that species. The differences, however, seem too great to be simply sexual, and there are other more nearly allied forms in Borneo and Java with similarly flavo-annulate antennae, these organs being broader and with joints 6-10 strongly transverse in *X. laticornis*, ♀.

43. *Xylophilus fusconotatus*, n. sp.

Short, broad, shining (when denuded); nigro-piceous, the margins of the prothorax, the base of the elytra narrowly, the apex of the latter indeterminately, and joints 1, 2 and 11 of the antennae, ferruginous or reddish, the palpi, tarsi, anterior femora, intermediate femora in part, and all the tibiae at base, testaceous; closely, finely punctate, thickly clothed with fine, cinereous and fuscous pubescence, the latter condensed on the elytra into a common, broad, angulate, post-median fascia and a spot on the disc below the base. Head very broad, short; eyes extremely large, occupying nearly the whole of the sides of the head, feebly emarginate, separated by rather more than half their own width; antennae very stout, joints 2 and 3 equal in length, short, much narrower than 4, 4-10 broad, strongly transverse, closely articulated, 11 acuminate-ovate, not wider than 10. Prothorax transverse, small, the sides parallel at the base and abruptly convergent anteriorly, the disc bifoveate posteriorly. Elytra short, broad, slightly rounded at the sides, feebly transversely depressed below the base. Legs short, rather slender, the tibiae straight, the posterior femora very stout, arcuate in front, clavate.

Length $1\frac{2}{3}$, breadth $\frac{7}{8}$ mm. (♀?)

Hab. INDIA, Sarda [Surda], Bengal (*F. W. Champion*).

One specimen in very fresh condition, received last year from one of my sons. It was captured, I believe, on the wing towards sunset. This insect bears some resemblance to *X. laticornis*, Pic, from Ceylon; but the antennae are still stouter, the head is shorter and much broader, the eyes are very large, the elytra are finely punctate and differently marked, the posterior femora are strongly clavate, etc. The general shape of the body is very like that of the Australian *X. albonotatus*, Ch. (1895),* which, however, is a much smaller insect.

* Nee *X. albonotatus*, Pic, from Perak (1913), renamed by the author *griseonotatus* in April 1916.

44. *Xylophilus megalocephalus*, n. sp. (Plate II, fig. 21, ♂.)

♂. Short, broad, robust, shining (when denuded); nigro-piceous, the prothorax obscurely rufescent, the mouth-parts, a small spot on the shoulder and another on the disc of the elytra towards the apex, the anterior and intermediate legs (except the tibiae in part), the base of the posterior tibiae, and the posterior tarsi, ferruginous or testaceous, the antennae obscure ferruginous, paler at the base; densely, finely, the elytra rather coarsely, punctate; finely cinereo-pubescent (the pubescence on the elytra apparently darker or denuded in places, giving them a variegate appearance). Head extremely large, transverse; eyes very large, nearly reaching the base of the head, feebly emarginate, separated by about half their own width; antennae rather short, comparatively stout, joint 3 not longer than 2, 4 stouter than 3, 4-10 gradually decreasing in length, 4-8 about as long as broad, 9 and 10 transverse, 11 acuminate-ovate. Prothorax short, small, subquadrate, abruptly, obliquely narrowed anteriorly, the anterior angles prominent, the disc feebly, confluently bifoveate before the base. Elytra short, broad, rather convex, a little wider than the head, parallel at the base, the post-basal depression transverse, shallow. Legs short, rather slender; posterior femora very stout, strongly clavate, arcuately swollen in front; posterior tibiae straight, more than twice the length of the basal joint of the tarsus.

Length (with head extended) $1\frac{2}{5}$, breadth $\frac{2}{3}$ mm.

Hab. LARAT (*F. Muir*).

One specimen. A minute, broad, robust form, with an extremely large head, a small prothorax, and stout antennae, the posterior femora greatly swollen in ♂. The elytral pubescence is perhaps somewhat abraded. Larat is an island to the south of Timor Laut.

45. *Xylophilus bigeminatus*, n. sp. (Plate II, fig. 22.)

Oblong, broad, dull, the elytra shining (when denuded); head black, antennae piceous, with joints 1-3 and 11 ferruginous, prothorax rufous; elytra brownish-testaceous, each with two oblong, coalescent patches just beyond the middle of the disc (together forming a common, broad, interrupted fascia), a faint subapical fascia, and a small bare spot below the base, fuscous or nigro-fuscous; legs (the nigro-piceous posterior femora and infusate posterior tibiae excepted) testaceous, the under surface fusco-ferruginous; densely, finely, the elytra more coarsely, punctate; variegated with fine greyish and brown pubescence. Head short, moderately

large, very narrowly extended on each side behind the eyes, the latter extremely large, emarginate, and separated by rather more than half their own width; antennae comparatively short, moderately stout, joints 2 and 3 short, subequal in length, 4 subtriangular, about as long as broad, 8-10 strongly transverse, 11 acuminate-ovate. Prothorax much narrower than the head, transverse, subquadrate, abruptly, obliquely narrowed in front, bifoveate before the base. Elytra broad, comparatively short, very much wider than the head, rather convex, somewhat rounded at the sides, transversely depressed below the base. Legs short, slender, the posterior femora stout and strongly clavate; basal joint of posterior tarsi less than half the length of the tibia, almost straight.

Length 2, breadth 1 mm. (♀?).

Hab. SIAM, Renong (*Doherty*: type); CEYLON (*Thwaites*, in *Mus. Oxon.*).

One specimen from each locality, apparently belonging to the same species, the Ceylon example having a smaller prothorax and slightly stouter antennae. Recognisable by the rather short, broad, interruptedly fusco-fasciate elytra, the black head, rufous prothorax, very large eyes, short legs, and stout antennae. *X. bigeminatus* is related to the Palaearctic *X. populneus*, Creutz., the type of *Xylophilus*, Latr., differing from that insect in its less elongate shape, shorter legs, larger eyes, etc. The Ceylon specimen is figured, the type being somewhat abraded. An unnamed, similarly coloured form from Hong Kong, with longer antennae, smaller eyes, etc., has been sent me by Commander Walker: it is too imperfect for description. *X. fasciolatus*, Mars., from Java, seems to be not unlike the present species.

Chinese Species.

46. *Xylophilus pectinatus*, n. sp. (Plate II, fig. 23, posterior leg, ♂.)

♂. Oblong, narrow, shining; testaceous, the head nigro-piceous, the posterior femora slightly infuscate; head sparsely, the prothorax densely, finely, and the elytra somewhat coarsely, punctate; clothed with long, fine, pallid hairs. Head short, broad, very narrowly extended on each side behind the eyes, the latter extremely large, subcontiguous in front, and deeply emarginate; antennae rather long, stout, joint 2 short, much shorter than 3, 3-10 very

gradually decreasing in length, 3-7 subcylindrical, 8-10 about as broad as long, 11 nearly as long as 9 and 10 united, strongly, obliquely acuminate. Prothorax convex, narrower than the head, the sides gradually converging from the rather prominent hind angles, the disc unimpressed. Elytra oblong, wider than the head, very gradually narrowed from a little below the base, and with an almost obsolete, oblique, intra-humeral depression. Legs long; anterior and intermediate tibiae rounded externally, bowed inwards from about the middle, appearing sinuous within, the anterior pair bisetose at the tip; posterior femora stout (fig. 23), curved, set with a double row of stiff setae along their flattened lower face, and armed with a sharp tooth at the upper apical angle; basal joint of intermediate and posterior tarsi rather stout, densely pubescent beneath.

Length $1\frac{3}{4}$, breadth $\frac{3}{4}$ mm.

Hab. CHINA, Hong Kong (*J. J. Walker*).

Described from a single male sent me in 1893. A rather worn, imperfect example of the same sex, more robust than the type, captured in Nov. 1853, is contained in the British Museum collection: this insect is labelled "China, Bowring." A small oblong, pallid form, with a comparatively smooth, nigro-piceous head, stout, subcylindrical antennae, bowed anterior and intermediate tibiae, and a comb-like armature to the stout posterior femora, in the ♂. *X. pectinatus* is related to *X. nigro-notatus*, Pic, from Ceylon, the ♂ of which has somewhat similarly armed posterior femora, differing from it in the shorter antennae, the much smoother, shining, blackish head, the immaculate elytra, the form of the legs, etc.

47. *Xylophilus spinimanus*, n. sp. (Plate II. fig. 24,
anterior leg. ♂.)

Oblong, shining, testaceous, the eyes black; densely, finely, the elytra more coarsely, punctate, clothed with rather long pallid hairs. Head short, broad, very narrowly extended on each side behind the eyes, the latter large, emarginate, more approximate in ♂ than in ♀; antennae moderately long, slightly shorter in ♀, rather stout, joint 2 very little shorter than 3, 3-10 subcylindrical, gradually decreasing in length, 8-10 transverse in ♀, 11 as long as 9 and 10 united, strongly, obliquely acuminate. Prothorax transverse, subquadrate, narrower than the head, obsoletey canaliculate behind. Elytra oblong, subparallel, very little wider than the

head in ♂, with a long, oblique, intra-humeral depression. Legs long; anterior tibiae (fig. 24) compressed, somewhat widened, slightly curved outwards, and armed at the outer apical angle with a long, stout, curved, outwardly projecting spur, which reaches as far as the apex of the first tarsal joint; posterior femora strongly clavate, arcuate inflated in front; posterior tibiae compressed, rather stout, almost straight; basal joint of posterior tarsi curved.

Length $1\frac{2}{3}$ – $1\frac{4}{5}$, breadth $\frac{2}{3}$ – $\frac{1}{5}$ mm. (♂♀.)

Hab. CHINA, Hong Kong (*Mus. Brit.*).

One male and two females, captured at various dates between 1852 and 1854. The male is extremely like *X. ceylonicus*, Pic, from Kandy, but it has the elytra subparallel, the antennae not so stout, the anterior tibiae less widened and with the long apical spur projecting straight outwards as in *X. cylindricornis* (supra), instead of being abruptly bent inwards from near the base as in *X. ceylonicus*,* and the posterior femora more inflated on the anterior aspect. The females have the elytra much less narrowed posteriorly than in the specimen of the same sex doubtfully referred to *X. ceylonicus* by Pic. Compared with the similarly-coloured *X. pectinatus*, the male has the eyes less approximate, the second antennal joint longer, the prothorax subquadrate, and the legs very differently formed.

48. *Xylophilus parvidens*, n. sp.

♂. Moderately elongate, shining, finely pubescent, rufo-testaceous, the eyes black; densely, finely, the elytra more coarsely, punctate. Head transverse, scarcely wider than the prothorax, extended on each side behind the eyes, the latter rather small, deeply emarginate; antennae slender, moderately long, joints 2 and 3 subequal in length, 4 and 5 a little longer and stouter [6–11 broken off]. Prothorax rather convex, transversely subquadrate, abruptly narrowed in front, the disc obsoletely, transversely depressed before the base. Elytra much wider than the head and prothorax, moderately long, somewhat convex, slightly rounded at the sides, transversely flattened below the base. Legs long, slender; anterior tibiae curved inwards at the apex, armed with a small triangular tooth on the inner side beyond the middle, and mucronate at the

* Cf. Ann. and Mag. Nat. Hist. (8) xvi, p. 222.

inner apical angle; posterior femora compressed, strongly clavate; basal joint of posterior tarsi almost straight.

Length 2, breadth $\frac{2}{3}$ mm.

Hab. CHINA, near Entrance Island, Chusan Archipelago (*J. J. Walker*).

One male, sent to the British Museum in 1893. A rufo-testaceous form, with comparatively small eyes, slender antennae, with small third joint, rather convex, oblong elytra, clavate posterior femora, and peculiarly armed anterior tibiae in ♂. *X. parvidens* might easily be mistaken for an *Anthicus*, if the tarsi and ventral surface were not examined. A broken ♀ from the Chusan Islands, sent me by the same collector, may belong here; but it has the head less transverse and the posterior femora infuscate to near the apex.

49. *Xylophilus chinensis*, n. sp.

Oblong, shining (when denuded), finely pubescent; ferruginous, the elytra, joints 1-4 of the antennae, and the legs (the basally infuscate posterior femora excepted) testaceous, the rest of the antennae slightly infuscate; densely, finely, the elytra a little more coarsely, punctate. Head short, broad, subangularly extended on each side behind the eyes, the latter small, deeply emarginate; antennae slender, moderately long, joint 3 small, narrow, scarcely so long as 2, 4-10 very gradually decreasing in length, 10 transverse, 11 acuminate-ovate. Prothorax nearly as wide as the head, transversely quadrate, abruptly narrowed in front, with a faint transverse depression before the base, the anterior angles tumid and subdentiform. Elytra oblong, broad, much wider than the head, slightly rounded at the sides, flattened on the disc below the base. Legs long, slender; posterior femora stout, clavate; posterior tibiae straight.

Length $1\frac{4}{5}$, breadth $\frac{7}{8}$ mm. (♀?)

Hab. CHINA (*Mus. Brit., ex coll. Bowring*).

One specimen, acquired in 1863. This insect is very like *X. rufinus*, Fairm., from Belgaum (as here restricted), differing from it in the broader head, the sides of which are subparallel behind the eyes, the more slender, outwardly infuscate antennae, and the sharper anterior angles of the prothorax, the head and prothorax, too, are more densely punctate. The broad head also separates *X. chinensis* from *X. parvidens*.

50. *Xylophilus quadratipennis*, n. sp.

♂. Oblong, depressed, dull, finely pubescent; nigro-piceous, the mouth-parts, front of the head, basal and apical margins of the prothorax, tarsi, and anterior and intermediate femora and tibiae in great part, testaceous; the elytra testaceous, with a broad, transverse, blackish-brown subapical fascia, not reaching the suture and extending forwards on the disc and at the sides to near the base; the antennae piceous, with joints 1, 2, and 11 ferruginous; the entire upper surface densely, finely punctate. Head very large, broad; eyes extremely large, narrowly separated, deeply emarginate, and occupying the whole of the sides of the head; antennae long, very stout, joint 2 short, 3 smaller than 2, 4-10 much thickened, gradually decreasing in length, 4-7 about as long as broad, 8-10 transverse, 11 ovate. Prothorax small, short, subquadrate, abruptly narrowed in front, with a deep, transverse depression before the base. Elytra broad, flattened, oblongo-subquadrate, the oblique intra-humeral depression deep and extending downwards to the middle. Legs rather short, slender; posterior femora stout, strongly clavate.

Length (with head extended) $1\frac{1}{3}$, breadth $\frac{4}{5}$ mm.

Hab. CHINA (*Mus. Brit., ex coll. Bowring*).

One specimen, received in 1863. It is assumed to be a male, on account of the greatly developed head, subapproximate eyes, and the very stout, long antennae. Amongst the species described in the present paper, *X. quadratipennis* comes nearest *X. megaloccephalus*, from Larat, which has very differently formed elytra and antennae. The Japanese *X. gibbulus*, Mars., is not unlike *X. quadratipennis*, the latter having much longer and stouter antennae, a much smaller prothorax, subparallel elytra, etc.

*Australasian Species.*51. *Xylophilus abnormis*.

Anthicus abnormis, King, Trans. Ent. Soc. N.S.W. ii, p. 24 (1873).

Syzeton laetus, Blackb., Trans. Roy. Soc. S. Austr. xiv, 2, p. 337 (1891).

♂. *Hylophilus major*, Pic, Bull. Soc. Ent. Fr. 1912, p. 48; Ann. Soc. Ent. Fr. 1912, p. 286.

Hab. AUSTRALIA, New South Wales, Victoria.

The additional synonymy of this species has already been noted by me elsewhere [Ann. and Mag. Nat. Hist. (8) xvi, p. 221]. Blackburn described both sexes, but the type acquired by the British Museum is a ♀. This is one of the two species (*S. laetus* and *S. lateralis*) he included in his genus *Syzeton* (*Xylophilus* being unknown to him), which do not differ structurally from many other *Xylophili* from other parts of the world. King specially noted the minute penultimate joint of the tarsi in his *A. abnormis*. Pic's type of *H. major* is a large ♂.

52. *Xylophilus undatus*.

Xylophilus fasciatus, Boh., Col. Res. Eugen. p. 107 (1858)
(*nec* Melsh. 1846).

Xylophilus undatus, Gemm., Col. Hefte, vi, p. 123 (1870).

Syzeton blackburni, Lea, Proc. Linn. Soc. N.S.W. (2) ix,
p. 621 (1895).

Hylophilus walesianus, Pic, Bull. Soc. Ent. Fr. 1912, p. 48;
Ann. Soc. Ent. Fr. 1912, p. 285.

Hab. AUSTRALIA, New South Wales.

Pic's co-types of *H. walesianus*, two males, captured by Mr. Bryant, agree exactly with Lea's description of the same sex of his *S. blackburni*, the strongly curved posterior femora being noted by each of them; Lea, however, omitted to mention the sinuate inner margin of the anterior tibiae, the apices of which are also armed with a slender tooth. It is unusual to find a sexual modification in all the legs, such as occurs in the ♂ of the present species. Boheman's name is preoccupied, and his type was probably a female.* All three authors give Sydney as locality.

53. *Xylophilus eucalypti*.

Xylophilus eucalypti, Lea, Proc. Linn. Soc. N.S.W. xxii,
p. 589 (1897).

Hab. W. AUSTRALIA.

* *X. (Syzeton) lateralis*, Blackb., type ♀, is somewhat similar, but it has differently formed antennae, and the black marking on the elytra broader, the elytra themselves more coarsely and not so closely punctate, and furnished with long, erect hairs amongst the conspicuous decumbent pubescence. The specific name is preoccupied in the genus (Gredler, 1866) and is here changed to *victoriensis*.

A specimen (♀?) from W. Australia (found by *Du Boulay*) in the British Museum, ex coll. Fry, agrees with *Lea's* description of *X. eucalypti*: it has the antennae (the basal joint excepted) and prothorax rufo-testaceous, the former rather short and slender. Two others, from the same source, with the antennae much longer, stouter, and a little darker, and the prothorax piceous or black, seem to be males of the same species. They all have the elytra flattened, very minutely punctate, and with an unusually deep post-basal depression; and the deep basal depression on the prothorax divided in the middle by a short carina. The types were beaten from the boughs of young gum trees.

54. *Xylophilus morulus*.

Xylophilus morulus, Champ., Trans. Ent. Soc. Lond. 1895, p. 250 (♂) (June 1st).

Lea in 1897 sunk *X. morulus*, from Tasmania, as a synonym of his *Syzetoninus impressicollis*, from Galston, N.S.W. [Proc. Linn. Soc. N.S.W. (2) ix, p. 624, March 28th, 1895], the type in each case being a ♂. This synonymy is incorrect, neither the Tasmanian ♂, nor a ♀ from Tasmania doubtfully referred to the same species, agreeing with his description of *S. impressicollis*. *X. morulus*, ♂, is an elongate, flattened insect, with long, parallel-sided elytra, the punctuation of which is uniformly fine and dense throughout, and long antennae.

55. *Xylophilus darwinensis*, n. sp.

♀. Oblong, depressed, opaque, the elytra shining, finely pubescent; testaceous, the head slightly infusate, the eyes black, the elytra with a narrow, faint, brown submedian fascia; closely, minutely, the elytra more distinctly, punctate. Head short, very little wider than the prothorax; eyes convex, distant, occupying nearly the whole of the sides of the head, feebly emarginate; antennae short, slender, joints 1 and 2 rather stout, 3 not longer than 2, 3-10 gradually becoming wider, 8-10 transverse, 11 acuminate-ovate, rather stout. Prothorax strongly transverse, narrowed in front, shallowly bifoveate at the base. Elytra oblong, wider than the head, somewhat rounded at the sides, transversely depressed below the base. Legs short, slender, the posterior femora slightly thickened.

Length $1\frac{2}{3}$, breadth $\frac{2}{3}$ mm.

Hab. N.W. AUSTRALIA, Port Darwin (*J. J. Walker*).

A minute, delicate, oblong, pallid form, with faintly fusco-unifasciate elytra, a very short prothorax, and short, slender limbs. The much larger *X. arcuaticeps*, Pic, from Queensland, is the only Australian species known to me at all approaching *X. darwinensis*.

56. *Xylophilus luniger*, n. sp. (Plate II. figs. 25, 25a, ♂.)

♂. Oblong, shining, finely pubescent, testaceous, the eyes black; head sparsely, the prothorax densely, minutely, the elytra closely, rather coarsely, punctate. Head short, wider than the prothorax, narrowly extended on each side behind the eyes, the latter rather small, distant, feebly emarginate; antennae (fig. 25a) long, rather stout, abnormal—joints 3 and 4 closely, and 5–11 loosely, articulated, 1 stout, oval, 2 short, subglobose, 3 very small, narrow, shorter than 2, 4 oblong, stout, 5 and 6 much shorter, 7 large, crescentiform, 8 oblong, curved, articulated with 7 at the outer horn of the crescent, and dentate at the base within, 9 somewhat similar, curved, produced into a tooth at the inner apical angle, 10 short, 11 stout, ovate. Prothorax narrow, about as long as broad, subquadrate, narrowed in front, obsolete bifoveate at the base. Elytra rather broad, oblong, subparallel, a little narrowed anteriorly, deeply transversely depressed below the base. Legs long, slender; posterior femora moderately incrassate; posterior tibiae gradually widened to the apex.

♀. Head less extended outwards behind the eyes (appearing narrowed behind them); antennae normal—short, slender, the last three joints dilated into a loosely-articulated club, 3 and 4 each about as long as 2, 5–8 a little shorter and gradually widening, 9 and 10 strongly transverse, 11 ovate; prothorax broader and more transverse; elytra much broader, rapidly narrowing from about the middle forwards.

Length $1\frac{1}{3}$ – $1\frac{2}{3}$, breadth $\frac{2}{5}$ – $\frac{1}{5}$ mm. (♂ ♀.)

Hab. MOKO HINOU ISLAND, off North Island, New Zealand.

One pair, from Dr. Sharp's collection, received by him (apparently from Captain Broun) under the MS. name *Sacium ochraceum*, and as the sexes of the same species. The extraordinary structure of the ♂ antenna is suggestive of that of various *Bythini*, the modified, loosely-articulated joints 7–9 together forming a clasping-organ. The ♀ has normal antennae, formed as in the same sex of *X. coloratus*, Broun, from New Zealand, which, indeed, is very like the

present species, except that the latter has shorter antennae, uniformly testaceous elytra, and shallow prothoracic foveae. *X. xenarthrus*, Broun,* from Raurimu, must be a nearly allied form; but (allowing for joints 3 and 4 of the ♂ antenna having been wrongly counted as one joint) the antennal structure by no means accords with that of the present insect, two asymmetrical joints only being given for the Raurimu insect.

South African Species.

57. *Xylophilus albopilosus*, n. sp.

♂. Moderately elongate, convex, shining; black, the palpi, the apex of the terminal joint of the antennae, a large humeral patch on each elytron, the tarsi and the extreme base of the tibiae, testaceous; densely, finely, the elytra coarsely, punctate; clothed with long, adpressed, cinereous hairs. Head short, broad, narrowly extended on each side behind the eyes, the latter large, deeply emarginate, and separated by about half their own width; antennae long, rather stout, joint 2 very short, 3-10 subequal, slightly longer than broad, 11 nearly as long as 9 and 10 united, obliquely acuminate. Prothorax narrower than the head, transversely subquadrate, narrowed in front, obsoletely canaliculate towards the base. Elytra moderately elongate, much wider than the head, gradually narrowed from the base, rounded at the apex, with a deep, oblique intra-humeral depression. Legs long, stout; anterior tibiae slightly curved inwards at the apex, and finely mucronate at the inner apical angle; posterior femora stout, clavate; basal joint of posterior tarsi curved.

Length $2\frac{1}{10}$, breadth $\frac{9}{10}$ mm.

Hab. S. AFRICA, Malvern, Natal (*G. A. K. Marshall*).

One male, captured in August 1897. A rather elongate, convex, shining, black insect, with a large humeral patch and the tarsi testaceous, the body clothed with long, cinereous hairs. The system of coloration is common to various other members of the genus. *X. natalensis*, Pic, is a very different insect. There are various Eastern and American species closely related to *X. albopilosus*.

58. *Xylophilus macrocephalus*, n. sp.

Moderately elongate, rather convex, shining, sparsely, finely pubescent; obscure testaceous, the legs (the infuscate posterior

* Bull. New Zealand Institute, No. 1, p. 54 (August 30, 1910).

femora and apex of the posterior tibiae excepted) paler, the eyes black, the antennae (the third joint excepted), the suture and the inflexed lateral portion of the elytra to about the middle, and the under surface in part, piceous; densely, finely, the elytra more coarsely, punctate. Head (with the labrum) about as long as broad, convex, much developed behind the eyes, the latter small, prominent, transverse, emarginate; antennae moderately long, joint 3 very small, shorter than 2, 4-8 [9-11 broken off] rather stout, about as long as broad. Prothorax narrow, nearly as long as broad, abruptly narrowed in front, with a deep transverse depression before the base. Elytra convex, oblong, somewhat narrowed anteriorly, at the middle nearly twice as wide as the head, transversely depressed below the base. Legs long, rather slender; posterior femora moderately incrassate; posterior tibiae somewhat thickened; basal joint of posterior tarsi curved.

Length $2\frac{1}{10}$, breadth (elytra) $\frac{9}{10}$ mm. (σ ?)

Hab. S. AFRICA, Malvern, Natal (*G. A. K. Marshall*).

One specimen, captured in June 1897. Recognisable by the rather elongate head, small eyes, narrow prothorax, minute third antennal joint, comparatively broad, convex, oblong elytra, and long legs. Amongst the numerous species here described, *X. macrocephalus* seems to come nearest to *X. parvicollis*, Ch., from Assam. It bears no relationship to *X. femoratus*, Fairm., from Port Elizabeth.

59. *Xylophilus ovalis*, n. sp. (Plate II, fig. 26.)

Oblong-oval, convex, subopaque (till denuded); rufo-testaceous, the eyes black, clothed with a very fine sericeous pubescence; the entire upper surface densely, minutely punctate. Head short, broad, obliquely narrowed anteriorly (subtriangular as seen from above), very narrowly extended on each side behind the eyes, the latter small, transverse, entire; antennae inserted at some distance before the eyes, short, rather stout, widening outwards, joints 2 and 3 subequal in length, 4 a little shorter than 3, 5-10 gradually becoming shorter and wider, 5 and 6 about as long as broad, 7-10 transverse, 11 ovate, obliquely acuminate; apical joint of maxillary palpi subsecuriform, somewhat rounded at the inner angle. Prothorax large, strongly transverse, trapezoidal, at the prominent anterior angles a little wider than the head with the eyes, almost unimpressed. Elytra broad, oval, moderately long, slightly flattened at the base. Legs rather short, slender, the posterior femora very little stouter than the others.

Length 2, breadth 1 mm. (σ ?)

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Hab. MASHONALAND, Salisbury (*G. A. K. Marshall*).

One specimen, captured in April 1900. This species could perhaps be referred to the section *Olotelus*, Muls.; it is closely related to the widely distributed *X. pallescens*, Woll. (the type of which was from Madeira); but differs from that insect in its much larger size, broader, more convex, oval shape, relatively wider prothorax, etc.

South American Species.

60. *Xylophilus ingens*, n. sp. (Plate II, fig. 27,
posterior leg, ♂.)

Elongate, broad, robust, dull (till denuded); ferruginous or obscure ferruginous, the eyes black, the head in part, a broad space down the middle of the prothorax, the antennae towards the tip, and the posterior femora and tibiae in part in ♀, piceous, the elytra reddish-brown, with an indication of a common v-shaped dark mark before the apex (in ♂); densely, finely, the elytra more coarsely, punctate; closely pubescent, the pubescence (in ♂) condensed into a common triangular patch within the v-shaped subapical mark. Head short, broad, convex; eyes large, very deeply emarginate, not nearly reaching the base of the head, separated by less than half their own width in both sexes; antennae (♂) very stout, moderately long, joint 2 a little shorter than 3, 3-10 rapidly widening, 3-6 about as long as broad, 7-10 transverse [11 wanting]. Prothorax much narrower than the head, transversely quadrate, abruptly narrowed in front, unimpressed. Elytra broad, long, subparallel, flattened on the disc, rounded at the tip, obliquely compressed on each side below the humeri and with a deep oblique depression on the disc anteriorly. Legs long, stout, more slender in ♀; intermediate tibiae slightly curved; posterior femora (♂) moderately incrassate, simple; posterior tibiae straight, armed at the apex above with a long, stout, pallid spine in ♂ (fig. 27), and with a smaller slender spine in ♀;* basal joint of posterior tarsi slightly curved.

Length $3\frac{1}{3}$ - $3\frac{1}{2}$, breadth $1\frac{1}{4}$ - $1\frac{1}{2}$ mm. (♂ ♀)

Hab. BRAZIL, Santa Catharina (*Fry*).

One pair, the ♀ in bad condition and wanting joints 5-11 of the antennae. Near *X. lacertosus*, Ch., from Guatemala, but with very differently formed legs in the ♂. The stout spine at the apex of the ♂ posterior tibiae is

* The female of the allied *X. mexicanus*, Ch. (found by Truqui), has a similar spine at the apex of the posterior tibiae.

a peculiar character, the slender spine in the ♀ corresponding to the tuft of hairs present in the same sex of *X. lacertosus*, *forticornis*, *humeralis*, and *v-notatus*. The male probably has a long apical joint to the antennae.

61. *Xylophilus forticornis*, Champ.

The types of this species were from Chiriqui, Panama, and Pic (Ann. Soc. Ent. Fr. 1912, p. 281) has since recorded it from Trinidad, from a ♀ found by Mr. Bryant. In the Fry collection there is a ♀ from Rio de Janeiro with the elytra uniformly fuscous, and the pubescence not condensed into definite markings or fasciae, which must, for the present, be referred to the same species. *X. (Elonus) crassicornis*, Pic, from Santa Rita, Boa Sorta, and Petropolis, seems to be an allied form with enormously developed posterior femora in ♂; *X. (Elonus) distincticornis*, Pic, from Pernambuco, has the head and prothorax partly reddish.

62. *Xylophilus triguttatus*, n. sp. (Plate II, fig. 28, ♂.)

♂. Oblong, rather convex, shining, sparsely, finely pubescent; head, basal joint of antennae, prothorax, posterior femora, and the intermediate femora at the middle, nigro-piceous or black, the rest of the legs and antennae, and the palpi, testaceous; the elytra testaceous, with a common, transverse, triangular scutellar patch, and a broad space at the middle of the disc (extending from near the suture to the outer margin and there continued forwards to near the humeri), nigro-piceous; closely, finely, the elytra more coarsely, punctate. Head short, broad, extended on each side behind the eyes, the latter large, deeply emarginate, and separated by about half their own width; antennae rather stout, moderately long, joint 3 slightly longer than 2, 4-10 subequal, as long as broad, 4 a little stouter than 3, 11 nearly as long as 9 and 10 united, ovate, obliquely acuminate. Prothorax subquadrate, convex, much narrower than the head, nearly as long as broad, narrowed in front, the disc shallowly transversely grooved on each side at about the middle. Elytra wider than the head, somewhat rounded at the sides, gradually narrowed from a little below the base, with a deep, oblique, intra-humeral depression. Legs rather stout, moderately long; anterior tibiae slightly curved, subangularly dilated on the inner side beyond the middle, and armed with a long, sharp mucro at the inner apical angle; posterior femora stout, strongly clavate, abruptly excavate

at the apex in front (appearing subangularly inflated on the anterior aspect); basal joint of posterior tarsi curved.

Length 2, breadth $\frac{4}{5}$ mm.

Hab. BRAZIL, Rio de Janeiro (*ex coll. Pascoe*).

One male. Recognisable by the dark head, prothorax, and basal joint of the antennae, the testaceous, nigro-trimaculate elytra, and the peculiarly formed posterior femora of the male, the insect in this respect approaching *X. 4-signatus*, Ch., from Chiriqui.

63. *Xylophilus suturifer*.

Xylophilus (Zonantes) cinctipennis, Champ., var. ? *suturifer*, Pic, Ann. Soc. Ent. Belg. xlii, pp. 262, 266 (1898).
Hylophilus suturifer, Pic, Cat. Hyloph. p. 18 (1910).

♀. Moderately elongate, rather broad, very shining, finely pubescent; head, basal joint of antennae, prothorax, under surface, and posterior femora (except at the base), nigro-piceous, the rest of the antennae and legs, and the palpi, testaceous; elytra testaceous, with a common triangular scutellar patch, two oblong, transversely placed, subconfluent patches on the outer part of the disc (the marginal one a little longer than the other), the suture towards the apex, and the apical margin narrowly, nigro-piceous; closely, finely, the elytra more coarsely, punctate. Head short, broad, narrowly extended on each side behind the eyes, the latter large, deeply emarginate, and separated by about half their own width; antennae rather stout, moderately long, joint 3 a little longer than 2, 4-10 stouter, very gradually decreasing in length, 10 transverse, 11 acuminate-ovate. Prothorax broader than long, subquadrate, much narrower than the head, transversely grooved across the middle. Elytra long, rather broad, narrowing from about the middle, transversely depressed below the base, and with an oblique intra-humeral depression. Legs long, rather stout; posterior femora stout, clavate; basal joint of posterior tarsi curved.

Length $2\frac{3}{4}$, breadth $1\frac{1}{6}$ mm.

Hab. BRAZIL (*ex coll. Bowring*), Boa Sorta [types].

One specimen, apparently referable to *X. suturifer*, Pic. This insect is so closely related to *X. triguttatus*, from Rio de Janeiro, the ♂ only of which is known, that I at first treated it as a variety of the ♀ of that species; it has, however, much more elongate elytra, and the dark markings at the middle of the disc are in the form of two oblong,

transversely placed, subconfluent patches. The example before me is without locality-label, but there can be little doubt that it is from Brazil. The sexual characters were not mentioned by Pic, and his types may be females.

64. *Xylophilus brasiliensis*.

Xylophilus (? *Zonantes*) *brasiliensis*, Pic, Ann. Soc. Ent. Belg. xlii, pp. 262, 265 (1898).

♀. Oblong, somewhat convex, very shining, clothed with long, adpressed, pallid hairs; head, basal joint of antennae above, prothorax, a large triangular patch on the outer part of each elytron at about the middle (extending obliquely inwards to near the suture), the posterior femora (except at the base), and the under surface in great part, nigro-piceous or piceous, the rest of the antennae, elytra, and legs, and the palpi. testaceous; closely, finely, the elytra coarsely, punctate. Head short, broad, narrowly extended on each side behind the eyes, the latter very large, emarginate, and somewhat narrowly separated; antennae moderately long, rather stout, joint 3 a little longer than 2, 4-10 very gradually decreasing in length, 10 transverse, 11 acuminate-ovate. Prothorax a little narrower than the head, transverse, subquadrate. Elytra moderately long, subparallel to about the middle, with a deep, oblique intra-humeral depression, a space on each side of the suture thus appearing tumid. Legs long; posterior femora stout, clavate; basal joint of posterior tarsi curved.

Length $2\frac{1}{2}$, breadth 1 mm.

Hab. BRAZIL, Rio de Janeiro (*Fry*), Boa Sorta and Petropolis [types].

Two specimens, apparently females. Very like the insect here identified as *X. suturifer*, Pic, but with a relatively broader prothorax, the elytra shorter and wanting the scutellar patch, the large triangular lateral patch extending obliquely inwards to near the suture. The types of *X. brasiliensis* not having been seen by me, a description is given of the examples in the British Museum; the male is stated to have very stout posterior femora.

65. *Xylophilus prehensus*, n. sp. (Plate II, fig. 29, anterior leg, ♂.)

♂. Oblong, rather convex, shining, clothed with rather long, fine hairs; testaceous, the head, antennae (the tip of the eleventh joint excepted), prothorax, a transverse patch at the middle of each

elytron (not reaching the suture or outer margin), and the intermediate and posterior tibiae towards the apex, nigro-piceous or piceous; closely, finely, the elytra more coarsely, punctate. Head very broad, short, narrowly extended on each side behind the eyes, the latter extremely large, deeply emarginate, very narrowly separated; antennae stout, long, joint 2 short, 3 a little longer, 4-10 wider, about as broad as long, 11 stout, nearly as long as 9 and 10 united, obliquely acuminate. Prothorax convex, much narrower than the head, broader than long, subquadrate, narrowed in front, transversely depressed across the middle of the disc. Elytra wider than the head, gradually narrowed from the base, with a shallow, oblique, intra-humeral depression. Legs long, stout; femora clavate, the posterior pair very stout; anterior tibiae (fig. 29) sinuate within, abruptly bent inwards beyond the middle, and armed with a long sharp mucro at the inner apical angle; posterior tibiae widened and feebly sinuate; basal joint of posterior tarsi curved.

Length $2\frac{1}{2}$, breadth 1 mm.

Hab. AMAZONS, between Para and Santarem (H. H. Smith).

One male, received in 1875. Very like *X. chiriquensis*, ♂ (figured elsewhere by myself and also by Pic), but with the antennae stouter and not quite so long, all the femora stout and clavate (the anterior pair more thickened than usual, and the posterior pair very stout), the elytra narrowed from the base and less elongate, the eyes extremely large and subapproximate. *X. (Zonantes) brasiliensis*, Pic, the ♂ of which is known, must be an allied form, but the description does not accord with the present insect. *X. nigricollis*, Ch. (renamed *atriceps* by Pic), from Grenada and Trinidad, has the upper surface similarly coloured, but it differs in other respects. This is one of five species captured by Mr. H. H. Smith on the Amazons, each represented by a single example, two of them too imperfect for description.

66. *Xylophilus obscuricolor*.

Xylophilus (? *Zonantes*) *obscuricolor*, Pic, Ann. Soc. Ent. Fr. 1905, pp. 261, 264, 269.

♂. Oblong, rather convex, shining, clothed with long, fine, adpressed, cinereous hairs; piceous, the head black, the mouth-parts, palpi, antennae, and legs (the outer half of the posterior femora excepted) testaceous; closely, finely, the elytra coarsely, punctate.

Head short, broad, narrowly extended on each side behind the eyes, the latter large, deeply emarginate, and narrowly separated; antennae rather slender, moderately long, filiform, joint 3 longer than 2, 4-7 much longer than broad, subequal [8-11 broken off]. Prothorax much narrower than the head, transversely subquadrate, abruptly narrowed in front. Elytra oblong, wider than the head, subparallel in their basal half, transversely depressed below the base, and with an oblique intra-humeral depression. Legs rather stout; anterior tibiae curved, sharply mucronate at the inner apical angle; posterior femora much thickened, clavate; posterior tibiae widened; basal joint of posterior tarsi slightly curved.

Length $2\frac{1}{2}$, breadth $\frac{1}{10}$ mm.

Hab. BRAZIL [type], Rio de Janeiro (*Fry*), Petropolis? (*sec. Pic*).

One male, apparently referable to *X. obscuricolor*, Pic, near *X. triguttatus*, *suturifer*, *brasiliensis*, etc., but with more slender, subfiliform antennae and entirely piceous elytra. The simply curved anterior tibiae of the ♂ (a character mentioned by Pic, though not recognised by him as a sexual mark of distinction) separates *X. obscuricolor* from the same sex of *X. triguttatus*, etc. The apical joint of the antennae (wanting in the specimen before me) is said to be dilated. *X. arcuatipes*, Pic, from Brazil, is described as having similarly arcuate anterior tibiae in ♂.

67. *Xylophilus rectifasciatus*, n. sp.

♀. Oblong, rather broad, moderately convex, shining, clothed with long, fine, adpressed, pallid hairs; piceous, the antennae, palpi mouth-parts, elytra (a common, transverse, laterally extended median fascia excepted), and legs (the slightly infusate posterior femora excepted), testaceous; densely, finely, the elytra a little more coarsely, punctate. Head short, moderately broad, narrowly extended on each side behind the eyes, the latter large, deeply emarginate, and somewhat narrowly separated; antennae rather slender, comparatively short, joint 3 slightly longer than 2, 4-10 subequal in length, 11 stouter, acuminate-ovate. Prothorax small, much narrower than the head, transversely subquadrate, abruptly narrowed in front. Elytra much wider than the head, subparallel in their basal half, with a shallow intra-humeral depression. Legs rather slender, the posterior pair much stouter, the femora of the latter clavate; basal joint of posterior tarsi almost straight.

Length $2\frac{1}{2}$, breadth 1 mm.

Hab. BRAZIL, Rio de Janeiro (*Fry*).

One specimen. Separable from the insects here referred to, *X. brasiliensis* and *X. suturifer*, Pic, by the more slender antennae and the more finely punctate, rectifasciate elytra. The basal joint of the antennae shows no trace of infuscation.

68. *Xylophilus insularis*, n. sp.

♀. Oblong, rather broad, robust, shining, clothed with long, pallid hairs; head and a narrow, common, post-median fascia on the elytra, extending forwards along the sides, nigro-piceous, the prothorax rufo-piceous, the under surface obscure ferruginous, the rest of the elytra, the mouth-parts, antennae, and legs testaceous; closely, finely, the elytra more coarsely, punctate. Head short, very little wider than the prothorax, narrowly extended on each side behind the eyes, the latter large, deeply emarginate, and somewhat narrowly separated; antennae short, rather slender, joint 3 scarcely longer than 2, 9 and 10 transverse, 11 stout, obliquely acuminate. Prothorax convex, transverse, very gradually narrowing from the base, unimpressed. Elytra oblong, convex, broad, slightly rounded at the sides, with a shallow intra-humeral depression. Legs long, the posterior pair stout, the femora of the latter strongly clavate; basal joint of posterior tarsi arcuate.

Length $2\frac{2}{3}$, breadth 1 mm.

Hab. BRAZIL, Ilha Santo Amaro, near Santos (*G. E. Bryant*: 13. iv. 1912).

One female, somewhat discoloured. Very like *X. rectifasciatus*, from Rio de Janeiro, and similarly coloured; but larger and more convex, with a broader, less quadrate prothorax, the apical joint of the antennae stouter and more acuminate, and the basal joint of the posterior tarsi strongly arcuate. The laterally extended dark median fascia of the elytra is placed a little beyond the middle.

69. *Xylophilus latefasciatus*, n. sp.

♀. Short, broad, rather convex, shining, sparsely pubescent; head, prothorax, a broad, complete median fascia on the elytra, and the posterior femora in part, black or piceous, the rest of the elytra (a large, subobsolete, triangular scutellar patch, extending downward to the median fascia, excepted) and legs, the antennae, and mouth-parts testaceous, the under surface obscure ferruginous; head rather sparsely, finely, the prothorax and elytra closely and

more coarsely, punctate. Head short, broad, narrowly subangulately extended on each side behind the eyes, the latter large, emarginate, and separated by about half their own width; antennae rather stout, comparatively short, joint 3 slightly longer than 2, 3-10 gradually decreasing in length, 8-10 transverse, 11 stout, as long as 9 and 10 united, obliquely acuminate. Prothorax strongly transverse, nearly as wide as the head, parallel-sided, almost unimpressed. Elytra short, broad, slightly rounded at the sides, unimpressed. Legs moderately long, the posterior pair stout, with the femora strongly clavate and the basal joint of the tarsi curved.

Length $1\frac{1}{2}$, breadth 1 mm.

Hab. AMAZONS, between Para and Santarem (*H. H. Smith*).

One specimen, assumed to be a female. A short, broad, convex form, with broadly nigro-fasciate elytra, a dark head and prothorax, and the rest of the upper surface (a faint scutellar patch excepted), the antennae, and legs (the posterior femora excepted) testaceous. A fragmentary ♂, from Tolé, Panama, provisionally placed by me under *X. aequinoctialis*, Ch. (B. C.-Am., Coleopt. iv, 2, p. 181), with the eyes much larger and subcontiguous, the triangular scutellar patch darker and well defined, and the anterior tibiae feebly curved and subsinuate within, seems to belong to the same species.

70. *Xylophilus amazonicus*, n. sp.

♂. Oblong, somewhat depressed, subopaque, clothed with very fine sericeous pubescence; nigro-piceous, with the anterior margin of the prothorax and the under surface obscure ferruginous, the mouth-parts, antennae, and legs, and the base of the elytra broadly, testaceous; the entire upper surface densely, minutely punctate. Head large, broad; eyes very large, occupying the whole of the sides of the head, feebly emarginate, somewhat narrowly separated above; antennae slender, moderately long, joint 3 much longer than 2, 3-10 very gradually decreasing in length, longer than broad, 11 acuminate-ovate. Prothorax much narrower than the head, broader than long, subquadrate, narrowed in front, with a broad transverse depression before the base. Elytra oblong, much wider than the head, gradually widened to the middle, transversely depressed below the base. Legs short, slender; posterior femora moderately incrassate and with a narrow pallid pad along their lower face.

Length $1\frac{1}{2}$, breadth $\frac{3}{4}$ mm.

Hab. AMAZONS, between Para and Santarem (*H. H. Smith*).

One specimen, assumed to be a male. Smaller and less convex than *X. flavipes* (*infra*); the elytra broadly testaceous at the base; the antennae similar, but with a smaller apical joint; the eyes much larger and subapproximate; the posterior femora with a similar narrow flavous pad beneath. The puncturing of the elytra is extremely fine.

71. *Xylophilus dryophiloides*, n. sp.

♂. Oblong, dull, clothed with a fine, greyish, sericeous pubescence; nigro-piceous, the antennae, palpi, and legs (the infusate posterior femora and apices of the posterior tibiae excepted) testaceous; the entire upper surface densely, finely punctate. Head short, broad; eyes very large, feebly emarginate, separated by about half their own width, occupying the whole of the sides of the head; antennae long, rather stout, joint 2 short, 3 longer and narrower, 4-10 wider, subtriangular, subequal, longer than broad, 11 acuminate-ovate. Prothorax much narrower than the head, transverse, subquadrate, abruptly narrowed in front, confluent bifoveate at the base. Elytra oblong, much wider than the head, feebly, transversely depressed below the base. Legs short, slender; posterior femora thickened, with a narrow, projecting, pallid pad along their lower face.

Length 2, breadth 1 mm.

Hab. BRAZIL, San Paulo (*Fry*).

One male. This insect bears a striking resemblance to the European *Dryophilus pusillus*, Gyll., one of the Anobiidae. It is very like the same sex of *X. flavipes*, but has the antennae much longer and stouter (joints 4-10 subequal in width, 11 thus appearing relatively narrower), and the eyes larger and more approximate. The general coloration is exactly that of *X. flavipes*.

72. *Xylophilus flavipes*, n. sp.

♂. Oblong, dull, finely sericeo-pubescent; nigro-piceous, the antennae, palpi, and legs (the slightly infusate posterior femora excepted) testaceous; the entire upper surface densely, finely punctate. Head short, moderately broad; eyes large, distant, feebly emarginate, occupying near the whole of the sides of the head; antennae short, slender, joints 3-10 subequal in length, but gradually becoming a little wider, 3 longer than 2, 11 stout, obliquely acuminate. Prothorax much narrower than the head, transverse,

subquadrate, abruptly narrowed in front, bifoveate at the base. Elytra oblong, much wider than the head, feebly transversely depressed below the base, the humeri rounded. Legs slender, rather short; posterior femora moderately thickened and furnished with a very narrow projecting pad along their lower face.

Length 2, breadth 1 mm.

Hab. BRAZIL, San Paulo (*Fry*).

One male. An oblong nigro-piceous insect, with slender testaceous limbs. The apical joint of the antennae abruptly stouter, the posterior femora with a narrow projecting pad along their lower face, much as in the same sex of *X. fragilis*, *bicolor* (renamed *championi* by Pic), *unifasciatus* and *inflatus*, Ch. *X. flavipes* is so like *X. dryophiloides*, from the same locality, that it was at first treated by me as the ♀ of the same species; the difference in the form of the antennae, however, is too great to be simply sexual,* and the structure of the posterior femora is certainly that of a male.

73. *Xylophilus fuscofasciatus*, n. sp.

♀. Short, broad, subopaque, thickly clothed with fine silky pubescence; obscure ferruginous, the elytra brown, with a common, narrow, transverse, fuscous fascia just behind the middle, the antennae and legs testaceous; the entire upper surface densely, finely punctate. Head short, very little wider than the prothorax; eyes moderately large, distant, feebly emarginate, occupying almost the whole of the sides of the head; antennae short, joints 1 and 2 stout, 3-6 slender, subequal in length, 3 slightly longer than 2, 7-10 rapidly widening, 10 transverse, 11 stout, ovate, obliquely acuminate. Prothorax strongly transverse, the angles obtuse, the disc shallowly bifoveate at the base. Elytra broad, much wider than the head, somewhat rounded at the sides, shallowly, transversely depressed below the base. Legs short, slender, the posterior femora a little stouter than the others.

Length (with head retracted) $1\frac{4}{5}$, breadth 1 mm.

Hab. BRAZIL, Rio de Janeiro (*Fry*).

One specimen. A short, broad, densely punctate, sericeo-pubescent, reddish-brown insect, with broad, faintly unifasciate elytra, short, slender limbs, and very feebly emarginate eyes, which occupy almost the whole of the sides of

* Greater than between the sexes of the European *X. (Euglenes) pygmaeus*, de Geer.

the head, the head and prothorax subequal in width. It can be placed in the section *Olotelus*.

74. *Xylophilus dentaticornis*. (Plate II, figs. 30, 30a, ♂.)

Hylophilus dentaticornis, Pic, Ann. Soc. Ent. Fr. 1912, p. 282.

The unique type of this extraordinary insect was captured by Mr. Bryant in Trinidad, in February 1903. It is, of course, a ♂, and to Pic's description may be added: anterior tibiae much thickened; anterior and intermediate femora, and intermediate tibiae, slender, the latter straight; posterior femora rather stout, clavate. A subcylindrical, pallid insect, with the head, and a small patch on each side of the elytra at about the middle, black; the head strongly deflexed; the eyes extremely large and contiguous in front; the antennae (fig. 30a) long, with joints 5-10 strongly dentate within and 11 crescentiform; the prothorax not much narrower than the elytra. *H. dentaticornis* should perhaps form the type of a separate genus. The general structure is suggestive of that of *Blumenophilus*, Pic (1911), type *B. externenotatus*, from Brazil, the smaller eyes and normal antennae of the latter being suggestive of ♀.

75. *Xylophilus trinitatis*, n. sp.

Hylophilus breviramus, Champ., var., Pic, Ann. Soc. Ent. Fr. 1912, p. 281.

♂. Elongate, rather narrow, dull, the elytra moderately shining, clothed with long, pallid, adpressed hairs; head, prothorax, and under surface, the antennae with joints 1, 2 and 11, and the tips of the rami, the anterior and intermediate femora at the apex, the posterior femora entirely, and the posterior tibiae in part, black or piceous, the rest of the antennae and legs testaceous or flavous; the elytra testaceous, with a common, transverse patch on the disc below the base, another before the apex, and a laterally-extended, complete median fascia, nigro-piceous; head densely, finely, the prothorax rugosely, and the elytra very coarsely, subconfluently, punctate. Head very large; eyes enormously developed, contiguous, deeply emarginate, occupying the whole of the sides of the head; antennae long, joints 4-10 each with a long ramus, 11 long, angularly dilated beyond the middle. Prothorax about as long as broad, narrow. Elytra not wider than the head (with the eyes),

moderately long, rather convex, subparallel. Legs long, the posterior femora strongly clavate.

♀. Prothorax and under surface rufescent; antennae normal, rather stout, moderately long, joint 2 short, 3 much longer than 2, 3-10 gradually decreasing in length, 11 stouter, acuminate-ovate, 1, 2 and 11 infusate; eyes much smaller, well separated; elytra broader than the head.

Length 2-2 $\frac{1}{4}$, breadth $\frac{3}{4}$ -1 mm. (♂ ♀.)

Hab. TRINIDAD (*G. E. Bryant* : ii. 1903).

One pair, treated as a var. of *X. breviramus*, Ch., from Chiriquí, but differing in various respects from that insect: the antennal rami of the ♂ are much longer, as long as in the same sex of *X. trifasciatus*, and one only of the apical joints is infusate in ♀; the elytra are relatively narrower (not wider than the head in ♂), parallel-sided, and less coarsely punctate; and the posterior femora are not so stout.

Antillean Species.

76. *Xylophilus halticoides*, n. sp.

Oblong, broad, robust, shining (when denuded); head, prothorax, and posterior femora nigro-piceous or piceous, the elytra reddish-brown, paler at the base, with a broad indeterminate darker space on each side, the antennae (the basal joint in part excepted) and palpi, the rest of the legs, and the under surface in great part, ferruginous or rufo-testaceous; densely, finely, the elytra more coarsely, punctate, clothed with fine adpressed pubescence. Head short, broad, narrowly extended on each side behind the eyes, the latter very large, deeply emarginate, and somewhat narrowly separated; antennae moderately long, stout, joints 2 and 3 very small, equal in length, 4-10 gradually decreasing in length, 4 twice as long as 3, 8-10 transverse, 11 acuminate-ovate. Prothorax about as wide as the head, strongly transverse, subquadrate, abruptly narrowed in front, the anterior angles rather prominent, the disc unimpressed. Elytra broad, oblong, somewhat rounded at the sides, feebly, transversely depressed below the base. Legs rather short, comparatively stout; posterior femora very stout, strongly clavate, arcuate in front; posterior tibiae and basal joint of posterior tarsi straight.

Length 2, breadth 1 mm. (♂?)

Hab. ANTILLES, Grenada, Mount Gay Estate, Leeward side (*H. H. Smith*).

One specimen, omitted from my 1896 list. A rather

broad, robust form, with stout rufo-testaceous antennae, dark head and prothorax, reddish-brown elytra, and the posterior femora so much thickened as to resemble those of a *Haltica*.

77. *Xylophilus atomarioides*, n. sp. (Plate II, fig. 31.)

Short, convex, oval, shining, sparsely, finely pubescent; testaceous, the eyes black, the elytra each with two, more or less confluent, oblong fuscous patches at the middle of the disc, together forming an interrupted fasciæ; rather sparsely, finely, the elytra more coarsely, punctate. Head short, broad; eyes large, distant, occupying nearly the whole of the sides of the head, very feebly emarginate; antennae short, very slender, thickened at the base and towards the tip, joints 1 and 2 stout, 3-8 narrower, subequal in length, 3 about as long as 2, 9-11 wider, forming a loose club, 11 ovate, stout, blunt at the tip. Prothorax very short, narrower than the head, with two deep foveae before the base. Elytra somewhat oval, convex, much wider than the head, transversely depressed below the base. Legs short, slender, the posterior femora moderately incrassate.

Length 1, breadth $\frac{2}{3}$ mm. (♀?)

Hab. ANTILLES, St. Vincent (*H. H. Smith*).

Two specimens. A minute, convex, testaceous form, with an extremely short prothorax, very different from any other species of the genus known to me. The elongate basal joint of the posterior tarsus separates it from *Cnopus*. The eyes might be described as entire, and *X. atomarioides*, therefore, approaches *Olotelus*, Muls. The examples described were placed amongst the Cryptophagids when Mr. Smith's Antillean captures were sorted, and the insect was thus omitted from my list (1896) of the Xylophilids of the Island.

Since the preceding pages have been in type, Mr. E. W. Ferguson, of Sydney, has sent me three additional species of *Xylophilus* from Australia, all apparently new, and the opportunity is taken of inserting descriptions of them at the end of this paper. They have been examined by Mr. A. M. Lea, and returned as unknown to him. The types have been presented to the British Museum.

78. *Xylophilus duplocinctus*, n. sp.

Oblong, robust, shining, somewhat coarsely pubescent; ferruginous, the head black, the legs and elytra testaceous, the latter

with two common, slightly undulate, narrow, nigro-piceous fasciae—one, at about the basal third, interrupted at the suture, the other, beyond the middle, not reaching the outer margin; elosely, finely, the elytra much more coarsely, punctate. Head large, broad, narrowly extended on each side behind the eyes, the latter very large and somewhat narrowly separated; antennae moderately long, rather stout, joint 3 a little longer than 2, 3 and 4 subequal, 5–10 slightly shorter, 11 ovate, stout, obliquely acuminate. Prothorax transversely subquadrate, narrower than the head, rather convex, feebly canaliculate down the middle posteriorly, without definite foveae. Elytra wider than the head, rather short, subparallel in their basal half, with a deep, oblique, intra-humeral depression. Legs comparatively short and stout, the posterior femora clavate, the basal joint of the posterior tarsi curved and about half the length of the tibia.

Length $2\frac{1}{2}$ mm. (δ ?)

Hab. QUEENSLAND, Cairns (*Ferguson*).

One specimen, in good condition. Not unlike *X. ceylonicus*, Pic, but with a black head, and more coarsely punctate, nigro-bifasciate elytra. There are also many allied tropical American forms.

79. *Xylophilus fergusoni*, n. sp.

δ . Oblong, rather convex, shining, clothed with very fine, silky, cinereous pubescence; black, the head (the eyes excepted), palpi, joints 1–3 of the antennae, the prothorax, and legs rufo-testaceous or testaceous; the head and prothorax sparsely, the elytra elosely and much more distinctly, punctate. Head broad, transverse; eyes large, separated by about one-half their own width (as seen from in front), and extending outwards beyond the very short post-ocular portion of the head; antennae long, not very slender, joint 3 short, slightly longer than 2, 4–10 longer and thicker, obovate, subequal in length, 11 stout, nearly as long as 9 and 10 mited, obliquely acuminate. Prothorax narrow, subquadrate, broader than long, with two deep transverse impressions at the base and an indication of a shallow transverse groove in front of this. Elytra oblong, nearly twice as wide as the prothorax, subparallel in their basal half, flattened on the disc and obliquely depressed below the base, the sutural region tumid towards the apex. Legs long, slender; anterior and intermediate tibiae feebly curved; posterior tibiae distinctly sinnate, rapidly widened outwards, truncate at the apex, and closely set with short hairs behind the

inner apical angle; basal joint of posterior tarsi elongate, very slender, straight, more than half the length of the tibia.

Length 2 mm.

Hab. NEW SOUTH WALES, Sydney (*Ferguson*).

One male, in perfect condition. An isolated form, with peculiarly shaped posterior tibiae in the male, a rufo-testaceous head and prothorax, and black, sericeo-pubescent elytra. The exposed penis-sheath is long and slender.

80. *Xylophilus fracticollis*, n. sp.

Short, shining, finely pubescent; head (except in front) and prothorax nigro-piceous, the basal and apical margins of the latter rufescent, the antennae (the infusate apical joint excepted), elytra, and legs testaceous, the under surface obscure ferruginous; head and prothorax very finely, sparsely, the elytra closely and more strongly, punctate. Head broad, narrowly extended on each side behind the eyes, the latter large and separated by about their own width (as seen from above); antennae short, slender, thickened towards the tip, joints 1 and 2 also stout, 3 small, 4-6 longer, subequal, 10 transverse, 11 ovate, stouter than the preceding joints. Prothorax small, transversely subquadrate, grooved across the middle, and with a very deep, transverse, mesially interrupted, depression before the base. Elytra about twice as broad as the prothorax, short, subparallel in their basal half, deeply, transversely depressed below the base. Legs slender, the posterior pair not very elongate, their tibiae straight, gradually widened from the base to the apex (thus appearing elongate-triangular), the basal joint of their tarsi more than half the length of the tibia.

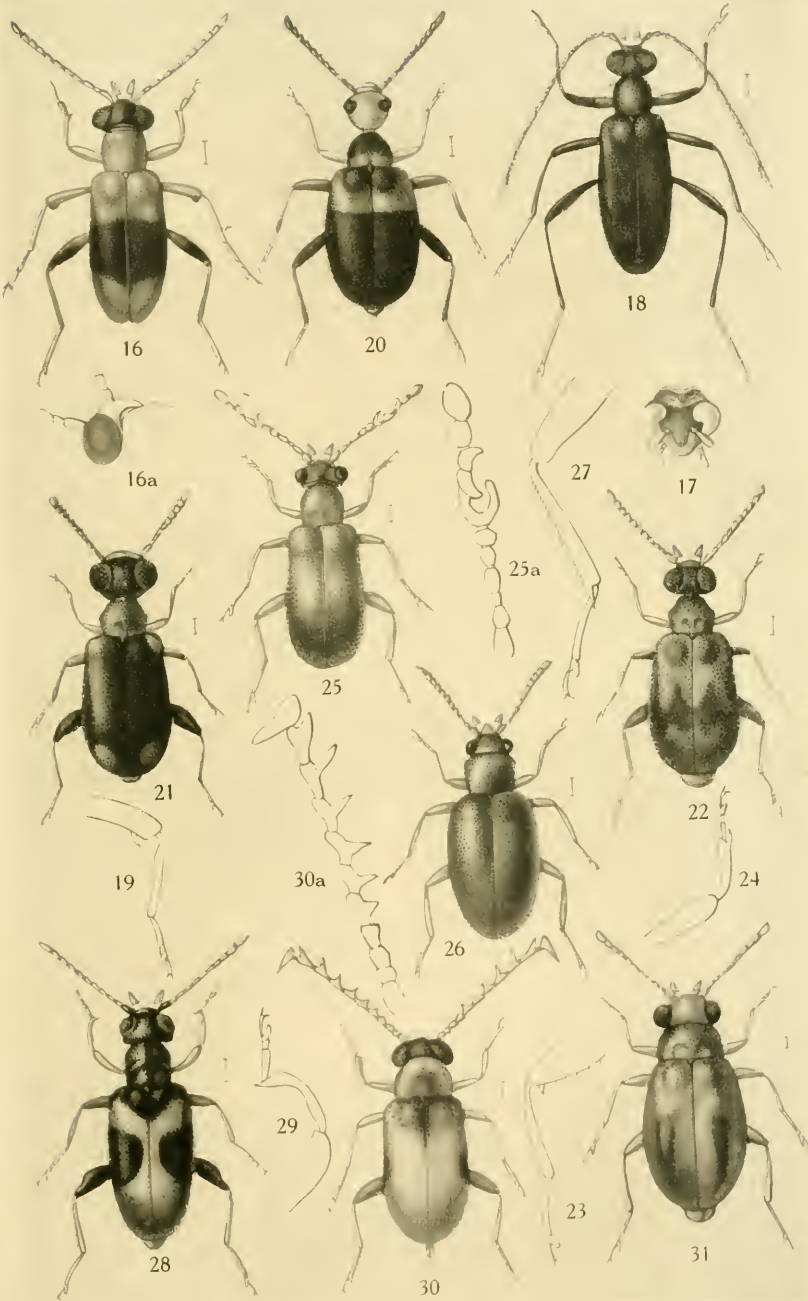
Length $1\frac{1}{3}$ mm. (σ ?)

Hab. NEW SOUTH WALES, Sydney (*Ferguson*).

One specimen, somewhat crushed, but with the head, antennae, and prothorax uninjured, and the insect in sufficiently good condition for description. The subclavate antennae, the transversely grooved, deeply impressed prothorax (much as in *X. malaccanus*), and the gradually widened posterior tibiae, are characteristic. Compared with *X. malaccanus*, the present insect is less elongate and very differently coloured, and the antennae are otherwise formed.

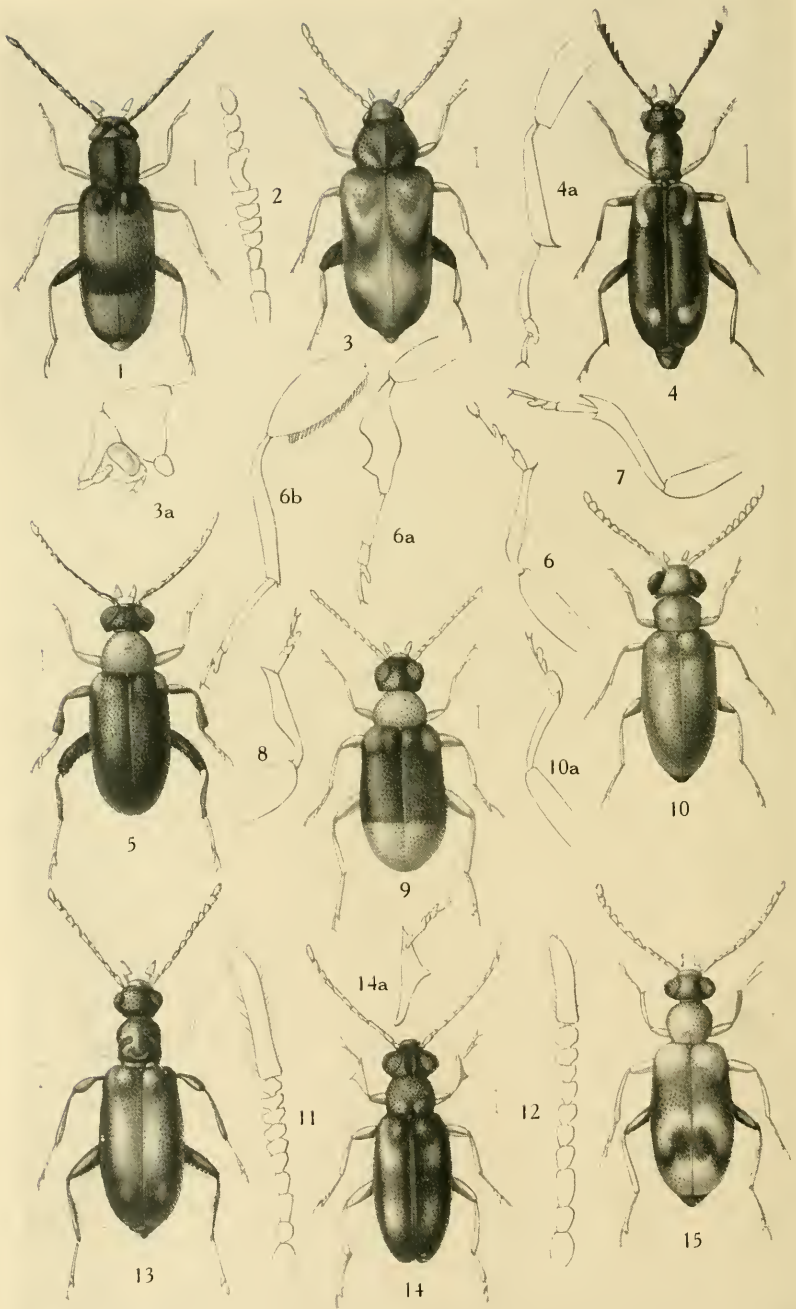
EXPLANATION OF PLATES I, II.

[See *Explanations facing the PLATES.*]



Horace Knight, del.

NEW OR LITTLE KNOWN XYLOPHILIDAE.



Horace Knight, del.

Andre, Sleigh & Anglo, Ltd.

NEW OR LITTLE KNOWN XYLOPHILIDAE.

EXPLANATION OF PLATE I.

- FIG. 1. *Hylobaenus fasciatus*, Pic, ♀? [Ceylon].
2. „ *fracticornis*, n. sp., ♂ [Assam], antenna.
3. *Notoxeuglenes impressicollis*, Pic, ♂ [Trinidad]; 3a, profile of head and prothorax.
4. *Euxylophilus principalis*, Champ., ♀ [Ceylon]; 4a, hind leg, ♂.
5. *Xylophilus podagricus*, n. sp., ♂ [Tenasserim].
6. „ *arthriticus*, n. sp., ♂ [Assam], anterior leg; 6a, intermediate leg; 6b, posterior leg.
7. „ *cylindricornis*, n. sp., ♂ [Assam], anterior leg.
8. „ *tavoyanus*, n. sp., ♂ [Tenasserim], anterior leg.
9. „ *trinotatus*, n. sp., ♀ [Tenasserim].
10. „ *nilgiriensis*, n. sp., ♂ [Nilgiri Hills]; 10a, anterior leg.
11. „ *barbicornis*, n. sp., ♂ [Nilgiri Hills], antenna.
12. „ *claviger*, n. sp., ♂ [Siam], antenna.
13. „ *penicillatus*, n. sp., ♂ [Manipur, India].
14. „ *furcatimanus*, n. sp., ♂ [Tenasserim]; 14a, anterior tibia and tarsus, from beneath.
15. „ *andamanensis*, n. sp., ♂ [Andaman Islands].

EXPLANATION OF PLATE II.

- FIG. 16. *Xylophilus sellatus*, n. sp., ♂ [Nilgiri Hills]; 16a, head in profile.
17. „ *palliditarsis*, Pic, ♂ [Ceylon], head from in front.
18. „ *trogodytes*, n. sp., ♂ [Selangor].
19. „ *uncifer*, n. sp., ♂ [Bombay], intermediate leg.
20. „ *annulicornis*, n. sp., ♂ [Tenasserim].
21. „ *megalocephalus*, n. sp., ♂ [Larat].
22. „ *bigeminatus*, n. sp., ♀? [Ceylon].
23. „ *pectinatus*, n. sp., ♂ [Hong Kong], posterior leg.
24. „ *spinimanus*, n. sp., ♂ [Hong Kong], anterior leg.
25. „ *luniger*, n. sp., ♂ [Moko Hinou Island, N. Zealand]; 25a, antenna.
26. „ *ovalis*, n. sp., [Mashonaland].
27. „ *ingens*, n. sp., ♂ [Sta. Catharina, Brazil], posterior leg.
28. „ *triguttatus*, n. sp., ♂ [Rio de Janeiro].
29. „ *prehensus*, n. sp., ♂ [Amazons], anterior leg.
30. „ *dentaticornis*, Pic, ♂ [Trinidad]; 30a, antenna.
31. „ *atomarioides*, n. sp. [St. Vincent, W.I.].

II. *New Lepidoptera from the Schouten Islands.* By J. J. JOICEY, F.L.S., F.Z.S., F.E.S., and G. TALBOT, F.E.S., with description of a new Tineid by J. HARTLEY DURRANT. F.E.S.

[Read October 6th, 1915.]

PLATES III-VI.

THE present paper is a continuation of one on Biak Lepidoptera by Messrs. Joicey and Noakes which appeared in the Transactions for 1915, Part II. p. 177 *et seq.*

The specimens were collected mostly on Biak by Messrs. A., C., and F. Pratt during May and June 1914, and some were obtained on the adjacent island of Soepiori (Mysore) at Korrido.

The types are in the collection of Joicey except where otherwise stated.

It may be said here that the expedition made by Messrs. Pratt to the Schouten Islands has added greatly to our knowledge of their *Lepidoptera*. The present paper brings the number of new forms discovered by these indefatigable collectors up to sixty-one.

The following notes on the island of Biak and its *Lepidoptera*, communicated to us by Mr. Felix Pratt, will be of interest. Very little information on this island is to be found in geographical literature.

“ On Biak, as on most islands out here, the commonest insects are Danaids and Satyrids. To the east, *Appias* and *Catopsilia*, particularly the former, were exceedingly common, *i. e.* for this part of the world. In South America forty to fifty *Catopsilia* in one sweep of the net is quite possible on a mule road. Such a take out here is an impossibility; four or five at once would be unusual. To the west, although the country is open and suitable to rapid-flying Pierids, the *Appias* and *Catopsilia* were conspicuous by their absence. In fact, speaking from the standard of most tropical islands, butterflies in general are rather rare on Biak.

“ The difference between the forms on Biak and their
TRANS. ENT. SOC. LOND. 1916.—PART I. (AUG.) F

allies in New Guinea and Jobi (Jappen), as far as is known with regard to the latter island, is remarkable. The same applies to the flora. Further, there are no paradise birds, kangaroos, cassowaries, or hornbills, yet all these are plentiful on Jobi, not thirty miles away. Yet the *Goura victoriae* (crown pigeon), which is a particularly heavy bird and can fly only a very short distance, is quite plentiful. This bird may, however, have been imported from Humboldt Bay centuries ago when there was perhaps communication with the more eastern districts. There is a lighter strain in many of the natives and some even have straight hair. This points to some past connection with the natives of the islands at the other end (south-east) of New Guinea. Were it not for the fact that Biak is apparently new land, one might suppose that it belongs to a former continent or great island. According to a missionary, one part, a small mountain, shows signs of being of very ancient formation; this tallies with the native folk-lore.

“The formation of Biak is coral-limestone. There is anchorage on the south coast at Mokmen, but I believe none on the north. In places one can stand on the edge of the coral reef at low tide and sound without finding any bottom at sixty fathoms, as at Bosnek on the south-east corner.

“The prevailing wind is, of course, the south-east. This is a trade wind and really blows all the year round, but what is known as the south-east monsoon blows from April to September. Then the north-westerly squalls begin.

“The altitude is not greater than 200 or 300 feet except in one part to the north, where a mountain runs up to 2000 feet. This, however, is not high enough to produce mountain forms.

“There are no swamps on the island, and behind Warido on the west are undulating plains. Here, in patches of secondary growth, most of the *Delias* were found.

“One might stop a considerable time on Biak and get very few *Delias*. Perhaps a few *euphemia* ♂♂ and, may be, both sexes of *multicolor* if one happened to see the jambosa tree in flower on the sea shore. To get *Delias*, particularly the females, one must find the flowering trees which they haunt, and wait patiently in the branches during the sunny hours; 4 p.m. is a good time for females. During the great heat of the day most things are still

except in the woods, where it is always possible to come across some females drinking. The female of *euphemia* is quite rare and very conspicuous; *maudei* is very rare indeed, and *bosnikiana* is yet rarer.

"*Papilio felixi* is found hovering over the mud near the shore. It is not at all common, but its habits are probably much the same as the other *thule* forms."

It would appear, from what Mr. Pratt says, that Biak is mostly of coral formation and has not been connected with the New Guinea mainland. The highest part of the island may, however, represent land which had some connection with a New Guinea and Moluccan land area when less specialised forms of *Lepidoptera* than are found at present inhabited the entire region.

(G. T.).

PAPILIONIDAE.

1. *Papilio* (*Troides*) *priamus teucerus*, subsp. nov.

Knowing the wide variation exhibited by the *poseidon* race of this species over New Guinea and adjacent islands, we should have hesitated to separate the Biak specimens if our series had been smaller. This series of 135 ♂♂ and 110 ♀♀ shows a certain constancy of form.

♂. *Upperside* of *hind-wing* with spots reduced in size and spot in cellule 4 absent or minute; a golden costal spot varying in size. *Underside* of *fore-wing* with cell-spot always large and other spots well developed.

♀. *Fore-wing* with cell-spot large and extending basad to vein 2 and generally beyond it; all spots enlarged. *Hind-wing* with 2 spots in cellule 6; band close to cell, especially in 3 and 4; a spot at end of cell, varying in size.

Variation—

♂. Typical specimens, 104, including 31 with spots on hind-wing absent = ab. *cronius*, Feld.

Ab. *cronius* with gold costal spot absent or minute, 8 specimens. Typical form without gold spot, 9. Hind-wing with more than 3 spots, 3.

Hind-wing with gold spots, 11.

♀. Typical specimens, 95.

Hind-wing with 2 spots in 7, 1. Hind-wing with second spot in 6 minute or absent, 14.

2. *Papilio ulysses denticulatus*, subsp. nov.

This form shows a transition to *ambiguus*, Roths., from the Bismarck Islands.

♂. *Fore-wing* with the blue beyond end of cell reduced to a few scales or a spot at the base of 6; spot above cell in 9 small or absent, spot in 5 minute or absent, the one in 4 small. *Hind-wing* with the blue area strongly dentate, the prolongations being between the veins and not along them as is the tendency in most of the forms.

♀. *Fore-wing* with all spots outside cell above vein 4 absent. *Hind-wing* with long denticulations in cellules 3-5; submarginal spots smaller than in *autolytus* and almost as much reduced as in *ambiguus*.

12 ♂♂, 3 ♀♀.

3. *Papilio codrus schoutensis*, subsp. nov.

This form is distinguished from typical *medon*, Feld., in the much reduced and more sharply defined costal spot on the hind-wing below, and in the band becoming obsolete.

One specimen approaches specimens of *medon* from Mefor in which the band is partly washed out, but the costal spot is larger than in these, being more typical; there are two similar specimens from Biak in the Tring Museum. Examples from Waigeu are more typically *medon* than those from Mefor.

A series of both sexes.

DANAINAE.

4. *Danaida marcia*, sp. nov.

(Plate III, fig. 1, ♀.)

This rather distinct species is apparently most nearly allied to *rotundata*, Gr.-Sm., from the Bismarck Islands.

♂♀. Ground-colour blackish-brown, markings white. *Fore-wing*.—A stripe in lower part of cell between veins 2 and 3; a small subcostal spot in cellule 10, a smaller one beyond it in 9 and just above the first of 3 post-cellular spots in 4-6, the middle one the longer, and the one in 4 shortest and nearly square; an oblong patch in 2, pointed towards angle of 2 and not touching cell; a small spot above it in 3 near cell; a stripe in 1b on submedian, nearer to base than to margin, and anteriorly convex;

below this an indistinct line on inner margin and reaching base; a submarginal row of 7 spots, the last three in 1c, 2 and 3, being twice the size of the first four; marginal dots in pairs between the veins chiefly present in 2 and 3. *Hind-wing*.—A wedge-shaped stripe in lower part of cell, not quite reaching the base; 4 post-cellular spots close to cell and to one another, their outer edges slightly concave; a patch in 1c extending to the base and slightly invaded by ground-colour near the submedian; a narrow stripe in 1b shorter than the preceding and a short basal line in 1a; an indistinct and narrow spot in cellule 6; a stripe in 7 nearly filling the cellule, acuminate near the margin, and indistinctly reaching the base; a sub-basal triangular spot in 8, a submarginal row of 6 spots in 1c-6, and a marginal series of dots in pairs between the veins.

Underside similar to above. *Fore-wing* with marginal dots better developed; a spot or dot distally of the larger one in 3; stripe on inner margin well marked.

In the ♂ the wings are less rounded and spots are a little smaller. On the hind-wing the spots in the distal area are faintly marked and the post-cellular spots are much smaller. Length of fore-wing: ♂ 34 mm., ♀ 39 mm.

It may be noted that this species bears some resemblance to *Neptis gregalis*, J. and N., and to the ♀ of *Pareronia chinki*, J. and N.

1 ♂, 3 ♀♀ received.

The ♀ of this species bears the strongest resemblance to the ♀ of *Euploea pyres mangolinella*, Strand, from Ysabel and New Georgia. Although it is not improbable that a similar form of *Euploea* may exist on Biak, yet such a resemblance as here noted could conceivably arise in the absence of the *Euploea*.

The factors operating to bring about the same convergence of pattern in a *Euploea* and in a Danaid in different habitats are probably of the same kind. The resulting pattern in each of these sub-families would conform more to one type than would the pattern of a Danaid and a Pierid belonging to distinct families.

EUPLOEINAE.

5. *Euploea confusa biaka*, subsp. nov.

Nearest to *faunia*, Fruh., from Dutch New Guinea. It is darker than other forms of the species. The median patch is proximally yellow-brown and outwardly much paler; it does not enter the

cell. On the *hind-wing* the brownish distal suffusion is confined to a slight indication in cellules 1c and 2.

Underside darker than above and fore-wing patch mostly white. The *hind-wing* has only 3 minute bluish streaks beyond the cell in 2-4.

The single specimen obtained is smaller than any other we have seen of the species. The fore-wing measures 37 mm. as against 40 mm. mostly attained by other forms.

1 ♂.

6. *Euploea lugubris*, Gr.-Sm., ♀.

(Plate III, fig. 2, ♂, 3, ♀.)

E. lugubris, Gr.-Sm. Nov. Zool. 1, pp. 342-3 (1894).

A pair of this species having been taken *in copula* we find that the ♀ does not agree with the specimen described by Grose-Smith. This ♀ is in the Tring Museum and appears to belong to another group of *Euploea* of which *cerberus*, Butl., is a representative. It is most likely the ♀ of our *incerta*.*

Upperside smoky-brown, paler at the margins, and some spots showing through from below; costa of hind-wing grey.

Underside paler. *Fore-wing* with a cell-spot near end; 3 spots near the cell in 2-4, the last being much smaller; a submarginal series of 7 dots curving outwardly from costa to cellule 5, the next two dots shifted inwards and the seventh below the sixth; a well-defined curved stripe in 1c and a shorter and greyish stripe below it; inner margin grey. *Hind-wing* with a cell-spot near end; a series of 6 spots round the cell and between these and the margin 4 spots in 4-7; 6 marginal dots in pairs between the veins in 4-6.

Length of fore-wing: 39 mm.

A series of ♂♂ and 2 ♀♀.

PALAEOTROPINAE.

Gen. TELLERVO, Kirby.

Lepidopterists are not yet unanimous as to whether this genus contains more than one species. In his report on the *Lepidoptera* of the Wollaston Expedition, Lord Rothschild has described two distinct forms of *Tellervo* from the same locality and treats them as races of *zoilus*, Fbr., and

* *Euploea incerta*, J. and N., T.E.S., 1915, Pt. II, p. 187, pl. 25, fig. 4.

assarica, Crm., respectively. We are led to a similar conclusion by receiving a long series of both sexes of two different forms from Biak. The *zoilus* form is represented by *mysoriensis*, Stgr., and the *assarica* form is undescribed.

Heer Van Eecke in his report of the *Rhopalocera* collected by the Third Dutch Expedition, follows Fruhstorfer in treating all the forms as belonging to one species; he further supposes that the whitest form was the most primitive and that a darkening process has been going on.

We have examined a large number of specimens, including those in the Tring Museum, and, as far as pattern goes, find three characters which, though not entirely constant, hold good for the majority of specimens representing *zoilus*, Fbr., and *assarica*, Crm. These characters may be thus tabulated:—

ZOILUS.	ASSARICA.
<i>Fore-wing</i> —	<i>Fore-wing</i> —
Apical spots separated.	Apical spots joined to form a band.
No spot below vein 3 or only a dot.	A spot below vein 3 generally well marked.
<i>Hind-wing</i> below—	<i>Hind-wing</i> below—
A second basal spot below the median.	No basal spot below the median or only a few white scales.

In a few specimens bearing the fore-wing characters of *assarica* we have found a well-marked second basal spot on hind-wing below. A series of 28 typical *assarica* from Ceram in the Tring Museum have all only 1 basal spot on hind-wing. The form we now describe also agrees in this respect without exception; on the other hand, every specimen of the *zoilus* form received from Biak possesses two basal spots.

If *Tellervo* contains two species a proper definition of them has still to be given.

7. *Tellervo assarica biakensis*, subsp. nov.

(Plate III, fig. 4, ♀.)

♂. *Upperside*. *Fore-wing* with apical spots more or less distinctly connected, a more or less distinct spot below vein 3; cell-spot more or less square, a dot near base. *Hind-wing* with discal

patch extending to inner margin near base; a short notch of black ground-colour at origin of vein 7.

Underside. *Fore-wing* with well-marked costal spot and triangular basal spot; apical spots more distinctly connected, and spot below vein 3 better developed than above. *Hind-wing* with one basal spot.

♀. *Fore-wing* with spots larger and apical spots generally markedly connected.

One ♀ specimen shows a darkening on the hind-wing of veins 1b, 2 and 3, and a dark spot at lower angle of cell. Another example shows on the fore-wing a much-enlarged cell-spot above which is a costal streak; the lower median spot is also large. There are 5 specimens in the Tring Museum from Korrido which probably belong here, in which the hind-wing shows a further extension of the darkening described in the specimen above. There is a specimen in the British Museum from Biak, collected by Doherty.

A long series of both sexes was obtained.

NYMPHALIDAE.

8. *Atella alcippe interposita*, subsp. nov.

This form connects *cervina*, Butl., from Dutch New Guinea, with *denosa*, Fruh., from the Bismarek Islands.

♂ ♀. *Upperside* with a well-defined and broader black margin the edge of which is nearly straight. *Fore-wing* with cell-markings and bar beyond cell well defined; small spots at base of cellules 1, 2 and 3. *Hind-wing* with distinct basal lines.

Underside more uniformly pale brown than in *cervina*, and in one specimen only is the distal area darkened with bluish-grey. The basal lines are well marked and the post-discal and submarginal lines are more narrowly margined with bluish-grey.

The ♀ is duller and more strongly marked on both sides.

A series of both sexes.

9. *Parthenos sylvia intermedia*, subsp. nov.

(Plate IV, fig. 3, ♂.)

This form appears transitional between Moluccan forms of *sylvia*, Crm., and *tigrina*, Voll. The basal brown on both wings is dull- and not yellow-brown as in *tigrina*.

♂. *Fore-wing* with the spot in 2 smaller than in allied forms, spot in 5 shortened proximally, the one in 6 larger and extending the

width of cellule on the underside, no spot between this and the one near base of 6. *Hind-wing* with well-marked submarginal lines.

One specimen only obtained.

10. *Prothoe australis satgeii* f. *bifasciata*, forma nov.

(Plate IV, fig. 4, ♂.)

Forms of *australis*, Guér., show all transitions from the wholly dark fore-wing to the presence of a complete band, and specimens with and without markings on the fore-wing occur together. The aberration here described is similar to *hewitsoni*, Wall., and conforms to the race *satgeii*, J. and N., in comparative reduction of underside markings.

♂. *Upperside*. *Fore-wing* with a sub-costal patch formed of 2 contiguous spots in 5 and 6; a large median patch of which the spot in 2, the larger, extends to within a third of length of cellule 2 from margin; beyond sub-costal patch 4 thin and short stripes in 4-7; a submarginal row of 7 rounded spots, the one at tornus being much larger and produced proximally as a short stripe. *Hind-wing* with discal patch as in the typical subspecies but more sharply defined.

Underside. *Fore-wing* with subcostal and median patches joined to a spot in 4; the 4 stripes above are represented by 4 spots of somewhat triangular shape; cell with 5 small spots and a dot in middle; no spot on costa; submarginal spots as above except that there are 2 at tornus and 2 short stripes next them. *Hind-wing* as in *hewitsoni*, Wall., but with reduced markings. The lunules in 2 and 3 are incomplete; the second stripe of discal patch in 3 does not reach base of cellule, and the other stripes are likewise shorter.

A single specimen obtained.

11. *Eriboea pyrha glauca*, subsp. nov.

Close to the race *jupiter*, Butl.

Upperside. *Fore-wing* with increased blue edging to the band; the spot beyond end of cell a little larger; submarginal spot in 4 shifted inwards. *Hind-wing* with increased distal glaucous-blue margin to the band, projecting on veins 2 and 3 and in two specimens joining the marginal spot on 2 which is larger.

Underside. *Fore-wing* with the black bar across cellule 3 oblique

and outwardly curved, either separated from the spot in 2 or just touching its outer edge; the two submarginal lines closer together and more bluish. *Hind-wing* with band more silvery-white and a little narrower, markedly so in one specimen; proximal bordering of submarginal spots more bluish and heavily marked.

The specimen with a narrow band on the hind-wing has a deep blue gloss over the outer margin of hind-wing above and all traces of green have disappeared.

3 ♂♂.

AMATHUSIIDAE.

12. *Morphopsis biakensis*, sp. nov.

(Plate V, fig. 2, ♂.)

Smaller than other forms of this genus and with a broader band on the fore-wing, but possessing the general pattern and coloration of *albertisi*, Ob. The fore-wing is more rounded than in other species of the genus; the outer angle much more oblique and lower median interspace much broader. The cell of the hind-wing is long and narrow, the middle discocellular being twice as long as the first.

♂. *Upperside*. *Fore-wing* with band broader anteriorly and distally and half surrounding apical ocellus; apical blackish-brown much reduced; one white dot in cellule 6 above the ocellus. *Hind-wing* with smaller eye-spot; submarginal line thinner, inner one obsolete.

Underside.—*Fore-wing* with band more yellowish; submarginal lines waved at apex, straight from vein 5, inner one much thinner; lower part of eye-spot lying within the band, a white dot placed anteriorly and touching the inner ring; band narrowly bordered with chocolate-brown proximally. *Hind-wing* with apical ocellus comparatively larger than in forms of *albertisi*, Ob.; proximally of this eye-spot and touching veins 5 and 8 a curved brown line as wide as its distance from the ocellus and parallel to its inner edge to vein 4, bending inward to 3, then thickening to form a curve in 2, thence to submedian where it joins an inner submarginal line of same colour; latter line thicker than in the allied species and more regularly waved, also closer to the first submarginal line; latter line closer to margin and only slightly undulate; a brown spot at end of cell and one at base of vein 7; a cell-streak placed more obliquely than in the allied species; 2 white curved marks near the inner submarginal line in cellules 3 and 4.

♀. Darker brown. *Upperside* of fore-wing with black-brown

apex and more sharply defined distal edge to the band; ocellus not touching the band; inner edge of the band broadly margined with black which merges into the chestnut ground-colour. *Underside* darker than in ♂. *Fore-wing* with grey-black apical half. *Hind-wing* with broader post-median band and thicker inner submarginal line.

Length of fore-wing: ♂ 41 mm., ♀ 45 mm.

2 ♂♂, 1 ♀.

LYCAENIDAE.

13. *Megisba orientalis*, sp. nov.

(Plate V, fig. 3, ♂.)

Allied to *monacha*, Gr.-Sm., from Humboldt Bay.

♂. *Upperside* of fore-wing with a white patch as in the allied species; hind-wing unicolorous black.

Underside. *Fore-wing* with 2 dots at base instead of one as in *monacha* and the post-discal row of spots somewhat differently placed, forming a series of curved marks parallel to margin in cellules 1b and 1c, 2, 3, and 4; 3 faint spots in 5, 6, and 9, at right angles to costa. *Hind-wing* as in *monacha* and somewhat bluish-white basally.

♀. Wings rounded. *Fore-wing* with white patch broader and extending above vein 4. *Underside* with margins not darkened.

Length of fore-wing: ♂ 11 mm., ♀ 12 mm.

1 ♂, 1 ♀.

14. *Candalides albiplaga*, sp. nov.

(Plate III, fig. 6.)

♀. *Upperside* blackish-brown. *Fore-wing* with a large white patch extending along inner margin from near tornus to near base, narrowing slightly to vein 2 and then slightly outcurved and reaching just above 3; it extends to the base of cellule 2 and does not enter the cell. Fringe whitish at outer angle. *Hind-wing* with outer costal area white and extending as a spot in the angle of 6 and 7. Fringe white.

Underside white. *Fore-wing* narrowly edged with black from apex to vein 2, and similarly the hind-wing from vein 4 to first sub-median.

Head, thorax, and abdomen blackish-brown above, white below. Length of fore-wing: 16 mm.

A single specimen only obtained.

15. *Lampides coeligena*, sp. nov.

(Plate VI, fig. 2, ♂, 3, ♀.)

Allied to *elpis*, Godt. ♂. Bright sky-blue, more intense than in *elpis*. Hind-wing paler along costa; at anal angle two short black bars divided by submedian.

♂. *Underside* more slaty-grey than in *elpis*. *Fore-wing* with a short median band reaching vein 3 and above it a discocellular bar; a curved post-median band widest on costa and reaching vein 4, as in *elpis*; a narrow submarginal band darker than ground-colour and formed of curved bars; marginal border darker than ground-colour. *Hind-wing* with lines less heavily marked than in *elpis*; post-median band more irregular; a submarginal row of black spots edged with white on inside, consisting of two larger apical spots, 3 smaller in 3-5, a white lunule edged with black placed over the anal spot, and a white streak edged with black at inner angle; a marginal row of smaller spots bordered with white; anal spot less broadly margined with yellow than in allied forms.

♀. Above with a black apical and marginal border, but not so broad as in *elpis*. The wings are less bright in colour than in ♂. *Hind-wing* with brownish costa; a marginal row of dark spots as in *elpis*, the one in 2 much larger than others, bordered with white; an inner row of brownish lunules edged with white proximally.

Underside as in ♂, with increased yellow bordering to anal spot.

1 ♀ only received.

♂ (Type) in Brit. Mus., also ♀, from Humboldt Bay, Sep.-Oct. 1892, W. Doherty (coll. Godman and Salvin).

16. *Philiris fulgens septentrionalis*, subsp. nov.

Differs from *fulgens*, Gr.-Sm., in the more extended purple on fore-wing which reaches costa and extends beyond cell half-way between it and apex, its edge evenly curved and nearer the margin than in the typical form. *Hind-wing* with increased blue in cellules 6 and 7.

1 ♂, Biak, 1 ♂ labelled "Kapaur" in coll. Joicey from Grose-Smith Coll.

17. *Thysonotis dissimilis*, sp. nov.

(Plate III, fig. 7, ♂, 8, ♀.)

Near to *hebes*, Druce, and very similar to *eudocia*, Druce, but has not the yellow costal streak on the fore-wing as in this species.

♂. *Upperside* deep blue with narrow black margins a little wider on hind-wing.

Underside black. *Fore-wing* with a broad white band narrowing anteriorly and ending in a point at vein 6, entering cell at lower angle, distally incurved between inner margin and vein 3; a greenish-blue stripe along upper part of cell from base to its end. *Hind-wing* with a broader white band than on fore-wing, and narrowing from inner margin to vein 5; a greenish-blue basal bar; a sub-marginal thin scalloped line the points of which rest on a thin greenish-blue marginal line, the spots thus formed being deeper black than the ground-colour.

♀. *Upperside* blackish-brown with a well-defined white band crossing both wings. The band on *fore-wing* forms a small spot in lower angle of cell and extends above vein 4; it does not fill the base of cellule 2 and its outer edge is not so well defined as the inner. On the *hind-wing* the band narrows to the inner margin and extends from near base to beyond cell, its outer edge being straight and well defined.

Underside similar to ♂. *Fore-wing* with costal stripe broader and somewhat larger. *Hind-wing* with band narrower than in ♂, its outer edge straight instead of curved; marginal spots more heavily defined by greenish-blue.

Length of fore-wing: ♂ 16 mm., ♀ 18 mm.

4 ♂♂.

18. *Deudorix ceramensis maudei*, subsp. nov.

(Plate V, fig. 4, ♂, 5, ♀.)

This peculiar species* is evidently closely allied to *despoena*, Hew. The pattern of the underside is almost as in Hewitson's species, but the blue on the upperside is replaced by bright orange-brown in the ♂.

♂. *Upperside*. *Fore-wing* black with an oblong median patch of bright orange-brown extending from base to vein 3, anteriorly rounded and bending obliquely inward from 1b to inner margin. In the typical form this patch extends above vein 3. *Hind-wing* bright orange-brown; base near costa to vein 5 and to just beyond angle of 7 and 5, black; fringe black; tail black tipped with white. In the typical form the costal black is extended but less so at the base.

* *Deudorix ceramensis*, Ribbe, "Iris," vol. 13, p. 336, t. vi, f. 3 (1900), (Ceram).

Underside buff, darker at inner margin of hind-wing; in *ceramensis* the ground-colour is white. *Fore-wing* with outer margin broadly smoky-brown, narrowing posteriorly and traversed by a thin line of ground-colour which becomes obscured anteriorly; a deep brown triangular costal patch, its apex directed outwards below vein 2; this patch is narrower in *ceramensis* and reaches lower submedian. *Hind-wing* with a narrow smoky-brown margin from apex to vein 3, and a faint smoky line running parallel to it; rest of margin yellow and proximally bordered by a black line edged with metallic blue; an admarginal whitish line from 1c-4; a round black spot bearing some metallic blue scales in its upper part, in the marginal yellow in 2; next this an oblong metallic blue spot, round in the typical form, is placed obliquely in 1c; anal lobe as in allied species; a dark-brown discal and inner-marginal band, as in *ceramensis* but broader. Thorax above chestnut-brown, abdomen rufous.

♀. *Upperside* similar to *despoena*, Hew. *Fore-wing* with blue area extending just beyond the white patch, its outer edge evenly curved and parallel to margin. *Hind-wing* with more extended blue than in *despoena* and only a faint whitish scaling on costal area.

Underside similar to the allied species. *Fore-wing* darker at the base; costal patch extended to 1b. *Hind-wing* darker at base; ochreous marginal patch in 3 bearing a black spot with a blue centre; other markings as in *despoena*.

Length of fore-wing: ♂ 17-21 mm., ♀ 20-21 mm.

13 ♂♂, 3 ♀♀.

19. *Deudorix biaka*, sp. nov.

This appears to be most nearly allied to *neopommerana*, Ribbe.

♀. Smaller than allied forms. *Upperside* paler than in *neopommerana*; costa, apical area, and cell of *fore-wing* darker; anal lobe brick-red and bearing a small dark central spot.

Underside grey and paler than in the allied species. On the *hind-wing* the inner edge of the spot in 7 is in line with the inner edge of the two discal spots, forming a line, broken in cellule 2, from costa to inner margin. Anal lobe black, eye-spot in 2 black ringed with pale yellow, a slight bluish scaling between it and inner margin. Abdomen below pale yellow.

Length of fore-wing: 15 mm.

A single specimen.

20. *Horaga schoutensis*, sp. nov.

Allied to *samoena*, Gr.-Sm., from Batchian.

♂. *Upperside* with grey-black ground-colour. *Fore-wing* with a large white discal patch extending from 1*b* to 6, narrowest above vein 4, widest in cellule 2, and not filling base of this cellule; the outer edge is outwardly curved and less well-defined than the straighter inner edge. Below cell, basal three-fifths scaled with violet-blue which extends slightly into the cell and forms a spot at its lower angle. *Hind-wing* with a narrow basal patch of blue scaling between veins 4 and 6. A bluish-white subterminal line, interrupted at the veins and obsolescent anteriorly; a marginal line darker than the ground-colour; cilia white on inner margin.

Underside olive-brown. *Fore-wing* with a well-defined white discal patch reaching vein 1*a*. Inner margin grey-white except at base. *Hind-wing* with a white discal band, widest on costa and narrowing posteriorly, ending in a point at 1*a*; its inner edge is well defined, straight to vein 7, projecting between this vein and 6, inwardly oblique to 4, outwardly so to 2 and from which it forms a deep inward curve to 1*a*; outer edge slightly diffused and gently curved, scaled with pale metallic blue from 1*a* to 3. A subterminal white line interrupted on the veins. Against this a black quadrate spot in 2, inwardly edged with metallic blue; a larger grey spot in 1*b* and smaller but similar and obsolescent spots in 3, 4 and 5. A black marginal line. Inner margin edged with bluish-white at base. Anal lobe black.

Length of fore-wing: 17 mm.

One specimen only obtained.

21. *Arhopala bosnikiana*, sp. nov.

Near *alce*, Hew., from Halmaheira, Aru, and German N. Guinea.

♀. Smaller than the ♀ of *alce*. *Upperside* with narrower marginal black and more intense blue. *Underside* with a grey-brown ground-colour and spots smaller. *Fore-wing* with cell-spots separate. *Hind-wing* with the 4 costal spots separate and not forming a dark patch. At base of cell a dark spot and a rounded spot in the middle; median band straighter and better defined; no blue scaling at anal angle and no dark anal spots.

Length of fore-wing: 20 mm.

A single specimen.

HESPERIDAE.

22. *Casyapa biaka*, sp. nov.

Smaller and of more delicate build than others of the genus.

♂. *Upperside* deep brown. *Fore-wing* without markings. *Hind-wing* with a narrow marginal band of orange-yellow from anal angle to vein 7 where it ends in a point; this colour runs out in short streaks on the veins. *Underside* a little paler than above.

Head, palpi, pectus, legs, and abdomen below orange-yellow. Antennae deep brown above, yellowish below. Thorax and abdomen deep brown above, the former slightly tinged with yellow.

Length of fore-wing: 22 mm.

A single specimen.

23. *Mimas basalis*, sp. nov.

♀. *Upperside* black with base of both wings pale greenish-blue. *Fore-wing* with basal blue extending slightly into the cell. *Hind-wing* with the blue filling the cell and extending a little below it; a white streak along basal half of submedian and a violet-blue patch below it. Cilia of both wings white at apex and at inner angle.

Underside blackish-brown. *Fore-wings* with some faint violet-blue subapical streaks; proximally of these are 3 similarly-coloured spots, the middle one smaller than the others; two short subcostal streaks near end of cell. *Hind-wing* with two small violet-blue spots in cellule 7; a submarginal row of 5 spots, the apical 3 faintly defined.

Antennae black; palpi clothed with black and white hair; frons white, vertex and base black; thorax and basal two abdominal segments black clothed with grey hair; remainder of abdomen black ringed with white between segments; pectus white mixed with black; legs black.

Length of fore-wing: 20 mm.

A single specimen.

AGARISTIDAE.

24. *Damias varia tripartita*, subsp. nov.

♂ ♀. Nearest to *transducta*, Wlk., from the North Moluccas. *Fore-wing* with lower discal spot tripartite as in the allied form but smaller. The cell-spot is reduced to a minute dot in the ♂ and is absent in the single ♀ specimen. *Hind-wing* with the band short and broad leaving a wider dark margin than in the allied

form. *Underside* of fore-wing with reduced basal streak and cell-bar. Fringes entirely black.

8 ♂♂, 1 ♀ obtained.

25. *Mimeusemia nigrescens*, sp. nov.

(Plate VI, fig. 4, ♀.)

This species is most nearly allied to *proerosia*, Druce, from the Key Islands, but is at once distinguished by the black ground-colour.

♀. *Upperside* black. *Fore-wing* with a pale yellow almost cream-coloured discal band placed at right angles to costa and extending from subcostal to near tornus, constricted slightly in upper part and rounded posteriorly, accompanied by a curved mark at its lower distal edge; some metallic blackish-blue markings comprising a spot in cell, a stripe closing cell, an inwardly curved row of 5 dots just beyond the band, some sealing along anterior margin of cell and along lower submedian. *Hind-wing* with pale yellow marginal patches more extended than in *proerosia*; fringe pale yellow, blackish proximally.

Underside blackish-brown. *Fore-wing* paler along inner margin; band as above, bent inwards below first submedian; some pale yellow sealing along inner margin. *Hind-wing* with series of marginal spots, two at apex obscure and free from margin, two streaks in 4 and 5 which scarcely touch margin.

Head, thorax, and abdomen black, pectus orange; tegulae pale yellow on inner edge; patagia traversed by a pale yellow line reaching below the eyes; a pale yellow line above the eyes on crown of head; palpi black, first segment fringed with pale yellow and second segment pale yellow inside; anal tuft orange; legs black, femora orange.

Length of fore-wing: 27 mm.

A single specimen.

GEOMETRIDAE.

26. *Dysphania tentans schoutensis*, subsp. n.

♂ ♀. Darker than *tentans*, Wlk. *Upperside*.—*Fore-wing* with no basal pale stripe below the cell; apical and post-median spots more or less reduced. *Hind-wing* with wider margin and reduced

light basal patch which does not extend beyond end of cell, its edges well defined, not reaching base; yellow distal spots absent or feebly marked.

Underside of hind-wing with basal patch forming a well-defined spot in cellule 7; distal yellow markings more prominent. Pectus blue-black.

Two specimens represent the extreme darkening in this race. The apical and post-median spots, excepting a small costal spot, have disappeared, and on the hind-wing there are no distal markings.

A long series of both sexes.

27. *Milonia caerulea*, sp. nov.

(Plate VI, fig. 5, ♂.)

This species is distinct from any other known in the genus.

♂. Ground-colour black. *Fore-wing* on both sides metallic greenish-blue to beyond the cell, leaving a broad apical and less broad marginal area. Below, the blue scarcely extends below first submedian and inner margin is greyish. *Hind-wing* on both sides excepting costa above, metallic greenish-blue, leaving a marginal border about 4 mm. broad which is shot with blue above as seen in a side-light.

Head, thorax, and abdomen metallic greenish-blue, as also the femora and tibiae on outer side; remainder of legs, pectus, and antennae smoky-black.

Length of fore-wing: 25 mm.

One specimen.

28. *Xanthomima plumbeomargo*, sp. nov.

Near *biquadrata*, Warr., from Key Island.

♂ ♀. *Upperside* with basal part ochreous-yellow, outer part dull black or lead-colour. *Fore-wing* with yellow area extending beyond middle, its costal edge finely blue-black, its outer edge slightly curved. *Hind-wing* with yellow area to beyond middle, outer edge curved outwards to vein 3 and below this incurved.

Underside as above.

Head, collar, antennae, legs, and pectus dull black, abdomen ochreous-yellow, thorax ochreous-yellow above.

Length of fore-wing: 18 mm.

2 ♂♂, 1 ♀.

CALLIDULIDAE.

29. *Cleis oceanitis*, sp. nov.

Distinct, but resembling *versicolor*, Feld., above.

♀. *Upperside* with black-brown ground-colour. *Fore-wing* with a large rounded golden-yellow patch, its proximal edge straight and running across end of cell to vein 2. *Hind-wing* with a golden-yellow patch more evenly rounded than on fore-wing and not quite touching costa and inner margin, nor reaching extreme base, and leaving a marginal border about $\frac{1}{4}$ of wing in width.

Underside golden-yellow. *Fore-wing* with a narrow black-brown outer margin, wider at apex, and narrowing to middle of costa. A black-brown triangular median patch from near base to beyond cell and not reaching its upper margin, the outer edge reaching to a third from tornus, the lower edge on inner margin. *Hind-wing* with a short basal stripe; a narrow marginal border, thin at middle of costa and at inner margin; broadest at apex.

Length of fore-wing: 16 mm.

2 ♀♀.

30. *Comella insularis*, sp. nov.

♂. *Upperside* pale yellow. *Fore-wing* with narrow brown marginal border wider at apex and tornus. *Hind-wing* with a narrow brown marginal border merging into the ground-colour.

Underside pale straw-yellow, bands narrower than in *lactifera*, Feld.

♀. *Upperside* yellowish-brown. *Fore-wing* with marginal border wider than in ♂, especially so at apex; a brown spot at end of cell. *Hind-wing* with narrow marginal border more clearly defined than in ♂.

Underside darker than in ♂, bands broader.

Length of fore-wing: ♂ 12 mm., ♀ 13 mm.

1 ♂, 6 ♀♀.

TINEINA

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HEMEROPHILIDAE.

IMMA, Walk.

Imma acribes, sp. n.

Antennae blackish. *Palpi* and *head* orange-ochreous. *Thorax* orange-ochreous, with two longitudinal blackish streaks; *tegulae* blackish, edged with orange-ochreous; *pectus* blackish. *Fore-wings* broad, costa rather strongly arched, apex rounded, not oblique; 7-8 stalked, 8 to apex; orange-ochreous, the interneural spaces strongly marked with black, causing the neuration to appear conspicuously in lines of the orange ground-colour, except toward the costa and termen where the ground-colour forms a subterminal band obliterating the black streaks, with the exception of the two preceding veins 11 and 12 which extend to the costa; the black streak between veins 5-6 differs from the others in widening inwardly, ending with a lunate expansion on the discoidal and is not connected with the black discal streak; the costa and termen are narrowly margined with black, the termen with a narrow lilac-grey line at the base of the dark fuscous cilia; underside pale orange-ochreous, the costa and termen margined with dark fuscous, with some blackish interneural shading. *Exp. al.* 34 mm. *Hind-wings* orange-ochreous, with a broad black basal patch, and narrowly black at the apex and along the termen; the black basal patch extends to beyond the cell and is irregular in outline, having four or five tooth-like extensions along the veins; cilia orange-ochreous, black at their base at the apex and along the termen; underside as above, but with an orange-ochreous streak in the cell above the media and the black terminal line extending to vein 2. *Abdomen* blackish, pale orange-ochreous beneath. *Legs* orange-ochreous, outwardly shaded with fuscous.

Type ♀ (300237), *B. M.*

Hab. Biak Id., VI. 1914 (*A. C. and F. Pratt*). Unique; Mr. J. J. Joicey has kindly presented this specimen to the Museum.



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NEW LEPIDOPTERA FROM THE SCHOUTEN ISLANDS.

EXPLANATION OF PLATE III.

- FIG. 1. *Danaïda marcia*, ♀.
2. *Euploea lugubris*, Gr.-Sm., ♂.
3. " " " " ♀.
4. *Tellervo biakensis*, ♀.
5. *Delias bosnikiana*, ♀.
6. *Candalides albiplaga*, ♀.
7. *Thysonotis dissimilis*, ♂.
8. " " " " ♀.

EXPLANATION OF PLATE IV.

- FIG. 1. *Elodina biaka*, ♂.
2. " " ♀.
3. *Parthenos intermedia*, ♂.
4. *Prothoe satgeii* f. *bifasciata*, ♂.
5. *Elymnias cinereomargo*, ♀.



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EXPLANATION OF PLATE V.

- FIG. 1. *Charaxes marcia*, ♂.
2. *Morphopsis biakensis*, ♂.
3. *Megisba orientalis*, ♂.
4. *Deudorix maudei*, ♂.
5. " " ♀.

EXPLANATION OF PLATE VI.

- FIG. 1. *Papilio comma*, ♂.
2. *Lampides coeligena*, ♂.
3. " " ♀.
4. *Mimeusemia nigrescens*, ♀.
5. *Milionia caerulea*, ♂.



NEW LEPIDOPTERA FROM THE SCHOUTEN ISLANDS.

—Huber, Stålsh. & Ancl. Ind.

—Huber, Stålsh. & Ancl. Ind.

Allied to *ramosa*, Drnt., but differing in the hind-wings, which are orange-yellow with an irregular black basal patch, and the apex and termen narrowly black, while *ramosa* has blackish fuscous hind-wings with a pale orange-ochreous marginal band; the shape of the black streak between veins 4-5 of the fore-wings is also a good distinguishing character.

EXPLANATION OF PLATES III-VI.

(See *Explanation* facing the PLATES.)

- III. *On the Biology of Sphodromantis guttata* (Mantidae).
 By C. B. WILLIAMS, B.A., F.E.S., The John Innes
 Horticultural Institute, Merton, Surrey, and P. A.
 BUXTON, B.A., F.E.S., Trinity College, Cambridge.

[Read November 17th, 1915.]

PLATES VII-X.

THE following paper includes some observations on the hatching, breeding and oviposition of *Sphodromantis guttata*, Thunb. (= *Hierodula bioculata*, Sauss.), and some criticisms of several of the hitherto published works on this subject. It is recognised that there are still many doubtful points on which further work is required, but, as there seems to be no probability of our being able to continue on this subject in the near future, we thought it best to put forward the present notes without any further delay.

The oothecae were collected by P. A. Buxton at El Kantara, S. Algeria, in April 1913. They were found on stones, sticks, bushes, etc., and were quite common in the little dry watercourses ("oueds") in the stony desert. Some of the larvae emerged before they were brought back to England, as early as April 19. Although no adult Mantids were seen they were probably there, as they are found at this time of the year in Egypt (Adair, 1914, i, p. 126).

A short account of the structure of the ootheca will be found below in connection with its construction. For the present it will be sufficient to recall the fact that the eggs lie in groups in the middle of a case, and that each group of eggs has a passage to the exterior along which the just-hatched larvae pass.

Emergence generally took place in the morning, a large number of young appearing almost simultaneously, followed by stragglers for a few hours, and further batches from the same ootheca on the following days. Several authors have commented on this simultaneous hatching of a number of eggs, and the remarkable spectacle of the dozens of young emerging from the ootheca. It is prob-

ably brought about by the vibration made by one larva as it emerges, exciting the larvae in the neighbouring eggs. We have noticed in other insects * that eggs may be ready to hatch and yet wait for some external stimulus. That all the eggs do not mature at the same moment is shown by emergence occurring on several successive days from the same ootheca.

The Mantis larvae invariably made their appearance head first; emergence was rapid, but there was a slight pause after the head and thorax had protruded from beneath the flap on the dorsal surface of the egg mass. Then the head was jerked backwards and the larva freed itself suddenly. It was unable to use its legs, and hung down over the edge of the ootheca on a double thread, which in some specimens was as much as two inches long. Brongniart (1882, p. 450) states that they hang in this position for some days; while Giardina (1899, p. 324) considers that those which remain hanging for long invariably die, and that normally they leave the ootheca by "breaking the filaments" at the entrance of the passage. All those under our observation hung down for a few minutes on the end of the thread and then moulted, as will be described later. In no case were the threads broken, but remained attached to the empty skin.

A larva removed from the egg just before hatching is shown in Plate VII. It is about 4.5 mm. long, and the prothorax is shorter than the head (prothorax .68 mm.; head .84 mm., measured dorsally). The head is not bent down on to the surface of the meso- and meta-sternum as described and figured in a Chinese species by Waterhouse (1912, p. cxxvi), but the two lateral projections of the head which bear the eyes are pressed diagonally (not folded) back against the sides of the prothorax. The larva emerges from the ootheca in this condition, except that in the passage along the exit tunnel the legs and antennae become unfolded and stretch out behind. On emergence it is yellow with paler limbs and dark greenish blue eyes; there are red spots at each femoro-tibial joint, and also mid-dorsally on each thoracic tergite.

On the anterior portion of the head the chitin is thickened,

* On one occasion when examining some eggs of a *Raphidia*, no sooner had they been disturbed from their original habitat and placed on a slide for examination than they all hatched. (Williams, C. B., "Entomologist," 1913, p. 7.)

forming a protective shield, or plate, which ends dorsally and ventrally in a pointed prolongation (Pl. VII, fig. 1*a*). The sides of this are reticulated for a short distance, and it is this reticulation that was apparently mistaken by Pagenstecher (1864) for the covering of the eyes ("augenflecken"). This plate may possibly be used in breaking open the egg.

On the ventral surface at the posterior end are two pairs of small papillae, one pair on the hind margin of the ninth sternite and the other beneath the sides of the posterior margin of the tenth tergite. The posterior pair (*c*) secrete the two threads by which the larva hangs from the ootheca. These threads frequently unite a short distance behind the larva, forming a flat band. Brongniart (1882, p. 451) states that one thread is attached to each end of the eggshell. This, however, is not so, as in sections of ootheca which expose empty eggshells, both threads can be seen entering the shell, and are attached to its interior surface near to the posterior end.

It is remarkable that we were able to draw out a considerable length of thread (2-3 mm.) from the papillae of a cast skin. Whether the whole thread-forming apparatus is cast with the skin we have not been able to decide, but it should be noted in this connection that at no other stage in the life of the Mantis is any thread or silk produced. According to Giardina, Pawlowa (1896) studied the development of the thread and found that it was formed from a mass of cells arranged in a single spiral series which take the form of a cellular filament. This undergoes morphological and chemical change until it loses all cellular structure and is reduced to a fine but resisting thread. We have been unable to consult Pawlowa's or Giardina's work.

Pagenstecher (1864, p. 13) and de Saussure (1872, p. 223) describe the presence of a number of backwardly directed spines on the abdomen of the just-hatched larva, by means of which they are enabled to work their way up the passage from the egg to the exterior, according to the latter "de la même manière qu'un épi de seigle, à l'aide de barbes à ergots, peut cheminer sur un morceau de drap soumis à des vibrations." Brongniart (1882, p. 450) denies this, and states that the spines on the body are confined to the cerci, and also remarks that the spines on the legs assist in the exit. Recent authors have unfortunately tended

to follow Brongniart, and his statement appears in most text-books. We find, however, that the two former writers were correct, and that the tergites of the meso- and meta-thorax and of the abdomen are covered, except for a narrow dorsal line; with a number of very minute backwardly directed flattened spines. These are broader and with an enlarged base towards the anterior margin of each tergite, particularly those of the thorax, and become narrower and longer towards the posterior margin (text fig. 1, A and B and Pl. VIII). They are also present on the labrum. The spines are only 8–12 μ long, and are best

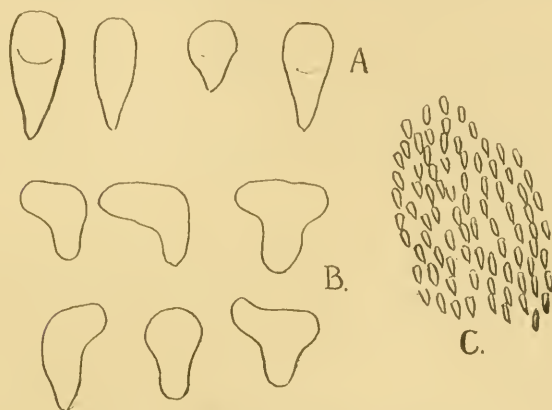


FIG. 1.—Spines on tergites of first larva.

- A. Near posterior margin of abdominal tergites.
- B. Near anterior margin of thoracic tergites.
- C. Portion of abdominal tergite less magnified.

seen in stained preparations of the cast skin under a high magnification. There are also four rows of much larger spines on the silk-producing papillae.

These spines have been found in a number of other species, including *Mantis religiosa*, *Stagmomantis carolina*, *Stagmomantis limbata*, and in several species of which we have been able to get a few dried cast skins still attached to old unidentified oothecae. There is no doubt that they will be found in all Mantidae.

We find also that all the distinctly visible spines on the legs (Pl. VII, fig. 1*d*) are *beneath* the first skin and are seen through it; they can therefore be of no service in

emergence. It is probable that the young larva moves along the passage by a series of telescopic expansions and contractions of the abdomen, rather than by a simple wriggling movement as de Saussure seems to imply in the remarks quoted above.

It is important to notice that the legs and antennae of the first-stage larva are free from the body, and that the skin, which is soon to be cast, envelops each limb separately. Several observers have made the mistaken observation that the skin enclosed the animal as a whole, pressing the legs and antennae against the body. They have assumed this from an examination of cast skins, in which the envelope of each leg becomes completely telescoped upon the base on the withdrawal of the leg, and is not obvious in a cursory examination. On Plate VIII are shown two microphotographs of a cast skin. In one the skins of the legs and antennae remain telescoped as left by the larva, and are very inconspicuous; in the second the leg skins have been drawn out before the specimen was mounted.

There has been much controversy as to the morphological status of this first skin, which is cast almost immediately after emergence. Most authorities have persisted in regarding it as an amnion, being misled by the idea which we have just corrected, that it encloses the whole insect like an eggshell, and also by Brongniart's statement that no spines are present on its surface. Pagenstecher's figure (1864, Pl. I) which showed these, and which is the best figure of the cast skin yet published, has even been designated as "fanciful" by Packard (1898, p. 584). However, in view of the observations stated above—namely, that it has a number of spines on the abdominal and thoracic tergites; that it envelops individually the limbs and the antennae; and that the threads from the end of the abdomen pass through it, and, further, from the fact that it is resistant to boiling in potassium hydroxide, and that its staining properties are similar to those of chitin—we have no doubt that it is a true skin and not an amnion.

Six and a half minutes after the first appearance of the larva the skin split mid-dorsally, and three minutes later the larva was completely free and fell soft and helpless to the ground. The limbs left the skin after most of the trunk was free; first the anterior pair, and then the two posterior pairs and the antennae almost simultaneously.

Finally the tail was freed. This is only accomplished with difficulty if the insect is hanging free of all foothold. If, however, it is lying on or against something solid, the following method is employed. The insect, lying on its ventral surface, strains away from the old skin, which is bound to the ootheca by the thread, applying leverage to the surface on which it rests by means of the joint at the trochanter. It moves the tail round in circles in such a way as to keep the threads stretched. After some effort the abdomen is finally freed from the old skin, which remains hanging on to the ootheca attached by the two threads. This is usually completed about nine or ten minutes from the first appearance of the larva.

The larva has now changed considerably in shape; the abdomen is longer, and for a few minutes lies straight out behind it on the ground; the sides of the head have spread out owing to their being no longer confined by the first skin, and the head assumes the typical hammer shape; the prothorax has elongated, and is now much longer than the head (head 1 mm., prothorax 1.8 mm.). The larva now lies motionless on the ground for some minutes. During this time the abdomen is shortened telescopically, and is cocked up over the back to the position which is normally retained till the end of larval life. Finally, after about ten minutes' rest, the skin has hardened and the larva can run about actively. The colour is matured in about two hours, during which a general darkening is observed, especially of the legs and the dorsal surface of the body. The colour at this stage, however, is no indication of that of the adult, as changes occur in larval and, according to Prziбраm (1906, pp. 203 and 206), even during adult life.

The larvae, now in their second instar, are very active. They can jump as much as two and a half inches, the second and third pair of legs alone being used in this, as also in slow walking; in running, however, all three pairs are used. They frequently sway from side to side for some minutes while standing still, recalling a similar habit in the related *Phasmodidae*.

Some of the larvae were fed on aphids, as it was the most easily obtainable food at the end of April. When they had captured one they rotated it with the end of the disengaged tibia until they were able to bite it at the back of the thorax. This treatment paralysed the prey rapidly, and

it was then consumed. Other specimens would not eat aphids, but having captured them threw them aside. From these and from contradictory records of other authors it seems probable that either different aphids are attractive in different degrees, or that this Mantid will only take them when it is without other more palatable food.

The following method of feeding the young Mantids was devised, and could be applied to the feeding of any small predaceous or insectivorous animals. Insects of every description were collected in a very fine mesh net by sweeping hedges, grass, growth along a ditch side, etc. The net was then turned inside out into a beaker. If this was done indoors, with the bottom of the beaker towards the light, very few flies escaped. Finally, the beaker was covered with a piece of coarse net and placed in the cage containing the larvae. All the smaller insects in it rapidly escaped through the net into the cage, while the larger ones, spiders, etc., were kept inside the beaker. In this way *Aleyrodos*, *Coniopterygidae*, Cercopids, Jassids and many small Diptera were supplied in numbers and eaten. The mesh of the net covering the beaker was increased as the Mantids grew, until finally they were able to take any insects obtainable.

Several times when the sun was shining on the cage the young larvae were observed on the back of the cage following and repeatedly attempting to capture the shadow of a fly moving on the glass front. This indicates that their sense of smell is not highly developed.

The insects lived throughout the summer, some in a hothouse (average temperature about 75°), some in a living-room; while others even survived a trip for a few days to an altitude of 3000 ft. in Norway. They are apparently extremely hardy.

As the larvae become older their habits change; the half-grown larva never jumps, and rarely stalks its prey, preferring to capture such insects as happen to approach it. More carelessness in feeding is also observed; legs and wings of the prey are frequently dropped, and sometimes the unconsumed portion of a fly is allowed to make its escape; the larvae also are no longer so particular in attacking their prey behind the head, but commence their meal at any convenient part, abdomen, head or even wings. When they were older their chief food was house flies (*Musca*) and bluebottles (*Calliphora*), but they would

also eat wasps, Syrphids, small Heteroptera and grasshoppers. They appeared somewhat afraid of butterflies, but when hungry attacked them. They would not eat caterpillars, and showed a strong dislike to Tipulids and Coccinellids. It is possible, however, that these are unmanageable rather than distasteful. A half-grown nymph consumed a whole bluebottle in $11\frac{1}{2}$ minutes. Occasionally one would capture one fly while still eating another, in which case the second fly was retained under the free arm till the first was finished. One larva was observed to take up a fly which had been dead some days and had dried up; nevertheless, with great difficulty it was devoured completely. On another occasion one was seen biting pieces off some dry hawthorn leaves. All the stages readily drank drops of water, and doubtless in the wild state are in the habit of sucking up the dew.

Cannibalism rapidly reduced the number of larvae, and soon only a very few were left. Sometimes a fight would be started by accident. Thus, in one case, a larva in striking at a fly caught the tail of a smaller larva and bit off one of the cerci. The latter retaliated by removing both antennae from the larger individual. Although they were separated, the smaller one was found partially devoured on the following day.

On September 2 a full-fed nymph cast its last skin and became an adult female. This fed on miscellaneous insects until October 24, when it made its first ootheca.

Oothecae, which differ greatly in different species, have been frequently described—*Mantis religiosa* by Pagenstecher (1864) and Giardina (1898 and 1899); *Hierodula saussurii* by Kershaw (1907); *Stagmomantis carolina* by Rau (1913); *Miomantis savignyi* by Adair (1914, i and ii); *Fischeria baetica* by Adair (1914, ii); *Sphodromantis guttata* (*bioculata*) by Adair (1914, ii); *Gongylus gongyloides* by C. E. Williams (1904); and unidentified species by Shelford (1909) and by Waterhouse (1912). The most complete account is that of Giardina (1899), with whose conclusions, however, we cannot entirely agree.

It will be convenient here to give a short account of the ootheca of *Sphodromantis guttata*, in order that the operations of the female described below may be better understood. Transverse, longitudinal vertical and longitudinal horizontal sections are shown in text fig. 2, I, II and III, and the letters below refer to these. The ootheca consists of a

central core containing the eggs C, surrounded by a protective layer D, and separated from it, laterally and ventrally, by a stout irregular wall F. The central part is divided by transverse vertical lamellae G into a number of flat chambers, each containing a group of eggs. Each chamber is roughly semicircular, being closed at the middle line (I), and the chambers on each side alternate (III). Each compartment communicates with the exterior by a passage (A and B) leading from the eggs to the dorsum of the ootheca, where it opens between the successive members of a series of flaps H. Within each opening there is a protective flap E, arranged as a valve, so that it can be pushed aside from within but prevents entry from without. The vertical divisions between the egg-chambers continue, less stout in structure, across the outer protective layer D, and are indicated on the exterior by a series of vertical furrows on the sides of the ootheca M. A few chambers at each end of the ootheca are without eggs, and act only as protection. Giardina (1899, p. 296) considers the transverse walls between the egg-chambers to consist of three layers closely pressed together, but we could see no evidence of this; they tend to split in places, but quite irregularly.

The whole ootheca is formed of a gumlike substance secreted from large abdominal glands, which open into the oviduct. This gum, which hardens on exposure to air after being secreted, is partly vacuolated into a kind of froth by the gonopophyses as it passes from the body. That portion which goes to form the outer protective layer is still more vacuolated afterwards.

The construction of the first ootheca laid by the female started about one o'clock in the afternoon, and by two o'clock, when it was first observed, about one-quarter had been completed. The insect was head downwards on the perforated zinc side of the cage, and was so engrossed in the process that, even when the cage was broken to pieces in order to get a better view, it was not in any way disturbed. The elytra were slightly raised and quite clear of the ootheca, and only the very tip of the abdomen was immersed in the froth, at certain times as far as the base of the cerci, which, however, were always quite free and were employed in feeling the surface under construction.

The use of the elytra in the formation of the ootheca has been affirmed and contradicted many times. There is no doubt whatever that the ootheca can be constructed

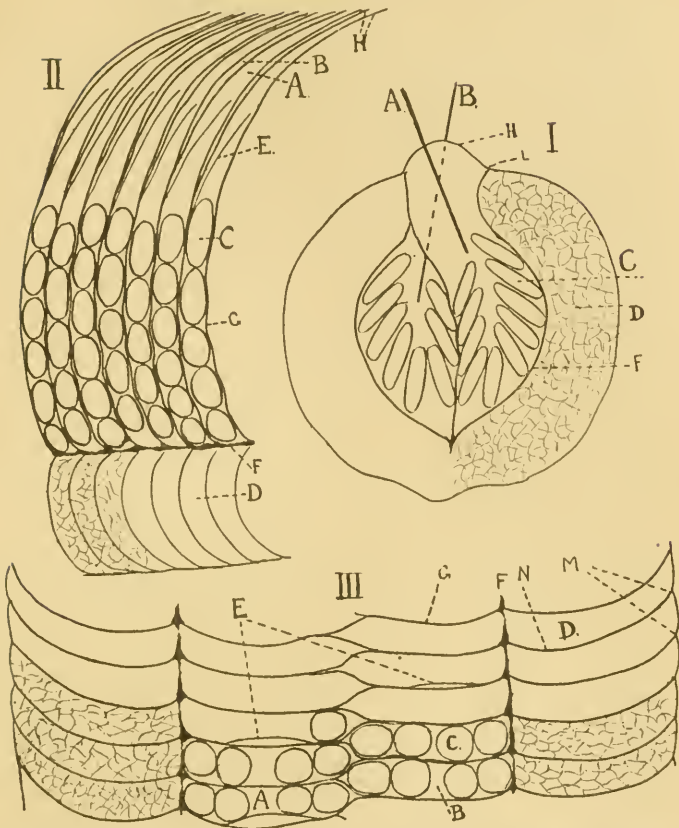


FIG. 2.—Portions of sections of ootheca of *Sphodromantis guttata*.

- I. Transverse.
- II. Longitudinal vertical.
- III. Longitudinal horizontal.
- A and B. Passages entering successive egg chambers.
- C. Egg.
- D. Chamber of outer protective layer.
- E. Protecting flap in passage.
- F. Outer wall of central portion containing eggs.
- G. Transverse partition between successive chambers.
- H. Dorsal flaps between which egg chambers communicate with the exterior.
- L. groove at each side of dorsal flaps.
- M. Vertical furrows on outer surface indicating position of transverse partitions.
- N. Portion of transverse partition traversing protective layer (D).

without their aid. The photographs (Pl. IX and X) show the position in which the Mantis remained during the whole process, and Adair (1914, I, p. 120) cut off the wings of one specimen which was laying its eggs, in order to get a better view, without disturbing the Mantis or the construction of the ootheca. In view, however, of the definite statements of Brongniart (l.c., p. 449), Perrier (1870) and Giardina (1899, p. 311), it seems possible that occasionally the elytra may assist. In any case, the view of Perrier and Giardina that the longitudinal furrows on each side of the dorsal flaps are due to the pressure of the elytra is unsound, and still more so the ingenious theory of the latter author, that the exit passage and protective flap are formed by the insertion of the elytra and hind-wing, for our ootheca, constructed entirely without their aid, has all these features in a normal condition. It occurs to us that when the insect is upside down the wings might be used to prevent the freshly secreted material from flowing away, but even at this stage it is not very liquid.

In the construction of the ootheca the tip of the abdomen goes through a regular cycle of movements, each repetition resulting in the laying of one group of eggs and the formation of the corresponding portion of the ootheca.* This cycle is shown diagrammatically at text fig. 3, which represents the face of the ootheca under construction (seen from the direction of the insect). This face is not flat but concave, being most sharply curved in a vertical plane, as may be seen in the partially constructed ootheca in Pl. X, 1, and also in sections of the completed ootheca, text fig. 2, II, by the curve of the divisional wall. The movements are as follows: When the insect has finished laying a group of eggs at A, on the left-hand side, the tip of the abdomen is moved with a slight curve to the top of the right-hand side of the ootheca, and then slowly down to the bottom along the periphery. During this movement the gonopophyses may be seen moving rapidly backwards and forwards just beneath the slightly hardened outer skin. By this process the gum in the outer layer is more vacuolated, the divisional transverse wall N in this area formed,

* Giardina (1899, p. 147) states that all the eggs and thecal material on one side of the ootheca are secreted by the corresponding ovary and colleterial gland. He gives no evidence for this, and we saw nothing in the construction that would necessitate this assumption.

and by stretching the outer surface with the tips of the gonopophyses the vertical ridge, or swelling, is formed, which is seen on the exterior alternating between the lines of the vertical divisions. During the downward movement a fresh supply of secretion is left behind on the right half of the face of the ootheca. The movement continues to the base, where an addition is made to the length attached to the support. Then the abdomen is inserted more deeply, up to the base of the cerci, into the centre of the right side of the ootheca at B, and remains comparatively quiet for about two minutes. During this time the group

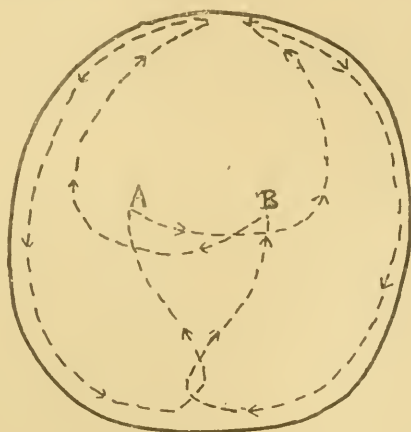


FIG. 3.—Diagram of movements of abdomen of female.
For explanation see text.

of eggs on this position is laid, and the walls of the compartment are formed by compressing the only partially vacuolated material displaced by the eggs. The abdomen then becomes more active and is once more moved in a curve, as shown, to the upper point of the left-hand side, where the slow downward movement once more begins.

The process of laying one group of eggs and the corresponding part of the ootheca occupies about four and a half minutes, and, as each side is formed alternately, there is an interval of about nine minutes between successive repetitions of the same operation on the same side. (Actual times measured were 9, 9, 9, 8, 7 minutes; the times would be less at the commencement and finish, as the ootheca

tapers off at each end and fewer eggs are laid in the earliest and latest compartments.) Thus the constructed portions on one side have had this time to harden before the next compartment on the same side is formed, and the pressure of some of the freshly secreted material against that which has already partially hardened results in the formation of the cross divisions.

The formation of the dorsal flaps and the protecting valve is still somewhat obscure. It must take place just before the descending movement, as only at that time is the tip of the abdomen at the dorsal part of the egg mass. Further observation on this point is needed. When the ootheca is first constructed there is not direct communication with the exterior, but the passages between the flaps are filled with a very delicate dried froth. The young Mantis on hatching pushes through this and breaks it up. In those compartments in which all the eggs have been parasitised this dried froth persists.

The construction was finished at 4.45 p.m., having occupied about three hours and forty-five minutes. The colour of the material when first exuded was very pale, but it rapidly darkened on exposure, so that before the completion of the ootheca the first-made portions were much darker than the more recent part.

On November 27 another ootheca was constructed by the same female, this one being much smaller than the first; probably, however, this was only due to insufficient feeding, as Adair (1914, p. 126) finds as many as six successive ootheca laid by one individual of this same species, and a dissection of the above female, which died on December 9, showed many eggs still in the ovaries.

The female had not paired, so that the eggs were infertile. Examination has shown that they have all dried up, so that parthenogenesis, so common in the allied *Phasmidae*, apparently does not occur in this Mantis.

Some notes on the Chalcid *Podagrion pachymerum*, which infested some of the oothecae brought back from Algeria, have already been published (Williams, C. B., 1914).

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EXPLANATION OF PLATES VII-X.

PLATE VII. Larva of *Sphodromantis guttata* extracted from the egg.

FIG. 1. Ventral view. *a.* head shield; *b.* papillae on 9th sternite; *c.* thread producing papillae on 10th abdominal segment; *d.* spines on leg beneath the first skin; *md.*, mandible; *lab.*, labrum; *mx.*, maxillae; *mx. p.*, maxillary palps.

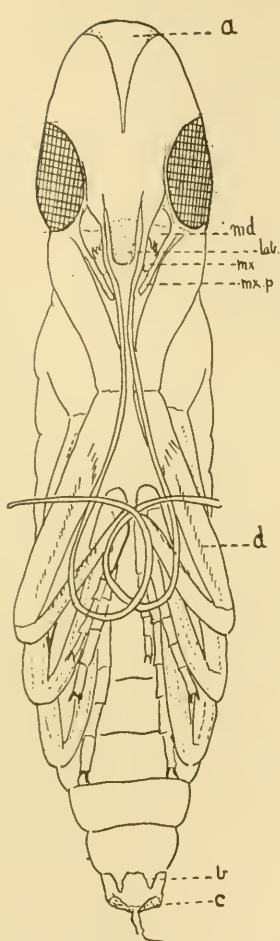
FIG. 2. Lateral view.

PLATE VIII. Microphotographs of first cast skin of larva; magnified 24 diameters.

The spiny areas and terminal papillae are shown. In fig. 1 the skin is shown as cast; in fig. 2 with the coverings of the legs pulled out.

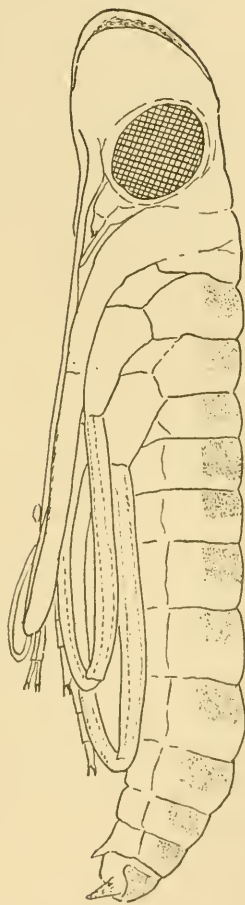
PLATE IX. Lateral view of female *Sphodromantis guttata* constructing ootheca. Ootheca nearly complete. Natural size.

PLATE X. Lateral and dorsal view of female constructing ootheca. Ootheca about half completed. Slightly reduced.



C. B. Williams, del.

FIG. 1.



Andre, Steigh & Anglo, Ltd.

FIG. 2.

YOUNG LARVA OF SPHODROMANTIS GUTTATA.



Photo, C. B. Williams.

FIG. 1.



Andre, Sleigh & Anglo, Ltd.

FIG. 2.

CAST SKIN OF YOUNG SPHODROMANTIS LARVA.



Photo, C. B. Williams.

Andre, Steigh & Anglo, Ltd.

SPHODROMANTIS GUTTATA OVIPOSITING.



FIG. 1.



Photo, C. B. Williams.

Andre, Sleigh & Anglo, Ltd.

FIG. 2.

SPHODROMANTIS GUTTATA OVIPOSITING.



IV. *On Specific and Mimetic Relationships in the genus Heliconius, L.* By H. ELTRINGHAM, M.A., D.Sc., F.Z.S.

[Read March 1st, 1916.]

PLATES XI-XVII.

SOME time has elapsed since Professor Poulton first suggested to me that an investigation into the specific relationships of the forms of the genus *Heliconius* would probably be productive of interesting results, and I must admit to having had some hesitation in embarking on such a work in view of the fact that a very lengthy and elaborate monograph of the genus already existed. This memoir, however, is based entirely on external characters, and it appeared that anatomical study might elucidate new facts with regard to the relationships of the forms, more especially as the mimetic phenomena are of an unusually complicated kind.

Perhaps the most valuable feature of the monograph above referred to (Stichel and Riffarth, in "das Tierreich," 1905) is the recognition by Riffarth that the whole genus can be divided into two sections by means of a peculiar character of the fore-wing underside in the male. It was my friend, Mr. W. J. Kaye, who pointed out* that, having divided the forms by means of the character mentioned, a most remarkable fact was disclosed.

A great number belonging to Section I resemble very closely forms belonging to Section II. In other words, intrageneric mimetic resemblance is of frequent occurrence. I here use the words "mimetic" resemblance in a wide sense as indicating merely a similarity of pattern; the precise nature of the resemblance may be considered later.

The present paper is an attempt to investigate more precisely the specific relationships of the forms of *Heliconius* by means of anatomical study combined with an examination of pattern gradations.

We are rarely able in such investigations to arrive at entirely satisfactory conclusions owing to lack of adequate

* Proc. Ent. Soc. Lond., p. xiv, 1907.

material and data, and I fear the present effort is no exception. The results may, however, serve to indicate the directions in which future workers, and especially those with facilities for making breeding experiments, may hope to obtain more definite results. For the opportunity of examining and dissecting many rare forms I am indebted to the generosity of Lord Rothschild, Mr. W. J. Kaye, and the Authorities of the British Museum, whilst my friend Professor Poulton has assisted me with his continual encouragement and valuable suggestions. Mr. Kaye has also given me much practical help in sorting specimens and in correspondence, and my friend Dr. F. A. Dixey has rendered valuable assistance in connection with Pierine mimics. Dr. Karl Jordan has kindly looked over most of my microscope preparations and given me the benefit of his views thereon.

Opinions may differ as to the significance of conclusions based on the structure of the male armature. However that may be, probably most naturalists will agree that close resemblance in these structures may usually be regarded as evidence of near relationship, whilst distinct and constant differences will probably generally be accepted as evidence of specific separability.

In the genus *Acræa* it was found that in nearly all cases the species were well defined, and anatomical differences easily recognised. Such is only partially the case in *Heliconius*, as will be seen later, nor are the structures particularly constant within the limits of the same species. It should be understood at the outset that I do not put forward the present paper as a statement of conclusive and final results, hence it is not to be taken as a complete revision of the genus. I do not consider that our knowledge of the forms is yet adequate to such a task. My desire has rather been to indicate the directions in which future effort should be made, and the lines on which, especially, those in the field might profitably direct their observations.

The genus is distinguished from *Eueides* by its much longer antennae. It can be divided, as Riffarth has shown, into two great sections. On the underside of the male fore-wing, from the inner margin to the first branch of the median, is an area which presents a peculiar silky grey appearance. In Section I of the genus this silky surface is continued right up to the median without any visible

change in texture. In Section II there is, adjacent to the median and its branch, a certain amount of dull "mealiness." This amount may be very small, but it is always recognisable, especially after a very little practice. The two sections were designated by the extremely clumsy names of *Opisogynni* and *Opisorhyperi* respectively. For convenience they may be referred to as Section I and Section II. Between these two sections the reputed species are nearly equally divided. In the monograph referred to Section I contains 31 species and 110 subspecies, whilst Section II includes 39 species and 79 subspecies. This division is apparently a natural one, and so far as my preparations go the genital armature of no species of Section I could be mistaken for that of a species of Section II.

Section I may now be further divided, and we will first consider the forms included by Riffarth under the name *Silvaniformes*. These include nearly all those species the patterns of which are composed of yellow, brown, white, and black markings. Generally speaking, it may be said that the ground-colour of one or both wings is brown or yellow, though there are one or two exceptions.

The evidence of the genitalia.

Whilst the genitalia of nearly all the members of this group are readily distinguishable from those of the rest of the genus, they are by no means so readily separable *inter se*. Moreover, at least one form hitherto regarded as rather widely separated from the *Silvaniformes* must now be included in that group. I refer to *H. atthis*. In the accompanying plates the genitalia have been illustrated by giving a carefully drawn outline of one clasper, as it is from the shape of this part that any conclusions can best be drawn.* After examination of a large number of preparations, it appears that they may be divided more or less into those which have a dense hairy tuft near the end of the clasper and those which are only moderately pilose. Whether this feature is of real value or not is difficult to decide; if, however, we accept the feature it would seem

* I much regret the poor quality of these plates. The present necessity for economy has, however, made it impossible to use the beautiful lithographic process by which the figures were reproduced in my paper on *Acraea*.

possible to separate the following reputed species and their forms from the remainder of the Silvaniformes.

- H. ismenius*.
 ,, "*silvana*" *metaphorus*.
 ,, *narcaea*.
 ,, *numatus*.
 ,, *ethilla*.
 ,, *gradatus*.

The first two above are separable from the rest on general differences in the armature, and we may now consider the remainder.

H. narcaea, Godt.

The typical form of this well-known species occurs in S. Brazil. In Seitz' ab. *connexa* the subapical band is completely separated and surrounded by black. The form *satis*, Weym., has a brown instead of a yellow band in the hind-wing. The form *flavomaculatus*, Weym., has a yellow instead of a white apical spot in the fore-wing, whilst *physcoa*, Seitz, has the fore-wing yellow band much broader than usual. The form *polychrous*, with largely increased black areas, is regarded by Stichel and Riffarth as a subspecies, though apparently occurring in the same localities as *satis*. It cannot be doubted that these are all forms of the same species, as they are for the most part mere colour variations. The outline of the claspers in three of the forms is shown on Pl. XIII. In general structure there is considerable agreement, though there is a marked difference between the actual outlines of the typical form and *narcaea polychrous*.

H. numatus, Cram.

Of this species some ten forms have been named, and they extend from Guiana across North Brazil to the Western Amazon region and Peru. The claspers of three forms are illustrated on Pl. XIII. The form *guiensis* is merely a variety of the type, but there is a greater difference between its clasper and that of *numatus numatus* than between the latter and *narcaea narcaea*. Indeed, the two last are not appreciably distinguishable. It may be said that they do not occur in the same locality and that thus there is no necessity for the respective armatures to be different.

There may be something to be said for this view, though it will not explain further cases yet to be described.

H. silvana, Cram.

Of this form three subspecies are named, and though the genitalia of the group are of little assistance in many of the cases of closer resemblance they seem to show that at least three of the forms hitherto regarded as subspecies of *silvana* do not belong to *silvana* at all, but to two other species. On Pl. XIII I have shown the claspers of two specimens of *silvana silvana* taken at random. One is hardly distinguishable from *numatus guianensis*, whilst the other is but little modified from *narcaea narcaea*. A part of the difference is due to the bending over of the apex of the clasper, but this is not a point of great importance and probably would not occur in a perfectly fresh specimen. Now, *silvana* occurs in Guiana, Venezuela, N. Brazil and Peru. The anatomy of the armature gives no reason to suppose that it is anything but a form of *numatus*, just as the latter on the same grounds appears to be as closely related to *narcaea*.

H. ethilla, Godt.

Some twelve forms of this species have been named, ranging through Trinidad, Guiana, Brazil, Venezuela, Colombia, and Panama. Seven illustrations of the claspers are given on Pl. XIII. The two specimens of *ethilla ethilla* are by no means identical, whilst the two of *ethilla tyndarus* are markedly different. One example of *ethilla ethilla* resembles *narcaea satis* and is not unlike *numatus numatus*. The outline of *ethilla aërotome* is very different from one example of *ethilla ethilla*, but not sufficiently distinct from one of *ethilla tyndarus*. My friend Mr. W. J. Kaye, regards *ethilla* as conspecific with *numatus*, a view I am strongly inclined to support, further adding that so far as the armatures are concerned there is no more reason for separating either from *narcaea* and *silvana*.

H. gradatus, Weym.

Of this rather rare species I have been able to make only one preparation from its subspecies, *thielei*, Riff. As will be seen from the illustration on Pl. XIII, the clasper

is much less different from that of *ethilla metalilis* than the latter is from some other forms of *ethilla*.

We thus see that on the structure of the genitalia we cannot satisfactorily distinguish between *narcaea*, *numatus*, *ethilla*, and *gradatus* and most of their forms.

We now turn to a large group containing ten reputed species and their forms. They all have at least this feature in common, that there occurs near the end of the clasper a tuft of bristles sufficiently evident to distinguish them from those of the *narcaea* group.

H. novatus, Bates.

The claspers of the three principal forms are shown on Pls. XIII, XIV, and present a closer agreement than any we have so far examined. The forms are found in Peru and Bolivia. Mr. Kaye informs me that *schultzei*, Riff., is merely the female of *novatus*.

H. hecale, Fab.

This large black form with a conspicuous white patch on the fore-wing occurs in Dutch and British Guiana. The clasper is shown on Pl. XIV, and differs in scarcely any respect but that of size from those of the last and next species. There is a form named *fulvescens*, Lathy, from Demerara, in which there is a brown basal suffusion in the fore-wing.

H. aristiona, Hew.

Of this species some twelve subspecies and several forms have been named, ranging through the Amazon region, Peru, Ecuador and Bolivia. I have shown the claspers of seven forms on Pl. XIV, and here again there is considerable general agreement accompanied by a certain variation in actual outline.

H. ithaka, Feld.

The typical form and two subspecies are all found in Colombia. It would be difficult to distinguish between the clasper shown on Pl. XIV and that of some of the forms of *aristiona*.

H. pardalinus, Bates.

The type form and four subspecies range through N. Brazil, Peru, Bolivia and probably Ecuador. The clasper

of *pardalinus lucescens* shown on Pl. XIV is shorter and broader than those already considered, yet, except in size, there is no very satisfactory difference between it and that of *anderida zuleika* on Pl. XV, and some forms of *anderida* are barely separable from *aristiona*.

H. fortunatus, Weym.

This and two subspecies occur in N. Brazil. I have illustrated a clasper of *fortunatus spurius* on Pl. XIV. It is much more rounded than those so far considered. If every specimen dissected out were identical with this, then we might, perhaps, say that it differed constantly from the other species, but a very small amount of variation would make it as difficult to distinguish as the rest.

H. quitaleus, Hew.

The type form and three subspecies range through Peru, Ecuador, Bolivia and N. Brazil. Reference to the drawings on Pl. XIV shows a marked difference between *quitaleus quitaleus* and *quitaleus felix*. The first might well be a variation of one of the forms of *novatus*. If the second differs from these it does so no more than from its own type.

H. anderida, Hew.

The type and six subspecies range through Venezuela, Colombia, Central America, and one form is said to have been taken in Dutch Guiana. The claspers of six forms are illustrated on Pls. XIV, XV, from which it may be seen that there is considerable variation. There is less difference between *anderida holocophora* and *aristiona floridus* than between the former and *anderida anderida*. Kaye is of opinion that *anderida fornarina* is either a good species or a form of *hecale*. The clasper is, however, very near to that of *anderida melicerta*, and though *hecale* has a somewhat different appearance it still seems connected with the other forms of this group.

H. paraënsis, Riff.

The two forms of this species are described from Para and Itaituba respectively. A clasper of the form *latus*, Riff., is illustrated on Pl. XIV, and is seen to be not satisfactorily distinguishable from several of the other forms described.

H. aulicus, Weym.

I have only had one example of this species to examine. Its clasper is shown on Pl. XV. It has the dense hairy tuft of the *novatus* group, and differs little from that of *aristiona tarapotensis*. The pattern of the wings is also so similar that it seems certain that they are the same species.

All the above seem to constitute a group of forms which cannot be constantly distinguished by the genitalia. Before passing to those species which have claspers of the *ismenius* type there are a few forms which must be separately considered.

H. "silvana" robigus, Weym. ; **H. "silvana" ethra**, Hübn.

The form *robigus* occurs in Brazil (Espírito Santo, Rio de Janeiro, Minas Geraes, etc.). The clasper is shown on Pl. XV. It cannot be placed in the *narcaeae* group owing to its form. It is less densely tufted than those of the *novatus* group. Two preparations show much the same structure. It is certainly incorrectly placed in being associated with *silvana*. Apart from the difference in the tuft, the form of the clasper suggests an affinity with *aristiona*, and further reasons for placing it in that association will be given later.

The clasper of "*silvana*" *ethra* shown on Pl. XV is barely distinguishable from that of "*silvana*" *robigus*. It is rather more densely tufted, but must, I think, be regarded as conspecific with *robigus* and probably with *aristiona* and *novatus*.

H. vetustus, Butl.

The typical form occurs in British Guiana and the form *metellus*, Weym., in N. Brazil. The clasper (Pl. XV) is of a curiously irregular shape. Except for the dense tuft of bristles it might well be a form of *numatus*.

H. sergestus, Weym.

This species occurs at Tarapoto in Peru. I have had but one example to examine, and the clasper is shown on Pl. XV. If its well-rounded and tufted form is constant it may well be regarded as definitely distinct.

H. atthis, Doubl.

This species, which has become so profoundly modified in mimicry of *Tithorea pavonii*, occurs in Ecuador. Though

hitherto regarded as related to the Cydnoformes, the structure of the clasper on Pl. XV shows it to belong rather to the Silvaniformes. If it had a denser tuft of bristles it would be difficult to distinguish it from *aristiona lenaeus*.

H. ismenius, Latr.

The typical and four subspecies occur in Colombia and Central America. Though the forms are placed near *narcaea* in existing works, I have placed them nearer to the latter part of Section I, since, if the form of the claspers is to be regarded as any indication of relationship, then they are undoubtedly closely allied to the *melpomene* association. The claspers of three forms are shown on Pl. XV, from which it will be noted that there is some variation between them. The clasper of "*silvana*" *metaphorus* is also shown, and is seen to resemble that of *ismenius telchinia* so closely that we cannot doubt that the form is much more closely related to *ismenius* than to *silvana*. Indeed, I am convinced that it is merely another form of *ismenius*.

We have now considered nearly all the reputed species which appear to belong to the group Silvaniformes. Forms of which I have been unable to obtain examples are *ennius*, *sulphureus*, and *hippola*. With so peculiar a genus it may be rash to speculate on the position of forms which have not been examined, but I should expect *ennius* to prove a form of *quitaleus*, and *sulphureus* of *ethilla*. As to the rare species, *hippola*, of which only the type seems to be known, its appearance gives no clue. It will, perhaps, prove to be near *narcaea*.

Assuming the structure of the genitalia to be of any value at all in these forms, we can, therefore, arrange the reputed species in six groups of which it may be said that if the respective members are not conspecific, at least they are extremely closely allied, and are not separable by any constant and recognisable features of the male armature.

I have left for consideration at the end of this group two species which are amongst the most remarkable of all the Heliconii. The first is *H. tumatumari*, Kaye, from Guiana. This species resembles *uoede astydamia*, forms of *erato*, and secondarily forms of *melpomene*. It is a tribute to Mr. Kaye's excellent judgment that he did not regard it as a form of *melpomene*, but described it as a separate species. The structure of the male armature is quite

different from that of any form of *melpomene*, and, in fact, has a typically silvaniform appearance. It is nearest to that of a species with which one would not at first think of associating it, viz. *vetustus*: indeed, the only obvious difference between the armature is that in *vetustus* the extremity of the clasper is rather more densely pilose. That the species is, in fact, closely related to *vetustus* I have no doubt, and the further evidence for this will be found under the discussion of patterns. It may here be mentioned that the most obvious difference between *tumatumari* and *melpomene* forms is the occurrence in the former of a sulphur yellow streak on the underside of the hind-wing, this streak being not *on* the costa, but below the costal nervure.

On my pointing out to Mr. Kaye the significance of this yellow line, he kindly brought for examination two *melpomene*-like forms, one of which agrees with *melpomene elevatus*, Nöld., and the other an undescribed female form somewhat like it, from his own collection. Both these had the peculiar yellow line, and without anatomical examination might well have been regarded as geographical forms of *tumatumari*. Microscopic investigation of the male example showed, however, that though it was apparently not a form of *melpomene*, it was equally specifically separate from *tumatumari*. The armature is again of a somewhat silvaniform type, but resembling that of *H. sergestus*. These two species, *elevatus* and *tumatumari*, will be further considered in the discussion of patterns.

Although they are separable from *melpomene* it must not be supposed that they are as markedly distinct from that species as are many of the species of Section II from one another. Preparations of the genitalia of *melpomene* show much individual variation, and whilst there would never be any difficulty in distinguishing the armatures of, say, *anderida* and *melpomene*, there might be more difficulty in separating some preparations of *melpomene* from certain of the Silvaniformes. In other words, the Silvaniformes are not, in spite of their *Melinaea*-like patterns, a markedly separate group, and, in fact, it may be said that all the species belonging to Section I are far less satisfactorily differentiated than those of Section II. This fact would seem to lend support to the view that Section I is of more recent development, as we should expect, since its members are mimics rather than models.

We now pass to those species grouped under the name of the

CYDNOFORMES.

H. cydno, Doubl.

The typical and eight subspecies are described with several varietal forms occurring in Central America, Peru, Ecuador, Colombia, and Venezuela. The claspers of five forms are shown on Pl. XV. They show a general resemblance of structure with a certain amount of variation.

H. weymeri, Stgr.

Of the typical form of this Colombian species I have had no example to examine, but have dissected out more than one armature from the form *gustavi*, Staud. There is no constant and recognisable difference between the armatures of this and of *cydno* (Pl. XV).

H. pachinus, Salv.

This species from Chiriqui and Costa Rica occurs commonly in collections. I have made several preparations which show but little range of individual variation. The pattern of the wings seems at first sight so distinct that it might well be regarded as a satisfactorily defined species, yet the armature (Pl. XVI) shows no distinction from that of *weymeri* and could not be constantly separated from some forms of *cydno*.

H. heurippa, Hew.

This species, with which I include *rubellius* of Smith and Kirby, occurs in Colombia. Typical *heurippa* has a striking appearance owing to the large patch of sharply divided yellow and red on the fore-wing. In the form *rubellius* this patch is reduced to very narrow dimensions. The clasper shown on Pl. XVI from a specimen of *heurippa* shows much the same structure as is found in *cydno*, *weymeri*, etc. There can be little doubt that *heurippa* and *cydno* are the same species, and it will be seen later that consideration of the pattern confirms this view.

H. melpomene, Linn.

Over fifteen subspecies of this form, with many varieties, are described. They range over the greater part of northern S. America, but have not, so far, been reported

from Colombia and Venezuela. A drawer filled with these forms presents a most bewildering diversity of patterns linked together by intermediate forms. On Pl. XVI I have illustrated eight of the claspers. From these it will be seen that there is a strong tendency for the point of the clasper to be fuller and more rounded than in *cydno* and some of the other forms. Two drawings are shown taken from consecutive specimens of *melpomene thelxiope*. The difference between these is as great as that between the second of them and one of the *cydno* forms, whilst that of *melpomene timareta contiguus* is essentially of the *cydno* pattern.

H. amaryllis, Feld.

The typical and two subspecies occur in Central America, N.W. Brazil, Peru, Venezuela, Colombia and Trinidad. Of the two claspers shown on Pl. XVI that of *amaryllis rosina euryas* is of the *cydno* type, whilst that of *amaryllis euryades* comes nearer to that of some forms of *melpomene*, showing that here again this reputed species cannot be definitely separated.

H. vulcanus, Butl.

The typical form occurs in Colombia and Panama, and is rather doubtfully recorded from Guiana. The form *cythaera*, Hew., occurs in Ecuador. Claspers of the two forms are shown on Pl. XVI, and present no clearly distinguishing features.

H. xenoclea, Hew.

This species appears as *batesi* in Stichel and Riffarth's monograph, Riffarth having thought that *xenoclea* belonged to the second section of the genus. Kaye pointed out the error,* and has given the name *microclea* to the form in Section II which resembles Hewitson's species. It occurs in Ecuador and Peru, and is distinguished by the two separate rounded spots on the fore-wing.

The clasper figured on Pl. XVI is not distinguishable from several of those already described.

H. nanna, Stich.

This reputed species occurs in S. Brazil, and a form occurring further north, in which the fore-wing red discal

* Proc. Ent. Soc. Lond., p. xiv, 1907.

band is less indented, has been named *burchelli* by Poulton. *H. nanna* resembles closely, on the upperside at least, *H. besckei*. The clasper as shown on Pl. XVI is no more distinctive than the others already considered.

H. besckei, Ménétr.

This species, occurring in S. Brazil, resembles *nanna* and *erato phyllis*. It is distinguished outwardly by a reddish submarginal line on the underside of the hind-wing. Kaye has expressed the view that it is a form of *H. erato phyllis*, but the structure of the armature precludes this possibility. A clasper is shown on Pl. XVI, and the principal feature in which it differs from the *cydno* and *melpomene* forms is the presence of a dense tuft of bristles near the point. If this be a good character, as has been supposed, in dividing the Silvaniformes, then we have grounds for separating the species, and the peculiarity of the hind-wing pattern supports this view.

We thus see that in so far as may be judged from the genitalia there is no reason to suppose that the forms now included under the *Cydnoformes* and *Melpomeneformes*, with the exception of *H. besckei*, really constitute more than one species. The extent to which pattern and other features support such a conclusion will be discussed in a later portion of this paper.

SECTION II.

In this section the structure of the armature provides much more satisfactory evidence of specific distinctions and to a considerable extent confirms the reputed species into which the forms have been divided. Taking these in the order adopted in Stichel and Riffarth's work, we find seven reputed species included in group I, the

HECALESIFORMES.

H. crispus, Stgr.

This species resembles *atthis*, but is modified so as to mimic *Tithorea bonplandii descandollesi*. It occurs in the Cauca valley. I have had no specimen to examine.

H. hecuba, Hew.

This Colombian species also resembles a *Tithorea*. Seitz regards both *choarinus* and *cassandra* as forms of this species, together with *tolima*, Fassl. I have had *hecuba*, *choarinus* and *tolima* to dissect, and they would certainly appear to be the same species. The claspers of *hecuba* and *choarinus* are shown on Pl. XVI. That of *cassandra* I have not been able to examine.

H. hecalesia, Hew.

The typical form occurs in Colombia and the form *formosus* in Guatemala, Nicaragua, Costa Rica, and Panama. I have dissected examples of both, and the clasper is shown on Pl. XVI. It is of quite distinct structure. *H. octavia*, Bates, has exactly the same type of clasper and is certainly the same species. It occurs in Guatemala and Honduras.

Two forms of this group remain, *H. gynaeisus*, Hew., and *H. longarenus*, Hew. The first of these Riffarth regards as a form of *hecalesia*. Unfortunately, I have had no example to examine, and the only specimen of *longarenus* known to me is the type. My view as to the position of these two forms will be found under the consideration of patterns.

AOEDIFORMES.

H. godmani, Stgr.

This species is included by Riffarth in the Aoediformes, but its appearance suggests an alliance with *gynaeisus*, though this may quite well be due to mimetic resemblance. I cannot express an opinion as to its true position, as the type is, so far as I know, the only specimen in existence. It was taken on the river San Juan in W. Colombia.

H. metharme, Erich.

A rather distinctive-looking species occurring in N. Brazil, Peru, Colombia, and doubtfully in Nicaragua. The male armature (Pl. XVI) is quite distinct from that of any other form examined except *aoede*.

H. aoede, Hübn.

The typical and three subspecies range through British Guiana, N. Brazil, Venezuela, Peru, and Ecuador. The

claspers of two forms are illustrated on Pl. XVI. They differ from one another considerably, but the differences are just such as to make it difficult to separate them on these structures from *metharme*. In the latter species the peculiar toothed organ on the inner side of the clasper seems intermediate in form between that of *aoede aoede* and that of *aoede astylania*. Allowance must be made for differences of position, as this organ appears to be movable. The matter will be further considered under the discussion of patterns.

XANTHOCLEDOFORMES.

H. xanthocles, Bates.

Five subspecies and the typical form are described from various parts of northern S. America. The male claspers are distinctive, those of two forms being shown on Pl. XVI. The most interesting feature is the small, upturned projection from the inside of the clasper, suggesting an alliance with *H. hierax*, Hew.* The only feature of the wing patterns which would support such a view is the row of small, almost marginal white spots on the underside of the hind-wing.

EGERIFORMES.

H. egeria, Hübn.

The typical and three subspecies of this large and handsome form have been described from Guiana and North Brazil. The male clasper is illustrated on Pl. XVI, and could not be confused with that of any other species I have examined, though suggestive of relationship with *burneyi catharinae*.

H. burneyi, Hübn.

The typical form and three subspecies range through Guiana, N. Brazil, Peru, Bolivia, and Colombia. I have illustrated the claspers of three forms (Pl. XVII) showing a very wide limit of variation, notwithstanding which, the clasper of only one other reputed species could be confused with them. This is *wallacei wallacei*, Pl. XVII, and it is

* On the clasper alone *hecuba*, *xanthocles*, and *hierax* would appear to be rather difficult to separate. There are certain other differences, however, notably in the shape of the uncus, which enable them to be separated.

difficult to see in the armature any grounds for regarding it as specifically distinct. *H. wallacei* colon shows a similar structure.

H. doris, Linn.

The forms of this species have a wide range, being recorded from the whole of northern S. America. It is characterised by the radiate coloured markings on the hind-wing, which may be blue, green, or red, or combinations of these, or even dusted with white. Three subspecies and some varietal forms are described. I have illustrated on Pl. XVII the claspers of only two forms, as further preparations show a similar structure characterised by a large upturned projection of the upper part of the clasper. No other species can be confused with it.

H. hierax, Hew.

I have already pointed out that the clasper of this species suggests a close affinity with *H. xanthocles*. It is certainly wrongly placed next to *doris*.

WALLACEIFORMES.

H. wallacei, Reak.

The typical and two subspecies are described from northern S. America. As indicated above, the claspers (Pl. XVII) show a near affinity, if not specific identity, with *burneyi*.

SAPHOFORMES.

H. sapho, Drury.

The typical and four subspecies are described from Peru, Ecuador, Colombia, Central America, and doubtfully from Jamaica. The claspers of two forms are shown on Pl. XVII, and those of other forms examined show a similar structure. They suggest relationship with the Clysonimoformes, though they are distinguishable from the fact that in the latter the lower inflated part of the clasper is of a thinner chitin. There seems little to separate the *sapho* forms from *antiochus*, *leucadia* and *sara*.

H. hewitsoni, Stgr.

This species is remarkable for its resemblance to *H. pachinus*. Though allied to *sapho* forms I think it is certainly distinct, the male armature having several peculiarities (Pl. XVII).

H. congener, Weym.

This species is closely allied to the *sapho* forms, but the uncus is much more slender, so that for the present we may keep it separate (Pl. XVII).

ANTIOCHIFORMES.

H. antiochus, Linn.

This species and four subspecies are described from Guiana, Brazil, Peru, Ecuador, Colombia, and Venezuela. A remarkable form, *salvinii*, Dew., from the Orinoco delta, has a transverse yellow hind-wing band (Pl. XVII).

H. leucadia, Bates.

The type and one subspecies are described from N. Brazil, Peru, Ecuador and Bolivia (Pl. XVII).

H. sara, Fab.

Six subspecies of this form are described from various localities ranging through the greater part of northern S. America. Claspers from the above three reputed species are illustrated on Pl. XVII, from which it will be seen that, though varying in size and slightly in form, there is no satisfactory feature to distinguish them either from each other or from *sapho* forms. Also, it may be observed, they approach in structure the *cydno* forms.

ERATOFORMES.

H. himera, Hew.

A small and interesting form from Ecuador.

H. notabilis microclea, Kaye.

Resembles *H. xenoclea*, Hew., but distinguished by the character of the section. Occurs in Peru and Ecuador. A form with the fore-wing spots more or less white occurs in E. Ecuador.

H. cyrbia, Godt.

The typical and two subspecies are described from Ecuador, Colombia, and Bolivia.

H. favorinus, Hopff.

A Peruvian form.

H. petiveranus, Doubl.

The typical and one subspecies described from Colombia, Venezuela, and Central America.

H. hydarus, Hew.

Five subspecies are described. The forms occur in Venezuela, Trinidad, Colombia, and Panama. The forms are remarkable for the great diversity of colour and pattern exhibited.

H. amphitrite, Riff.

A Peruvian species closely resembling *erato callycopsis viculata*.

H. erato, Linn.

The typical and no less than eleven subspecies are described. Extending over the greater part of northern S. America. It is a species in which pattern and colour seem to run riot much as in *melpomene*.

Claspers taken from the foregoing eight reputed species are illustrated on Pl. XVII. All are characterised by the toothed projection at the outer end of the clasper, which takes the form of a flattened lobe with a peculiar twist, as though it had been taken in forceps and given part of a turn, whilst the rest of the clasper remained fixed. An examination of the figures shows that no satisfactory character differentiates these forms. The figures are only a selection from many preparations, all of which show the same kind of structure. Whether or not all are forms of one species, they certainly cannot constantly be distinguished by the structure of the armature.

One more species of the group remains, viz.—

H. hermathena, Hew.

This remarkable species from the Lower Amazon region has the fore-wings of one of the *erato* forms and the hind-

wings of *H. charithonia*. The clasper shows a near relation to *erato*, but there is a peculiar formation below the twisted projection, giving it the appearance of having been pinched (Pl. XVII).

CHARITHONIFORMES.

H. charithonia, Linn.

A common and well-known species having a very wide range over S. America and even into southern N. America. The clasper is very small for the size of the insect, and though not very characteristic may probably be regarded as distinct (Pl. XVII). There is one subspecies, *peruviana*, Feld., in which the claspers are similar.

H. nattereri, Feld.

Of this rare Brazilian (Bahia) species I have had no example to examine.

H. fruhstorferi, Riff.

Resembles the above and is thought to be its female. I have not seen an example.

CLYSONIMIFORMES.

H. clysonimus, Latr.

The typical and two subspecies are described from Central America, Colombia, and Venezuela. The principal characteristic feature of the clasper, shown on Pl. XVII, is the compressed appearance of the end of the dilated portion.

H. hortense, Guér.

From Ecuador, Colombia, Guatemala, and Honduras. The clasper (Pl. XVII) has a curious little hook-like projection.

H. telesiphe, Doubl.

From Peru and Bolivia. A form with yellow instead of white band on hind-wing (*sotericus*, Salv.) occurs in Ecuador. The clasper on Pl. XVII is simple and not very characteristic. Though somewhat resembling *sapho* forms, the uncus (not shown) is of a stouter form and slightly toothed.

We have now considered the apparent relationships of

most of the reputed species of the genus, from the point of view of the structure of the male claspers. In a general way the conclusions suggested show considerable and in some cases remarkable correspondence with the order in which the reputed species have been arranged in existing works. Most of the forms which now appear conspecific have already been placed together as nearly related.

The question of the specific value of the genitalia is difficult and complicated. The claspers have many forms, showing that we are not dealing with a genus in which these organs are of a primitive and simple character. The highly modified form of the armatures in many species supports the view that specific identity alone accounts for the resemblances found between the organs of forms hitherto regarded as distinct. It will be interesting to see to what extent external features help to confirm the conclusions arrived at from anatomical study.

The evidence of pattern and colour.

In considering the question of pattern it is important to distinguish between resemblance due to affinity and that due to mimetic influences, and it is just on this point that the evidence of the genitalia affords valuable clues. Thus the resemblance between "*silvana*" *ethra* and *narcaea flavomaculatus* would at first appear to support the theory of the affinity of *silvana* and *narcaea*. We have seen, however, that whilst on anatomical grounds *silvana* and *narcaea* do appear to be conspecific, "*silvana*" *ethra* is not to be regarded as a *silvana* at all. According to Seitz, *ethra* and *narcaea flavomaculatus* fly together at Bahia and are hardly distinguishable from one another. This fact, coupled with the known anatomical difference, points strongly to an instance of mimetic resemblance. As is well known, most of the Silvaniformes are modified to resemble Melinaeas and other butterflies of different subfamilies. Whether in likeness to a common model or to each other, several forms of the Silvaniformes bear strong resemblance to other Silvaniformes. Thus—

<i>ethilla aërotome</i>	resembles	<i>pardalinus lucescens</i> .
<i>anderida melicerta</i>	„	“ <i>silvana</i> ” <i>metaphorus</i> .
<i>anderida zuleika</i>	„	<i>hecalisia octavia</i> .
<i>anderida holocophora</i>	„	<i>numatus superioris</i> (dark form).

In each of these cases, as in that of "*silvana*" *ethra* and *narcaea flavomaculatus*, the forms which resemble one another are *separable on the anatomical structure*, and the resemblance may be regarded as mimetic without stopping to define the particular class of mimicry to which each case should be referred.

Bearing in mind the above facts, we may now consider the extent to which the patterns support the conclusions formed on the anatomy.

The *narcaea* association.

The typical form of this species appears to be very distinct from the other reputed species with which I have associated it, and it cannot be said that pattern affords much support for the conclusions based on the anatomical structure. Other members of the association, however, offer strong support to these conclusions. Comparison of *silvana silvana* with the typical form of *numatus* shows that there is really little difference between their patterns. *H. gradatus thielei* is scarcely separable from forms of *numatus* on pattern. As to *ethilla*, pattern would certainly support the view of a close affinity with *numatus*, especially if the undersides of *numatus numatus* and *ethilla eucomus* be compared. *H. ethilla claudia*, which resembles *anderida melicerta*, stands out rather distinctly from the rest. As we have seen, the claspers of forms of *ethilla* vary greatly, but in *ethilla claudia* they so closely resemble those of *ethilla ethilla* that there can be no doubt of their specific identity. Riffarth's diagnosis of this case was extremely shrewd. With reference to the other reputed species, the claspers of which I have not been able to examine, *H. hippola* must remain very doubtful, though an example of *narcaea satis* with the apical spot suppressed and the discal band darkened to the ground-colour would be difficult to distinguish from *hippola*. It is difficult on mere outward examination to appreciate the grounds on which *sulphureus* has been separated from *ethilla*.

The *novatus* association.

The pattern exhibited by the reputed species here associated are extremely diverse, though some of the special features may be traced through several different forms.

1. A tendency to melanism in the hind-wings is seen in *aristiona* and its forms *messene* and *aurora*, and appears again in *ithaka* and *pardalinus lucescens*, reaching a climax in *hecale* and *anderida fornarina*.

2. The undersides of *aulicus* and *aristiona lenaeus* are nearly identical, if we except the central and marginal black markings of the former, which, however, are traceable as vestiges in the latter.

3. The relationship of the underside pattern of *novatus leopardus* to that of *aristiona arcuella* is very evident on careful comparison.

4. The brown markings seen on the underside of *anderida fornarina* are faintly represented in some examples of *hecale*, whilst the yellow markings of the fore-wing upper-side in *fornarina* are partially reproduced in white in *hecale*.

5. Comparison of the hind-wing underside in *pardalinus lucescens* and *aristiona aurora* shows a close relationship of pattern.

6. The pattern of *quitaleus felix* is merely a slight modification of that of *pardalinus tithorides*.

7. The vestigial submarginal yellow spots in the hind-wing of *ithaka* appear to correspond with those in *anderida anetta*.

8. The various *anderida* forms graduate so obviously one into another that a connection between any of them and one of the other reputed species serves as an indirect connection for all.

9. In considering the form of the armature of these species I stated that there was a further reason for connecting "*silvana*" *robigus* with this association. The underside pattern of this form, especially of the hind-wing, is nearly identical with that of *novatus novatus*.

10. The hind-wing underside of *paraensis latus* closely resembles that of *aristiona arcuella*.

11. Similar close resemblances may be observed between examples of *fortunatus* and *pardalinus*.

We thus see that careful comparison of the wing patterns of the *novatus* association tends to support the conclusions based on an examination of the male armatures.

H. *vetustus*.

This species and its subspecies *metellus*, though closely allied to the *novatus* association, may for the present be

kept separate. The forms are rather rare in collections, and I have not been able to examine a large series. It may well prove ultimately to be a member of the *novatus* association.

H. sergestus.

The position of this species is obscure. Its pattern suggests a close relationship with *pardalinus*, but the clasper is of a very different form, and it must for the present remain separate.

H. atthis.

The structure of the armature of this species shows that it belongs to the Silvaniformes, though the pattern has been profoundly modified in mimicry of a *Tithorea*. The markings show no indication of its affinity, though the claspers are hardly distinguishable from those of *anderida*. They are rather less densely tufted.

H. ismenius.

The apparent specific identity of "*silvana*" *metaphorus* with the forms of *ismenius* is one of the surprising results of this investigation. The patterns are very different, though certain similarities may be observed. Thus the white and yellow spots on the underside of the fore-wing apex are practically identical with those in *ismenius telehinia*, and the same may be said of the white spots of the hind-wing underside.

There are two doubtful species included in the Silvaniformes concerning which nothing can be said. They are *H. arcuatus*, Kirby, and *H. euclea*, Godt. Their identity has not been satisfactorily established.

H. tumatumari, Kaye.

This peculiar species has already been mentioned in connection with the armature structure. As stated, the anatomy indicates relationship with *H. vetustus*, and whilst I think there are grounds for regarding it as a good species, certain particulars of the pattern support the above view of its affinity. Examination of the fore-wing underside shows in *tumatumari* three subapical spots and a fourth submarginally placed below the extremity of the first branch of the median. Precisely similar white spots are found in *vetustus metellus*. The discal pattern of the

fore-wing evidently bears a close affinity in the two species. If *tumatumari* be carefully examined in a good light, it will be seen that on the hind-wing underside the brown colour above the cell is very dark, whilst beneath this dark area is a paler stripe traversing the cell, its hinder border line passing out of the cell exactly at the origin of the second subcostal branch. The positions of these dark and light areas correspond precisely with those of the black-brown and orange-brown in *vetustus*, whilst there is an orange-brown streak below the cell in *vetustus* corresponding accurately with the distinctive yellow streak in *tumatumari*. Taken singly these points may be small and might be accidental; collectively they appear to me to be very significant.

H. *elevatus*, Nöld.

It is scarcely surprising that this species has been regarded as a form of *melpomene*. There is practically no external feature to distinguish it, beyond the yellow streak already referred to, yet it is more nearly related to some of the *Silvaniformes* than to *melpomene*. Three male examples are before me from Chanchamayo, Saõ-Paulo (Amazon), and Beni River (Bolivia) respectively. The first two agree nearly with the description of *elevatus*. The third differs in the following respects. The fore-wing discal yellow fills the outer third of the cell, and extends across the space between the first and second median, and as a suffusion half-way down to the submedian. On the margin of the hind-wing underside it has very distinct white dots, absent in the two other specimens. These dots are described as occurring in the type. In all three the hind-wings above have an orange-red horizontal band passing through the cell and ending beyond the subcostal. This is followed by the usual straight band of black, and seven orange-red internervular "nail-headed" streaks almost reaching the hind-margin.

As has been stated, the armature approaches in structure that of *sergestus*. If there is any real affinity there is no indication of it on the upper surface. On the under surface, when the third specimen described above is compared with *sergestus*, we find that the position and general contour of the fore-wing discal yellow is very similar to that in *sergestus*. The latter furnishes one of the rare cases in which a silvaniform *Heliconius* has a red

spot at the base of the hind-wing, and *elevatus* has an exactly similar spot, though, of course, this feature is only of value in conjunction with the anatomical similarity, as so many of the non-silvaniform *Heliconii* have basal red spots.

These two species, *timatumari* and *elevatus*, are of extraordinary interest as showing that there is no marked line of division between the Silvaniformes and the other members of Section I. The hind-wing pattern of *elevatus* raises another very interesting point. The "flame pattern" so frequently found in *Heliconius* is of two kinds. In *melpomene* forms (Section I) it is always cut across in a nearly straight line and the rays are of the "nail-headed" type, whereas in the species of Section II in which it occurs, the rays at their inner ends follow the contour of the cell. Why should the pattern of *H. elevatus* be of the nail-headed type? The reply seems to me to be that the characteristic horizontal black bar in the hind-wing of species of Section I is an ancestral pattern of considerable stability. It appears in one form or another in *narcaeae*, *silvana*, *numatus*, *ethilla*, *novatus*, *pardalinus*, *quitaleus*, *paraensis*, *aulicus*, forms of *anderida*, etc., and its inner (upper) edge runs across at the level of the cell end. Hence when a "flame" pattern is developed it is cut off straight along the top by this characteristic bar. Thus, if my suggestion be well founded, we should expect any species of Section I which developed a flame pattern to produce the straight-cut, more or less nail-headed type found in *melpomene* and *elevatus*, irrespective of fascies of more recent ancestry. The nearest approach to a flame pattern in any truly silvaniform-patterned species that I know is in an example before me which agrees with Weymer's *H. fortunatus*. Here the usual black band is very distinct, and beneath it is a series of orange internervular marks of the ground-colour which, whilst running off to fine points marginally, are cut off proximally by the black band and have the nail-head pattern, though greatly foreshortened.

Professor Poulton has suggested to me that the black bar may have been developed in Section I of *Heliconius* in mimicry of *Melinæa* forms, doubtless an association of great antiquity. The idea has much to recommend it, since if it were a character of still greater antiquity we should expect it to be common to both sections of the

genus. However that may be, the bar is now a deeply established factor of the pattern, and sufficiently accounts, I think, for the special characteristics of the flame pattern as developed in Section I.

The *melpomene* association.

Some ten reputed species are here included, totalling, with subspecies and varieties, sixty or seventy named forms. On Pl. XI I have figured twenty-six butterflies which exhibit some of the forms included in this association. All the figures are much reduced from natural size, but for convenience of comparison it was desirable to have them all on one plate. The forms of *cydno* exhibit great diversity of pattern. White and lemon-yellow are easily interchangeable in both wings. The broad yellow fore-wing discal band of *cydno* is divided into two separate bands in the form shown at fig. 3, and in fig. 4 there is a submarginal row of white spots, the other fore-wing markings having become white. On the hind-wing of *cydno* there is a white border of medium width, almost marginal. In fig. 3 it is twice as broad, and in fig. 5 it is broad and yellow. In *hermogenes* (fig. 4) it is yellow and considerably separated from the margin, whilst in fig. 7 it is vestigial, but providing a link with the peculiar hind-wing marginal pattern in *vulcanus cythera*, fig. 8. Fig. 2 represents the underside of fig. 1. Note the peculiar pattern of the hind-wing. Two red-brown bands are faintly visible and the white sub-marginal border of the upperside is repeated. In some cases the upper red-brown band is practically horizontal, broad proximally and tapering towards the hind-margin. It is important to bear these variations in mind when comparing the patterns of the other reputed species.

Fig. 14 represents *weymeri*, Stgr., which is separated by Riffarth, but regarded by Seitz as conspecific with *cydno*. The latter view is undoubtedly correct. The fore-wing pattern is only a slight modification of fig. 3, whilst the hind-wing central yellow band is probably a development from the red-brown band of the underside of *cydno*. This central yellow band is a common feature in the genus; it occurs in both sections, and I shall have to refer to it again.

Fig. 15 is the form known as *weymeri gustavi*, Stgr. It has lost the fore-wing markings altogether and become

a remarkable mimic of a species in Section II. An example kindly lent me by Mr. Kaye is to some extent intermediate, having in the fore-wing a white spot above the first median, another below the first subcostal, whilst with a lens white scales can be seen in several other positions. The underside of this specimen is very remarkable, since the dull brown colour is paler all round the margin of the hind-wing over an area corresponding exactly with that of the white border in forms of *cydno*. Moreover, on the fore-wing the discal area is paler, not over an area corresponding with the white marks in *weymeri*, but representing the yellow patch of *cydno*.

We may now turn to *heurippa*, a nearly typical example of which is shown at fig. 10. There is little or nothing to associate it with *cydno*. Fig. 9, however, shows the fore-wing of *heurippa* with the *cydno* band in the hind-wing. This is the form known as *vernickei*, Stgr., and there is a somewhat similar form, *emilius*, Weym., which has the hind-wing band slightly suffused with grey as in some forms of *cydno*. These facts would seem remarkable enough, but there is further and stronger evidence. My figs. 10, 11, and 12 show a regular gradation of pattern, ending in the form at fig. 12, which is very near the stage of having nothing but a red patch on the fore-wing. Now this specimen, which is in the Tring Museum, has on the underside (fig. 13) the "ghost" of the pattern of the *cydno* underside. The delicacy of the shades of brown is difficult to reproduce, but the beauty of the actual specimen is very striking, and I am certain that no one could see it without being convinced of the specific identity of *cydno* and *heurippa*. The specimen shown at fig. 11 is also remarkable from the fact that on the underside of the hind-wing there is a pale horizontal band exactly corresponding to the yellow horizontal band of *weymeri*.

At fig. 16 is a figure of a form of *melpomene* which does not quite correspond with any of those named in the monograph already referred to. The fore-wing has the bicoloured patch of *heurippa*, but in other respects the example resembles *melpomene amandus*, shown at fig. 17. This form approaches *nanna burchelli*, but has more red in the cell. *H. melpomene amandus*, fig. 17, connects *nanna* with *heurippa*, and through the latter with *cydno*. Fig. 18 is *amaryllis rosina*, which is merely a form of *melpomene* with the hind-wing yellow band, whilst fig. 19

is *amaryllis euryades*, lacking the yellow band on both surfaces of the hind-wing, though in the form *euryas* it is present on the underside, and in one example before me from the Rio Dagua there is a trace of a white submarginal band on the hind-wing underside. These forms bring us to *melpomene*, fig. 20, which is merely a modification of the form of *heurippa* shown at fig. 12. All the yellow has disappeared and nothing but the bright red fore-wing patch remains. Occasionally an example of *melpomene* may be found in which the dull brown of the hind-wing underside has a rather lighter appearance corresponding in position to the yellow band of other forms.

Fig. 21 is the form described by Lathy as *xenoclea confluens*. It may be regarded either as a *xenoclea* in which the two patches have run together, or more probably as a *melpomene* with an extended patch not yet separated into two. In any case it connects *melpomene* with *xenoclea*, shown at fig. 22. In fig. 23 the two patches of *xenoclea* are white with a dusting of red. The example shown at fig. 24 exhibits the well-known "flame" pattern in the hind-wings together with basal red in the fore-wing. The flame pattern occurs in many forms of *melpomene* and also in species of Section II, though in the latter the red streaks radiate from the borders of the cell and have not the appearance of being horizontally cut off at their upper end.

Fig. 25 represents *melpomene eulalia*, in which, as in fig. 26, we see a distinct trace of the *heurippa* band in the fore-wing, the flame pattern recurring in fig. 26. Fig. 27 is a remarkable combination of the *melpomene amandus* fascies with the flame pattern superimposed. Finally, fig. 28 shows *H. pachinus*. The genitalia of this cannot be distinguished from those of all the other forms shown on the plate, and as to pattern, the yellow bands appear to be a mere modification of those of the fore-wing of figs. 3 and 6 and the hind-wing of fig. 4. Moreover, on the underside of *pachinus* there is frequently to be seen on the hind-wing a submarginal series of white spots like the vestige of the white border of *cydno*.

I have discussed the *melpomene* association at some length because I happen to have had access to a great number of examples, and these fortunately exhibit remarkable intermediate forms, which, together with the pre-

parations of genitalia, provide, at least in my own opinion, conclusive evidence of the specific identity of all the forms above considered, and divided in Stichel and Riffarth's monograph into ten species. Considered alone, the question of whether all these forms are representatives of one or several species is of little real importance except as a study in variation. The interest of the matter will, however, become apparent when we come to investigate the peculiar mimetic relationships occurring between the two sections of the genus.

H. besckei.

This species I keep separate both on account of the form of the clasper with its tuft of bristles and also because of the pattern of the hind-wing underside. Kaye was at one time of the opinion that it was a form of *erato phyllis*, though this cannot be maintained in view of the structure of the male claspers. Also I think it is rightly placed in Section I. It should be noted, however, that on the hind-wing underside there are some small whitish spots at the apex, and similar spots are occasionally found in examples of *melpomene*, and the relationship, if not specific, is extremely close.

SECTION II.

H. crispus.

I have not been able to examine the armature of this species, and the pattern, being so profoundly modified in mimicry of a *Tithorea*, furnishes little evidence of its identity.

H. hecuba.

The patterns of *hecuba*, *choarinus*, and *cassandra* support the view that they are all one species, and whilst I have had no example of *longareus* to examine, its pattern indicates that it is conspecific with *cassandra*. If another example of *longareus* is ever discovered I shall be surprised if its locality is not found to be identical with that of *gynaesius*.

H. hecalesia.

The armature of *hecalesia* is so characteristic that the fact of the same organ in *octavia* being precisely similar leaves no doubt in my mind that they are forms of the

same species. An examination of pattern leaves little doubt that *gynaesius* is also a form of *hecalesia*, since *octavia* forms an almost perfect transition thereto. Indeed, if the basal brown be eliminated from the fore-wing of *octavia* there is no distinction from that of *gynaesius*, whilst a proportionate reduction of the hind-wing brown in *octavia* would leave the hind-wing pattern of *gynaesius*. If Stichel and Riffarth were satisfied that *gynaesius* was a form of *hecalesia* it is strange they should have kept *octavia* separate. It should further be noted that whilst the underside of the hind-wing in *octavia* has a very different appearance from that in *hecalesia*, it is practically identical with that in *hecalesia formosus*, whilst the latter has a trace of the fore-wing basal brown found in *octavia*.

H. godmani.

Stichel and Riffarth place this form in their *Aoediformes*, presumably on account of its shape. In other respects it differs little in appearance from *gynaesius*. The structure of the armature would probably settle the point at once, but I know of no example except the type, and this is not available for dissection.

H. metharme.

Whilst the difficulty of distinguishing the claspers suggests the specific identity of *metharme* and *aoede*, the difference in the shape of the wings suggests their separation. On the other hand, the radiate red pattern in the hind-wing in *aoede* is repeated on the underside of *metharme*, and there is an example of the latter in the Tring collection, having indications of the flame pattern on the upperside, though it must be remembered that the radiate pattern is common in several undoubtedly separate species. I think we must be content to regard them as doubtful species, but certainly very nearly allied.

H. xanthocles, H. hierax, H. egeria.

These three species are sufficiently distinct on the structure of the armature, and need no further comment.

H. burneyi.

The suggestion that *burneyi* and *wallacei* are conspecific is strongly supported by their patterns. On the hind-wing

underside the white internervular streaks and fringes are well represented in *wallacei colon*, the peculiar arrangement of the basal red is similar, and the conspicuous precostal yellowish spot is common to both. The base of the fore-wing costa beneath in *wallacei* is deep red, corresponding with a more conspicuous basal red in *burneyi*. Indeed, the hind-wing undersides in *wallacei colon* and *burneyi catharinae* are practically identical, and if a series of the hind-wings of both were mixed together it is difficult to see on what grounds they could be separated.

H. doris.

This species and its forms are readily recognised and specifically distinct, as the male elaspers show, though many features of the pattern would suggest relationship with *metharme*.

H. hewitsoni.

A distinct species, as shown by the armature.

H. congener.

Probably distinct, on the structure of the armature.

H. sapho, etc.

The forms of *sapho* resemble those of *cydno*, and, as in that species, the two colours, lemon-yellow and white, are remarkably interchangeable. The broad white discal band in *sapho cleusinus* and *sapho leuce* appears as a double yellow band in several other forms, whilst the hind-wing hind-marginal white may vary from a mere fringe in *sapho leuce* to a broad band in *eleuchia*, or become a still broader yellow band in *sapho primularis*. The reputed species *antiochus*, *leucadia*, and *sara* do not show any characteristic differences in the structure of the elaspers, and their patterns support the theory of specific identity in the following ways—

1. All have a tendency to white fringes pointed with black at the nervure ends.

2. The fore-wing subcostal and median nervures are generally dusted with pale yellow on the underside, the fore-wing subcostal almost invariably. In *antiochus* this dusting is on the subcostal and median. In many species of *sara* and *leucadia* the yellow scales can be seen on the median with a lens.

3. A very slight modification of the two fore-wing yellow bars in *sapho eleuchia* gives us the characteristic yellow or white bars in forms of *antiochus*.

4. *H. sara theudela* presents only a very slight modification of the pattern of some examples of *sapho primularis*.

5. Some examples of *leucadia pseudorhea* have the rudiments of a hind-wing marginal white border, strongly suggesting that more highly developed in *theudela* and forms of *sapho*.

6. Many forms of *leucadia* and *sara* have on the underside of the hind-wing a variable number of red spots forming a discal row more or less parallel with the hind-margin, though I have not seen any trace of this in *sapho* or *antiochus*.

7. Except for the red subcostal streak in *antiochus*, the hind-wing basal spots on underside of that species are almost exactly like those in *sara*. Moreover, in many examples of *antiochus* there is a yellow spot near the middle of the inner margin on the hind-wing underside. Several specimens of *sara* show the same peculiar yellow spot.

H. erato, etc.

The forms and reputed species included in this association present a case somewhat analogous to the great *melpomene* association in Section I.

The following considerations of the patterns support the conclusions based on the structure of the armatures—

1. *himera* may well be a form of *hydarus* with the red and yellow markings reversed.

2. *notabilis microclea*, with its double spots, may be traced to *erato* through a form of *erato estrella*, which has white subapical spots in the fore-wing, exactly the same white spot appearing in *notabilis notabilis*.

3. *hydarus hydarus* (resembling *melpomene*) has several admittedly conspecific forms which are totally unlike. Of these *hydarus colombinus* has a red fore-wing discal band and a central horizontal hind-wing yellow band. Beyond a slight difference in shape of this yellow band there is little to distinguish it from that of *petiveranus*.

4. *hydarus chestertoni* is a glossy blue form with a central horizontal hind-wing yellow band. If *cyrbia* be compared with this, the hind-wing yellow in that form, apparent only on the underside, is quite evidently the same as that

in *hydarus chestertoni*, *cyrbia*'s fore-wing red being obtained from *hydarus hydarus*. The peculiar white-dusted hind-wing border in *cyrbia* is more difficult to account for. It would at first suggest affinity with *sapho*, but the structure of the armature precludes this. The form is, of course, either a mimic or a model of *vulcanus cythera*.

5. *amphitrite* is merely a development of *hydarus*, the armatures being practically identical.

6. *erato* appears in many forms, some of which have developed the flame pattern common in other species. All kinds of intermediates are known, for which some forty-three names are recorded by Seitz. Most of these forms resemble others belonging to Section I, of which they are either the models or mimics. Its variability is, perhaps, even greater than that of *melpomene*, and there is nothing improbable in supposing that the forms I have associated with it are really the same species.

H. hermathena.

Closely related to the *erato* association, but apparently distinct. A very remarkable species combining the fore-wing spots of *erato phyllis* with the hind-wing of *charithonia*.

H. charithonia.

The true relationship of this common form is rather obscure. It is apparently a good species.

H. nattereri, H. fruhstorferi.

Of these I have had no examples to examine. There is, as already stated, some probability that they are male and female of the same species, though whether distinct or merely forms of *charithonia* must remain for the present undecided.

H. clysonimus, H. hortense, H. telesiphe.

These three forms are probably distinct species and call for no special comment, except that *clysonimus* is probably related to *antiochus* through forms of *sara*, in which traces of the hind-wing red band can still be seen.

We thus see that examination of the patterns and colours of the various forms dealt with supports in most cases the relationships suggested by the study of the genital armatures. We may, therefore, draw up the following table embodying the results of the foregoing investigation. Forms apparently not specifically distinguished are placed

under one number. Those forms, examples of which have not been available for examination, are marked with an asterisk. Except where otherwise stated, all the subspecies formerly included under a type name are here included also.

SECTION I.

1. *H. narcaea*, Godt.
 - „ *numatus*, Cram.
 - „ *silvana*, Cram. (not including *metaphorus*, *robigus*, and *ethra*).
 - „ *ethilla*, Godt.
 - „ *gradatus*, Weym.
 - „ *sulphureus*,* Weym.
 - „ *hippola*,* Hew. (?)
2. *H. novatus*, Bates (including *schultzei*, Riff.).
 - „ *hecale*, Fab.
 - „ *aristiona*, Hew.
 - „ *ithaka*, Feld.
 - „ *pardalinus*, Bates.
 - „ *fortunatus*, Weym.
 - „ *quitaleus*, Hew.
 - „ *anderida*, Hew.
 - „ *paraensis*, Riff.
 - „ *aulicus*, Weym.
 - „ *ennius*,* Weym. (?)
 - „ “*silvana*,” *robigus*, (?) Weym.
 - „ “*ethra*, (?)
3. *H. atthis*, Doubl.
4. *H. vetustus*, Butl.
5. *H. tumatumari*, Kaye.
6. *H. sergestus*, Weym.
7. *H. elevatus*, Nöld.
8. *H. ismenius*, Latr.
 - „ “*silvana*,” *metaphorus*.
9. *H. cydno*, Doubl.
 - „ *weymeri*, Stgr.
 - „ *pachinus*, Salv.
 - „ *melpomene*, Linn.
 - „ *heurippa*, Hew. (including *rubellius*, Gr.-Sm.).
 - „ *amaryllis*, Feld.
 - „ *vulcanus*, Butl.
 - „ *xenoclea*, Hew.
 - „ *nanna*, Stich.
10. *H. besckei*, Ménétr.

SECTION II.

11. *H. crispus*, Stgr.
12. *H. hecuba*, Hew.
 ,, *choarinus*, Hew.
 ,, *cassandra*,* Feld.
 ,, *longareus*,* Hew.
13. *H. xanthocles*, Bates.
14. *H. hierax*, Cram.
15. *H. hecalesia*, Hew.
 ,, *octavia*,* Bates.
16. *H. godmani*, (?) Stgr.
17. *H. metharme*, Erich. } (doubtfully separate).
18. *H. aoede*, Hübn. }
19. *H. egeria*, Cram.
20. *H. burneyi*, Hübn.
 ,, *wallacei*, Reak.
21. *H. doris*, Linn.
22. *H. hewitsoni*, Stgr.
23. *H. congener*, Weym.
24. *H. sapho*, Dru.
 ,, *antiochus*, Linn.
 ,, *leucadia*, Bates.
 ,, *sara*, Fab.
25. *H. himera*, Hew.
 ,, *notabilis*, Godm.
 ,, *cyrbia*, Godt.
 ,, *favorinus*, Hopf.
 ,, *petiveranus*, Doubl.
 ,, *hydarus*, Hew.
 ,, *erato*, Linn.
 ,, *amphitrite*, Riff.
26. *H. hermathena*, Hew.
27. *H. charithonia*, Linn.
28. *H. nattereri*,* Feld. } ? ♂ and ♀.
 ,, *fruhstorferi*,* Riff. }
29. *H. clysonimus*, Latr.
30. *H. hortense*, Guér.
31. *H. telesiphe*, Doubl.

One fact is especially striking. If the conclusions arrived at are sound, Section I, containing some 35 reputed species, is reduced to 10, whilst Section II, containing some 37 reputed species, is reduced to 21. Furthermore, when considering the mimetic side of the question, it will appear

TABLE I.—Forms of *Heliconius* and those of other genera which they resemble.

Heliconius	Spp. of other genera	Locality
narcaea narcaea } "silvana" ethra }	Mechanitis nessa Lysimnia, Hübn. Ceratinia daeta, Bds. Melinaea ethra, Godt. Dismorphia astynome, Dalm. Ceratinia euryanassa, Feld. } ? Eresia emice, Hübn. }	Central Brazil.
narcaea connexa	Hirsutis harmonia, Cram. Lycorea ceres, Cram. } Melinaea mediatrix, Weyn. } Mechanitis panitera, Butl. }	S. Brazil.
numatus numatus	Melinaea flavo-ignata phasiana, Butl. } ? Lycorea eva concolor, Staud. } Ceratinia maenas, B. Haas. }	Br. Guiana.
numatus isobellinus } ? aristona arcuella } quitaleus sisyphus }	Melinaea parai a. Reak. } Mechanitis silvanoides, Godm. }	W. Amazon.
silvana silvana	Protogonius ochraceus, Butl. } Hirsutis megara, Godt. }	Guiana, etc.
ethilla ethilla	Hirsutis furia, Godt.	Trinidad.
ethilla metallis	Lycorea cleobaea cinnamomea, Weyn. } Melinaea muelus cydon, Godm. } " madeira, Staud. } Mechanitis equicollis, Godm. } " egaensis, Butl. } Ceratinia pardalina, Hopf. } " anastina, Hew. } Dismorphia egana, Bates } Protogonius castaneus, Butl. }	Venezuela.
ethilla aërotome } pardalinus lucescens }	Melinaea idae, Feld. } Mechanitis macrinus, Hew. } Callichromia beronita, Hew. } Ceratinia philetæra, Hew. } Ichomia lphanassa panamensis, Bates }	W. Amazon.
ethilla claudia } "silvana" metaphorus } anderida melicerta }	Mechanitis deceptus, Butl. Melinaea mothone, Hew. Ceratinia honesta bicolora, Hsch. " manaos semifulva, Salv. Napeogenes achaea, Hew. Hyoscada fallax, Staud. Eresia murena, Staud. " ithomiola, Salv. Protogonius s. multivus, Butl. Eucides acacetes, Hew. Papilio bachus, Feld. Peronius bydra, Butl.	Panama, Colombia, Ecuador, etc.
aristona aristona	Bolivia, Peru.	Bolivia, Peru.

	<p><i>Melinaea messanina</i>, Feld. } <i>Mechanitis messenioides</i>, Feld. }</p>	Colombia, Ecuador.
<i>aristiona janaens</i>	<i>Melinaea zaneka</i> , Butl.	Ecuador.
<i>aristiona tarapotensis</i>	<i>Melinaea menophilus tarapotensis</i> , Ilaen.	Ecuador.
<i>aristiona euphone</i>	<i>Melinaea menophilus menophilus</i> , Hew.	Colombia.
<i>aristiona aurora</i>	<i>Melinaea lucifer</i> , Bates } <i>Ceratinia soror</i> , Sskr. }	W. Amazon.
<i>aristiona tinuens</i>	<i>Melinaea flavosignata orestes</i> , Salv.	W. Amazon.
<i>auderita zuleika</i> } <i>hecalesia octavia</i> }	<p><i>Hirsutiis phthias</i>, Godm. <i>duenna</i>, Bates ? <i>Phyciodes itilomoides</i>, Hew. <i>Ceratinia callisila</i>, Bates <i>Napeogenes tolosa</i>, Hew. <i>Callithomia hedlia</i>, Godm. " <i>hezia</i>, Hew. <i>Hypocada adelphina</i>, Bates <i>Eresia nigripennis</i>, Godm.</p>	Central America.
<i>atthis</i>	<i>Tithorea pavonii</i> , Butl.	Peru.
<i>charithonia peruvianus</i> }		
<i>ismenius ismenius</i>	<p><i>Melinaea messatis</i>, Hew. <i>Napeogenes larina</i>, Hew. <i>Hypocada adelphina</i>, Bates <i>Ithomia candescens</i>, H.-Sch. }</p>	Colombia.
<i>ismenius fatuus</i>	<i>Ithomia celemia</i> , Hew. } <i>Ceratinia fulminans</i> , Hew. }	W. Colombia.
<i>ismenius clarescens</i>	<p><i>Melinaea scyllax</i>, Salv. <i>Ithomia plagiata</i>, Butl. " <i>callisila</i>, Bates, <i>Disimorphia sororia</i>, Butl. (♀)</p>	Costa Rica, etc.
<i>ismenius telechia</i>	<p><i>Melinaea imitata</i>, Bates <i>Lycorea ategatis</i>, Doubl. <i>Mechanitis doryssus</i>, Bates <i>Euclyptus cleobaea zorcaon</i>, Reak. <i>Ceratinia diomaea</i>, Hew. <i>Perrhybris malenka</i>, Hew. (♀) <i>Disimorphia praxinoe</i>, Doubl. (♀) <i>Eresia phillyra</i>, Hew. (♀) <i>Protogonius cecrops</i>, Doubl. <i>Pericopsis angulosa</i>, Walk.</p>	Central America.

that all but two species in Section I mimic species of other genera. Intrageneric mimicry occurs between two or three species in Section I and between a much larger number of species in Section II. One species in Section I produces forms which mimic six or seven species in Section II, a phenomenon recalling that of the mimicry of several species of *Planema* by one species of *Pseudacraea*.

Whilst I think that fuller knowledge of the genus is likely to confirm the majority of the conclusions here attained, it must not be forgotten that cases occur in which Lepidoptera quite undistinguishable on the armature structure are, nevertheless, known from other characters to be distinct species, and it seems probable that instances of this condition will also be found in the present genus.

The mimetic relationships of *Heliconius*.

The species and forms included under the group *Silvaniformes* nearly all resemble species of other genera and subfamilies. They are members of great mimetic associations which include species of widely separate affinities. It is not within the scope of the present paper to study in detail all these associations. They are fairly well known, and have been referred to by many authors. Beyond the fact that *hecalesia octavia* resembles *anderida zuleika*, the forms of *Silvaniformes*, excluding the intermediate *tumatumari* and *elevatus*, do not, as a rule, resemble those of members of Section II of the genus. The accompanying table (Table I) gives some of the more striking associations to which forms of the *Silvaniformes* belong.

As already stated, Mr. W. J. Kaye has pointed out* that, having once separated the forms of the genus into their two sections, we find that many of those of Section I resemble forms of Section II. In order more fully to illustrate this remarkable parallelism, I have prepared Pl. XII. The figures, as in Pl. XI, are much reduced, but will suffice to illustrate the patterns. The examples shown in the second and fourth columns are all forms belonging to *melpomene*—that is, accepting the conclusions already arrived at, are all the same species. The specimens figured in the first and third columns are all members of Section II, and belong to several species.

Fig. 1 is *egeria egerides*, fig. 2 *melpomene funebris cybele*.

* *Loc. cit.*

Both occur in Guiana and North Brazil as far as the Rio Negro. Figs. 5 and 6 are *burneyi hübneri* and *melpomene penelope*, both from Bolivia. Figs. 9 and 10 represent *hewitsoni* and *pachinus* from Panama. Figs. 13 and 14, 17 and 18, 21 and 22 represent respectively three forms of *sapho* and three of *cydno*. Figs. 25 and 26 are *himera* and *melpomene timareta contiguus*. In this case the patterns are by no means so alike as in most of the other examples, but that of the hind-wing of the *melpomene* form is the more interesting in that it shows the crowding together of the flame pattern rays in order to produce a resemblance to the band of *himera*.

Figs. 3 and 4 are *notabilis microclea* and *xenoclea* respectively, and beneath them (figs. 7 and 11) are *notabilis notabilis* and *erato rothschildi*, to which correspond the two *melpomene* forms, figs. 8 and 12. Figs. 15 and 16 are *hydarus chestertoni* and *weymeri gustavi*. These, I am told, have not the same vertical distribution, though possibly their enemies may not be correspondingly separated. Figs. 19 and 20 are *hydarus colombinus* and *amaryllis rosina* from Bogota. Figs. 23 and 24 represent *erato phyllis* and *melpomene amandus*, the latter example approximating to the form *nanna burchelli*, Poulton. It has been pointed out by Professor Poulton (Ann. Mag. Nat. Hist., p. 33 et seq., 1910) that where *nanna* occurs within the range of *erato phyllis* the red bar of the fore-wing is deeply toothed at the lower outer edge, just as in *erato phyllis*, whereas in his form *burchelli* the red bar is of less irregular outline. Finally, at figs. 27 and 28 are shown peculiar forms of *erato* and *melpomene* from Bolivia.

Adhering to our previous conclusions, we have, then, on Pl. XII, fourteen forms of one species of Section I which, whilst differing widely from one another, present respectively a remarkable resemblance to fourteen forms of Section II belonging to six different species. The examples shown by no means exhaust the subject. It would be possible to fill another plate with corresponding forms of *erato* and *melpomene*; *aoede*, *xanthocles* and *doris*, all have forms which could be included, and whilst so many forms in Section I mimic others in Section II, some of those in the latter seem to mimic each other. The nature of this mimicry is somewhat difficult to define. Mr. Kaye (*loc. cit.*) has himself pointed out its peculiarities. The comparative rarity of the forms of Sections I and II is not constant.

Thus *nanna* and *rosina* are much rarer than *phyllis* and *colombinus*, whilst, on the other hand, *xenoclea* is much commoner than *notabilis microclea*. He points out, however, the possibility that in some or, perhaps, most of the localities, members of one section may be always more dominant than the other. Also that the exact times of appearance may not coincide.

Hitherto it has been the custom to assign all such cases of mimicry either to the Batesian or Müllerian category. Those of us who have heard Mr. Swynnerton's remarks on his experiments in South Africa, given some time ago before the Linnean and Entomological Societies, know that the relative distastefulness of insects is a variable character dependent on factors not entirely related to the insect itself. Mr. Swynnerton's papers are not yet published, so that I cannot utilise his results for the present discussion. Meanwhile, we know that, although no direct experiments have been made with *Heliconius*, the genus gives great evidence of being a distasteful one, and we may therefore regard the existing resemblances as being of a Müllerian character. We are, however, faced with the difficulty of the multiplicity of patterns. If Section II contains the models it would appear to be a great disadvantage to the forms to have so many different appearances, since each form is not necessarily confined to a special locality but considerable overlapping occurs. Where mimicry occurs between separate species of separate genera, then multiplicity of patterns in the models may be compensated for by diversity of habit of the different species. Thus Mr. Kaye, in discussing mimetic groups in the Potaro district of British Guiana, states that the species of *Heliconius* with patterns resembling *Ithomiinae* frequent flowers of a certain plant, whilst other species of *Heliconius* are never, in his experience, found on these flowers. This is an extremely valuable point and one which should be remembered in considering mimetic phenomena.

It does not, however, seem probable that forms of the same species will have different habits corresponding to those of their respective models. Apart from the preferences of insectivorous enemies, whether absolute or conditional, the unpalatability of the insect is, of course, a relative factor. Thus resemblance of a species of *Heliconius* in Section I to a species in Section II may be a measure of protection to both, assuming the two species

to possess a certain degree of distastefulness. Another species of *Heliconius* may resemble a *Melinaea* or a *Lycorea*. We know that in most cases the Melinaeas are much more numerous than *Heliconius*, and we may suppose that the former are so much more unpalatable than the latter that, in spite of the degree of distastefulness in *Heliconius*, the latter may be practically a Batesian mimic of the *Melinaea*. At the same time it is, perhaps, inappropriate to use the term Batesian in this connection, since it was the mimicry of *Heliconius* which Bates himself felt unable to explain on his own theory. To understand more fully the relationships of models to mimics in *Heliconius* we require much more information concerning geographical distribution, and also as to comparative rarity of forms and other bionomic factors. S. America is a very large area, and the commonest type of data on our labels is "Upper Amazon," "Colombia," "Peru," and even sometimes "Brazil." We might as well be told that a certain insect occurs in Europe.

Including the examples figured on Pl. XII the following is a list of some of the most remarkable instances of intrageneric mimicry in the genus.

SECTION I.

cydno chioneus
 „ *epicydnides*
 „ *galanthus*
 „ *alitha*
weymeri gustavi
pachinus
melpomene funebris cybele
 „ *equadoriensis*
 „ *vicinus*
 „ *funebris deinea*
 „ *penelope*
 „ *penelope margarita* (?)
 „ *timareta contiguus*
 „ *aglaope f.*
xenoclea corona
amaryllis rosina
 „ *euryades*
vulcanus cythaera
xenoclea
nanna nanna

SECTION II.

sapho eleusinus
 „ *eleuchia*
 „ *leuce*
 „ *primularis*
hydarus chestertoni
hewitsoni
xanthocles
 „ *melior*
 „ *melete*
burneyi catharinae
 „ *hübneri*
erato anacreon ottonis
himera
erato rothschildi
notabilis notabilis
hydarus colombinus
 „ *hydarus*
cyrbia cyrbia
notabilis microclea
erato phyllis

SECTION II.

<i>doris delila</i>	<i>burneyi hübneri</i>
„ <i>metharmina</i>	<i>metharme</i> }
	<i>sara</i> ff. }

Of the genus *Eueides*, Seitz remarks that it may be said that no *Eueides*, without any exception, has a character of its own. Some copy *Heliconius*, others *Lycorea* and *Actinote*, and in some species the male copies one species whilst the female resembles another. A few of such resemblances are given below.

<i>Eueides.</i>	<i>Heliconius.</i>
<i>ricini</i> , Linn. }	<i>clysonimus</i> }
<i>procula</i> , Doubl. }	<i>hortense</i> }
<i>eanes</i> , Hew.	<i>erato lativitta</i>
<i>eanes eanides</i> , Stich.	<i>melpomene aglaope</i> f.
<i>dianasa</i> , Hübn.	<i>narcaea</i>
„ <i>decolorata</i> , Stich.	„ <i>satis</i>

All the numerous forms of *E. isabella*, Cram., resemble various forms of *Heliconius* of the *Silvaniformes* group.

In addition to the mimetic associations above tabulated there are further instances of considerable interest. Thus the resemblance of *Colaenis telesiphe* to *H. telesiphe* is well known. They fly together and cannot be distinguished on the wing. In Ecuador the *Heliconius* has the hind-wing band yellow instead of white and broader than in the typical form. The *Colaenis* in the same region is correspondingly modified. Several *Papilio*s present *Heliconoid* patterns, notably *P. zagreus*, Doubl., and its form *P. bachus*, Feld., which have an appearance recalling that of species of the *Silvaniformes*. *P. pausanias* is a mimic of *H. sara* and is also said to imitate the *Heliconius* flight.

P. euterpinus, Godm., though it can only be said to be a rough mimic of a *Heliconius*, presents the *melpomene* pattern which, as Dr. Dixey has shown, may be traced over a large area and through many species, including many forms of *Heliconius*, *Eresia castilla*, Feld. *Adelpha lara*, Hew., *Agrais amydon*, Hew., *Siderone* spp., *Catagramma euomia*, Hew., *Callithea davisii*, Butl., *Daedalma* sp., several species of *Pereute*, *Catasticta tentamis*, Hew., and a number of

moths, including Aretiids, Hypsids and Syntomids. With regard to *H. erato phyllis*, Seitz (Macrolepidoptera) records that, whilst it occurs all the year round in Rio and Santos, it becomes comparatively scarce in January and February, at which season only worn specimens are found. At the same time *Eresia lansdorfi* appears, a species which, as may be seen from its pattern, copies not a fresh, but a worn and faded *phyllis*. Several forms of *Heliconius* resemble species of *Tithorea* and *Hirsutis*. Some have already been mentioned, as *H. atthis*, etc. *H. crispus* flies with *T. bonplandii descandollesi* in the Cauca Valley. *H. hecuba* mimics *T. humboldti*, and *H. hecuba tolima* is a copy of *T. bonplandii*. *H. hecalesia* resembles *T. hecalesina*, *Ceratinia peridia*, *Callithomia tridactyla*, and others which form a large association, whilst its Central American form, *formosus*, resembles *T. pinthias*.

It is remarkable that *H. charithonia*, perhaps the commonest species of *Heliconius*, should have no close imitators. Professor Poulton points out to me that the females of *Catonephele nyctimus* approach this pattern, as also do those of *C. acontius*. The latter has a wider eastward range than *charithonia*, but the former is the better mimic in that the hind-wing yellow band is broader, though in both cases the resemblance is very slight. The *peruvianus* form of *charithonia* is evidently a modification in the direction of *Tithorea pavonii*, Butl., the marginal and sub-marginal spots being white instead of yellow. In one respect it is a better mimic of the *Tithorea* than is *H. atthis*, since the fore-wing yellow band is broader, as in the *Tithorea*, and curves down, not up, as in *Atthis*. The ♀ of *Pieris viardi*, Boisd., is also modified in the direction of *H. charithonia*, whilst *P. mandela tithoreides*, Butl., approaches *Tithorea pavonii* in the same way as does *H. charithonia peruvianus*.

Some of the most interesting *Heliconius* mimics occur amongst the *Pierinae*, such cases being the more noticeable since the normal Pierine fascies are so unlike those of *Heliconius*. Thus, *Euterpe bellona hyrnetho*, Fruhst., ♀, from Bolivia, has black wings with a fore-wing discal yellowish patch and a radiate red pattern on the hind-wing, thus resembling similar forms of *H. erato*. *Euterpe bellona cutila*, Fruhst., ♀, also shows the incipient stages of such a pattern. *E. bellona negrina*, Feld., ♀, bears on the underside a very good copy of the underside of *H. erato venusta*.

It is interesting to note that the flame pattern in these Pierines is a copy of that occurring in the species of *Heliconius* belonging to Section II, and not those of Section I. *Pieris mandela locusta*, Feld., ♀, and the form *noctipennis* resemble to some extent *H. sapho leuce*, whilst *Pereute charops*, Boisd., ♀, resembles *H. hydarus*. On the underside of the hind-wing (all that shows when at rest) the female of *Perrhybris lorena* is very like *H. antiochus aranea*, though the upperside is more like one of the Silvaniformes. A similar silvaniform appearance is also presented by several females of *Perrhybris*, though the resemblance is probably secondary, both being influenced by Ithomiine models. It seems unnecessary further to enumerate special cases of mimicry connected with the genus. An examination of any large collection will convince the observer of the prevalence of mimetic patterns.

Apart from a few exceptional instances, it appears to be the rule that, whereas species of *Heliconius* belonging to Section I are mimetic and constitute members of large associations of which they are not themselves the dominant models, species of Section II act as models and are imitated either by forms of Section I or by butterflies of other genera, and moths. The *melpomene* forms of Section I seem to be all one species, whereas their counterparts in Section II belong to several. Again, where a butterfly of another genus appears to be a *Heliconius* mimic, its model will almost always be found in Section II and not in Section I. Thus *Eueides* finds its models in Section II. Even *Napeogenes duessa* is apparently an incipient mimic of an *erato* form which is very perfectly imitated by a moth of the genus *Pericopis*. Moths of this genus come into mimetic associations of which silvaniform *Heliconii* are fellow members, but the moths are certainly not the models, though *Pericopis* is doubtless a protected genus. Distastefulness is a relative factor, and we are, of course, quite justified in speaking of model and mimic, even in Müllerian associations. The model is the form which, from whatever cause, not necessarily palatability, has attained to a greater predominance, and in the genus *Heliconius* it would appear that, generally, the species of Section II have in some way evolved a degree of such predominance superior to that enjoyed by the species of the other half of the genus. It is interesting to see an independent property of this kind correlated with recognis-

able differences of internal anatomy and a slight, though evident, external characteristic.

It remains to consider certain points in connection with the modifications which occur in various geographical areas. Several exhibits have been made and papers read on this subject. Mr. W. J. Kaye read a paper in 1906,* in which he described and illustrated the many forms of *Melinaea*, *Heliconius*, etc., forming a great characteristic group in the Potaro District of British Guiana. In this group were found to occur the following forms:—

NYMPHALIDAE.

Ithomiinae.

Melinaca 4

Mechanitis 2

Ceratinia 2

Heliconinae

Heliconius 4

Eueides 3

Nymphalinae

Eresia 1

DANAIDAE

Lycorcanae

Lycorea 2

ERYCINIDAE

Lemoniinae

Stalachtis 1

together with the outlying members of the group not up to that time actually taken on the Potaro, *Tithorea harmonia*, Cram., *Protoponius hippona*, Cram., *Dismorphia amphione*.

The dominant member of the group was *Melinaea mneme*, Linn., which occurred in "prodigious numbers." The *Heliconius* forms were found to be by far the closest mimics of the *Melinaea*, whilst at the same time they were comparatively rare.† Great variation was observed in the banding of the hind-wing from a narrow bar to almost entirely black. A careful and interesting analysis is made of the degree of blackening observed in the various forms, with the result that there is found to be a closer agreement on the underside than on the upper. Only two species

* Notes on the dominant Müllerian group of butterflies from the Potaro District of British Guiana. Trans. Ent. Soc. Lond., p. 411 et seq., 1906.

† See also Proc. Ent. Soc., p. liv, 1903.

showed a large proportion with heavy black underside. The tendency to melanism was found to be more prominent on the upperside. The author concludes that the forces of selection are now acting more forcibly on the underside pattern, as might be expected from the sedentary habits of the group, and that these forces are now tending to produce forms with less blackening. A further point of great interest was that already mentioned—namely, that all the members of the group are commonly found feeding on the white flowers of *Eupatorium macrophyllum*, and that whilst there are many other differently coloured forms of *Heliconius* in the neighbourhood, they are never, in the author's experience, found on these flowers. This point is worthy of special remark as showing how the advantages of similarity of pattern may be increased by the development of a common habit.

In 1908 Mr. J. C. Moulton read a paper "On some of the principal Mimetic (Müllerian) Combinations of Tropical American Butterflies" (Trans. Ent. Soc., p. 585 et seq., 1908) in which he described four great associations of mimetic forms, including *Ithomiinae*, *Heliconinae*, and members of other subfamilies. Association I is classed as the North Central American type from Guatemala, Honduras, and Nicaragua. The typical pattern is here that of *Melinaea imitata*, which is closely copied by *H. ismenius telchinia*, the rest of the group including—

Ithomiinae 5
Danainae 1
Nymphalinae 2
Heliconinae 1
Pierinae 2
Hypsidæ 1

Association II is described as the East Brazilian type and is divided into two subgroups (*a*) having the fore-wing subapical spots yellow and (*b*) having the same spots white. The first is centred round *Melinaea ethra*, Godt., and includes *H. "silvana" ethra* and other species of the following subfamilies:—

Ithomiinae 4
Danainae 1
Nymphalinae 2
Heliconinae 1
Pierinae 1



Peru	Bolivia	E. Amazon	W. Amazon	E. Brazil	S. Brazil	Trinidad
				(S. of Amazon)		
melpomene amaryllis euryades		melpomene				amaryllis euryades
amphitrite		erato cally- copsis				hydarus
melpomene aglaope	melpomene penelope	melpomene thelxiope melpomene aglaope	melpomene aglaope			
xanthocles melior doris delila erato deme- ter erato lati- vitta	aoede lucre- tius xanthocles melete doris delila erato venusta erato lati- vitta	aoede doris delila crato ama- zona	aoede bart- letti doris delila erato lati- vitta			
amaryllis					nanna besckei	
erato phyllis	erato phyllis				erato phyllis	

The second is apparently centred round *Mechanitis lysimnia*, Fab., and includes *H. narcaea* and *H. narcaea polychrous*.

Association III is the Upper Amazon or Ega type, containing dark brown forms and including *Mechanitis egaensis*, Bates, and a form of *H. pardalinus* and seven species of other subfamilies.

Association IV is described as the Bolivia, Ecuador and Peru type, characterised by orange-tawny markings on a black ground and including *Melinaea mothone*, Hew., and *H. aristiona aristiona* also.

Ithomiinae 4
Satyrinae 2
Nymphalinae 3
Heliconinae 2
Acraeinae 1
Papilioninae 2
Hypsidæ 2

M. C. Oberthür has published an interesting account,* with a wealth of illustration, of the variation of *H. vesta* (*erato*) and *H. thelxiope* (*melpomene*), in which he shows how the variations of one are exactly copied by the variations of the other throughout their range. He comes to the remarkable conclusion that, whilst the two species can be distinguished in nearly all their localities, they each ultimately produce a form which he calls *melpomene*, and the *melpomene* form of *vesta* is indistinguishable from the *melpomene* form of *thelxiope*. Oberthür's figures of these *melpomene* forms are equivalent to *H. erato callycopsis*, f. *viculata* and *H. melpomene melpomene* f. *atrosecta* respectively. Oberthür was, of course, unaware of the character separating the genus into two sections, though his two forms of "*melpomene*" can also be distinguished by the shape of the red band on the fore-wing.

It may be interesting to note the geographical distribution of some of the characteristic patterns of the genus, and the appended table (Table II) shows the range of five such patterns. It is based on existing information as to the localities in which the forms named have been taken. Such information is, of course, of a positive nature, whereas the absence of any record of a form from a given locality

* Étud. d'Ent., 21, 1902.

TABLE II.

	Guiana			Venezuela	Colombia	Central America	Ecuador	Peru	Bolivia	E. Amazon	W. Amazon	E. Brazil (S. of Amazon)	S. Brazil	Trinidad
	French.	Dutch	British											
I. <i>melpomene</i> pattern. Black with f.-w. red patch	melpomene	melpomene	melpomene vulcanus pyrforus	amaryllis rosina euryas amaryllis euryades	amaryllis rosina euryas vulcanus	amaryllis rosina euryas vulcanus	melpomene	melpomene amaryllis euryades		melpomene				amaryllis euryades
		erato callycopsis		hydarus hydarus guarica	hydarus hydarus guarica	hydarus petiveranus tristis		amphitrite		erato callycopsis				hydarus
II. <i>huebneri</i> pattern. F.-w. with basal red and discal yellow H.-w. with "flame" pattern	melpomene eulalia	melpomene eulalia					melpomene aglaope	melpomene aglaope	melpomene penelope	melpomene thelxiope melpomene aglaope	melpomene aglaope			
	aoede xanthoicles vala doris delila	xanthoicles vala doris delila		aoede lucretius	xanthoicles melete		aoede bartletti xanthoicles melior doris delila	xanthoicles melior doris delila erato demeter erato lativitta	aoede lucretius xanthoicles melete doris delila erato venusta erato lativitta	aoede doris delila erato amazona	aoede bartletti doris delila erato lativitta			
III. <i>phyllis</i> pattern. F.-w. with discal red H.-w. with yellow band					amaryllis rosina	amaryllis rosina		amaryllis					nanna besckeii	
				petiveranus	petiveranus hydarus columbinus	petiveranus		erato phyllis	erato phyllis				erato phyllis	
IV. <i>sapho</i> pattern. F.-w. discal yellow or white H.-w. marginal yellow or white					cydno cydno cydno temerinda cydno epicyd- nides	cydno chioneus cydno galanthus	cydno alithea							
					sapho eleuchia	sapho leuce	sapho primularis							
V. <i>himera</i> pattern. F.-w. discal yellow H.-w. discal red				doris erantonia clysonimus	doris erantonia clysonimus hortense	doris transiens doris erantonia clysonimus hortense	hierax himera clysonimus hortense							

is merely negative evidence of its non-occurrence. In the case of the "*melpomene*" pattern (No. 1) forms of Section I are accompanied by forms of Section II in seven out of ten localities. Applying the same method of analysis to the first four selected patterns, we find that of twenty-four occurrences of such patterns appertaining to members of Section I, twenty-one are accompanied by corresponding patterns in members of Section II. The fifth pattern occurs only in members of Section II, and in this case no species occurs without another which resembles it, whilst in Ecuador no less than four species having this coloration form an interesting group.

In the light of present information there seems little more to be said with reference to these resemblances. That the genus *Heliconius* contains only some thirty good species instead of about seventy is not a very surprising conclusion in view of the methods hitherto adopted in species determination, and the fact that probably no other genus of Lepidoptera exhibits so great an instability of pattern. The remarkable varietal and mimetic phenomena exhibited by the two sections of the genus provide, however, a field of valuable research, calling for an experimenter who can carry out in S. America the class of work we inevitably associate with the names of Marshall, Swynnerton, Lamborn, and Carpenter in Africa.

EXPLANATION OF PLATES XI-XVII.

[See Explanations facing the PLATES.]



EXPLANATION OF PLATE XI.

FORMS OF *Heliconius* APPARENTLY CONSPECIFIC WITH *H. melpomene*.

- FIG. 1. *H. cydno cydno*, Doubl.
 2. " " " (underside).
 3. " " *cydnides*, Staud.
 4. " " *hermogenes*, Hew.
 5. " " *alitha*, Hew.
 6. " " *hahneli*, Staud.
 7. " " *zelinde*, Butl. (near).
 8. " *vulcanus cythera*, Hew.
 9. " *heurippa wernickei*, Staud.
 10. " " *heurippa*, Hew.
 11. " " " f. nov.
 12. " " *rubellius*, Gr.-Sm. (near).
 13. " " " (underside).
 14. " *weymeri weymeri*, Staud.
 15. " " *gustavi*, Staud.
 16. " *melpomene penelope*, ab. *pluto*, Stgr. (near).
 17. " " *amandus*, Sm. and Kirb.
 18. " *amaryllis rosina*, Boisd.
 19. " " *eurycles*, Riff.
 20. " *melpomene melpomene*, Linn.
 21. " *xenoclea constuens*, Lathy.
 22. " " *xenoclea*, Hew.
 23. " " *corona*, Niep.
 24. " *melpomene isolda fibaria*, Niep.
 25. " *melpomene funebris deinia*, Moschl. (near).
 26. " " *tyche*, Bates.
 27. " " *penelamanda*, Stgr.
 28. " *pachinus*, Hew.

EXPLANATION OF PLATE XII.

INTRAGENERIC MIMICRY IN *Heliconius*.

- FIG. 1. *H. egeria egerides*, Staud.
2. ,, *melpomene cybele*, Cram.
3. ,, *notabilis microclea*, Kaye.
4. ,, *xenoclea xenoclea*, Hew.
5. ,, *burneyi hübnéri*, Staud.
6. ,, *melpomene penelope*, Staud.
7. ,, *notabilis notabilis*, Godm.
8. ,, *xenoclea corona*, Niep.
9. ,, *hewitsoni*, Staud.
10. ,, *pachinus*, Hew.
11. ,, *erato rothschildi*, Niep.
12. ,, *melpomene isolda fibaria*, Niep.
13. ,, *sapho primularis*, Butl.
14. ,, *cydno alithea*, Hew.
15. ,, *hydarus chestertoni*, Hew.
16. ,, *weymeri gustavi*, Staud.
17. ,, *sapho eleuchia*, Hew.
18. ,, *cydno cydnides*, Staud.
19. ,, *hydarus colombinus*, Staud.
20. ,, *amaryllis rosina*, Boisd.
21. ,, *sapho leuce*, Doubl.
22. ,, *cydno galanthus*, Bates.
23. ,, *erato phyllis*, Fab.
24. ,, *melpomene amandus*, Sm. and Kirb.
25. ,, *himera*, Hew.
26. ,, *melpomene timareta contiguus*, Weym.
27. ,, *erato anacreon ottonis*, Riff.
28. ,, *melpomene*, f. *penelope margarita*, Riff. (near).

MODELS

MIMICS

MODELS

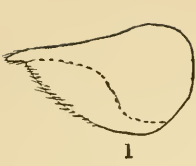
MIMICS



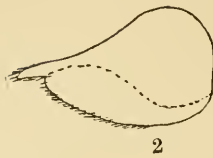
Trinsbam

Andre, Steich & Angle

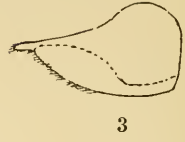
GENUS *HELICONIUS*, MODELS AND MIMICS.



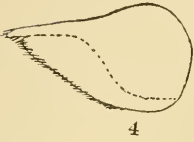
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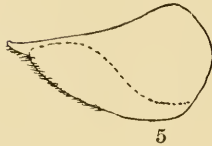
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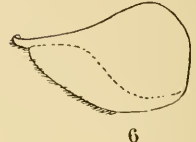
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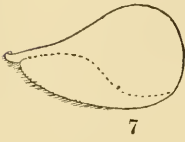
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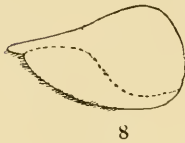
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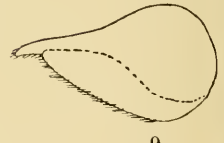
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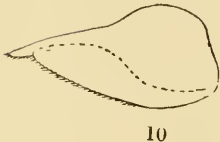
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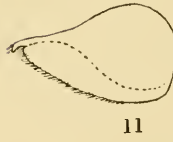
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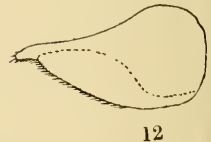
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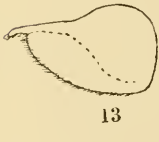
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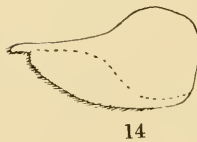
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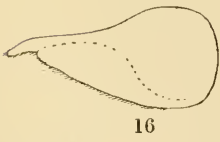
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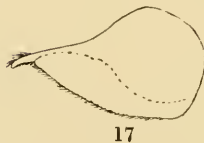
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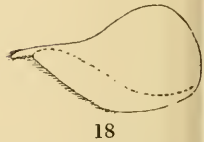
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CLASPERS OF HELICONIUS.

EXPLANATION OF PLATE XIII.

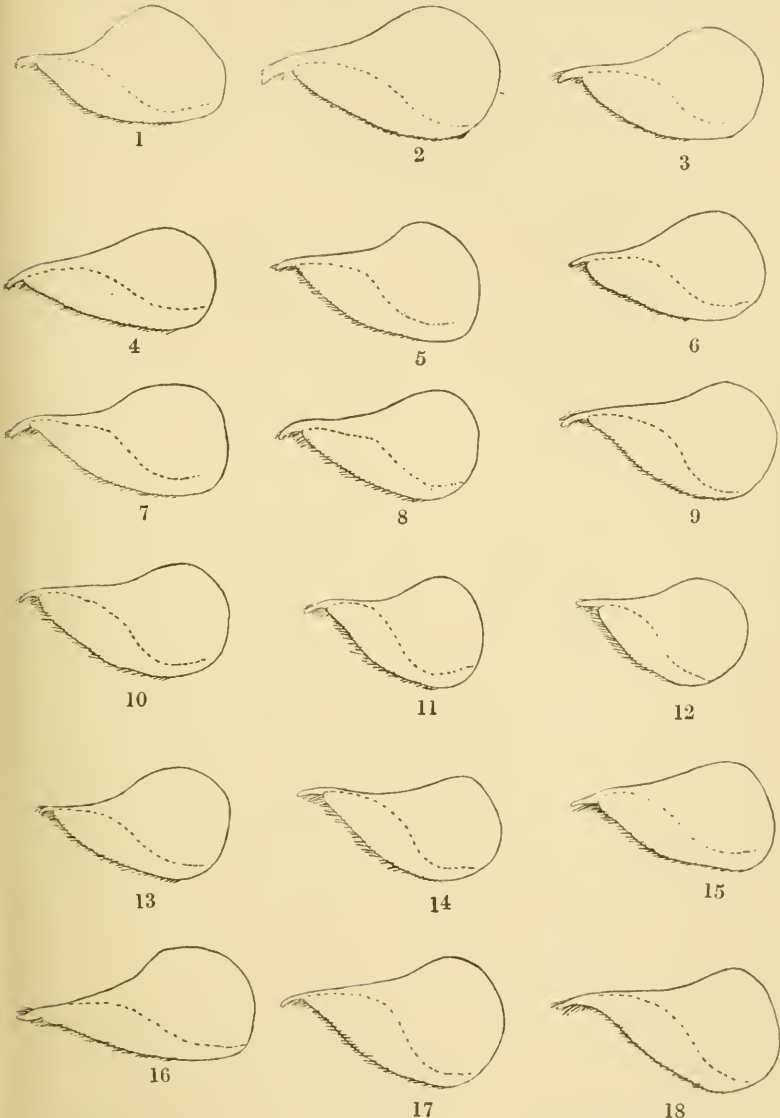
OUTLINES OF MALE CLASPERS IN *Heliconius*.

- FIG. 1. *narcaea narcaea*.
2. „ *salis*.
3. „ *polychrous*.
4. *numatus numatus*.
5. „ *superioris*.
6. „ *guiensis*.
7. *silvana silvana*.
8. „ „
9. *ethilla ethilla*.
10. „ „
11. „ *tyndarus*.
12. „ „
13. „ *aerolome*.
14. *gradatus thielei*.
15. *ethilla metalilis*.
16. „ *claudia*.
17. *novatus novatus*.
18. „ *leopardus*.

EXPLANATION OF PLATE XIV.

OUTLINES OF MALE CLASPERS OF *Heliconius*.

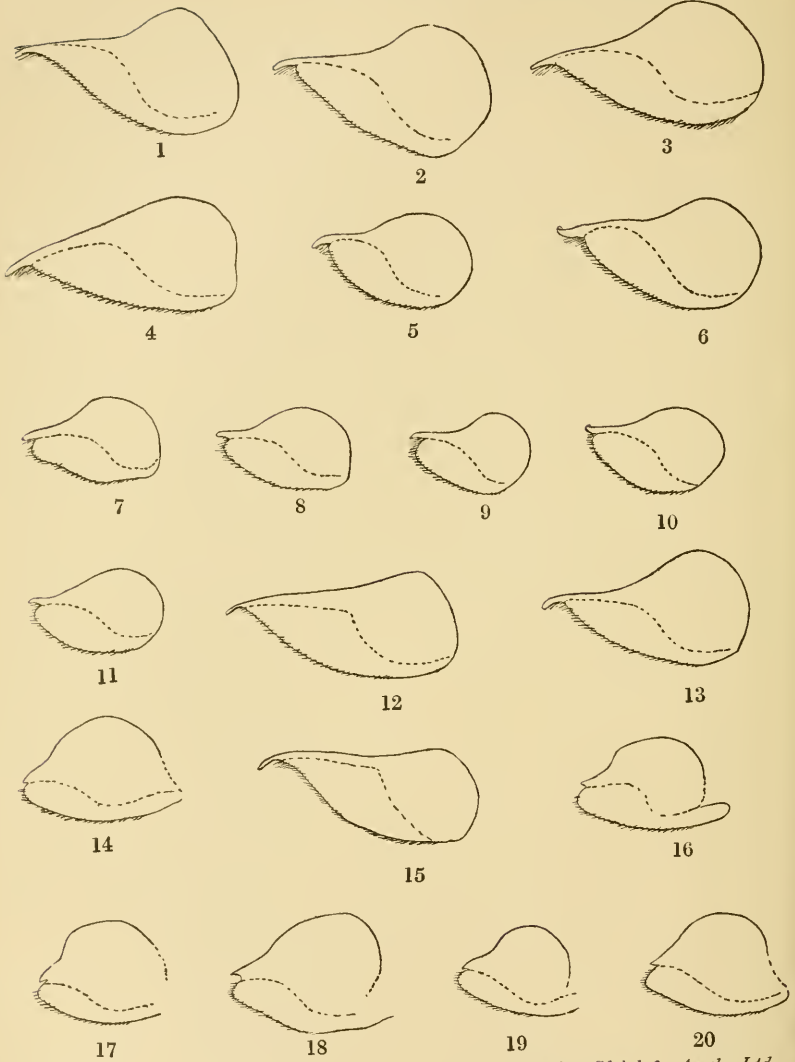
- FIG. 1. *novatus mira*.
2. *hecale*.
3. *aristiona aristiona*.
4. ,, *tarapotensis*.
5. ,, *lenaeus*.
6. ,, *messene*.
7. ,, *aurora*.
8. ,, *arcuella*.
9. ,, *floridus*.
10. *ithaka*.
11. *pardalinus lucescens*.
12. *fortunatus spurius*.
13. *paraensis latus*.
14. *quitalenus quitalenus*.
15. ,, *felix*.
16. *anderida anderida*.
17. ,, *melicerta*.
18. ,, *holocophora*.



H. E. dcl.

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CLASPERS OF HELICONIUS.



H. E. del.

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CLASPERS OF HELICONIUS.

EXPLANATION OF PLATE XV.

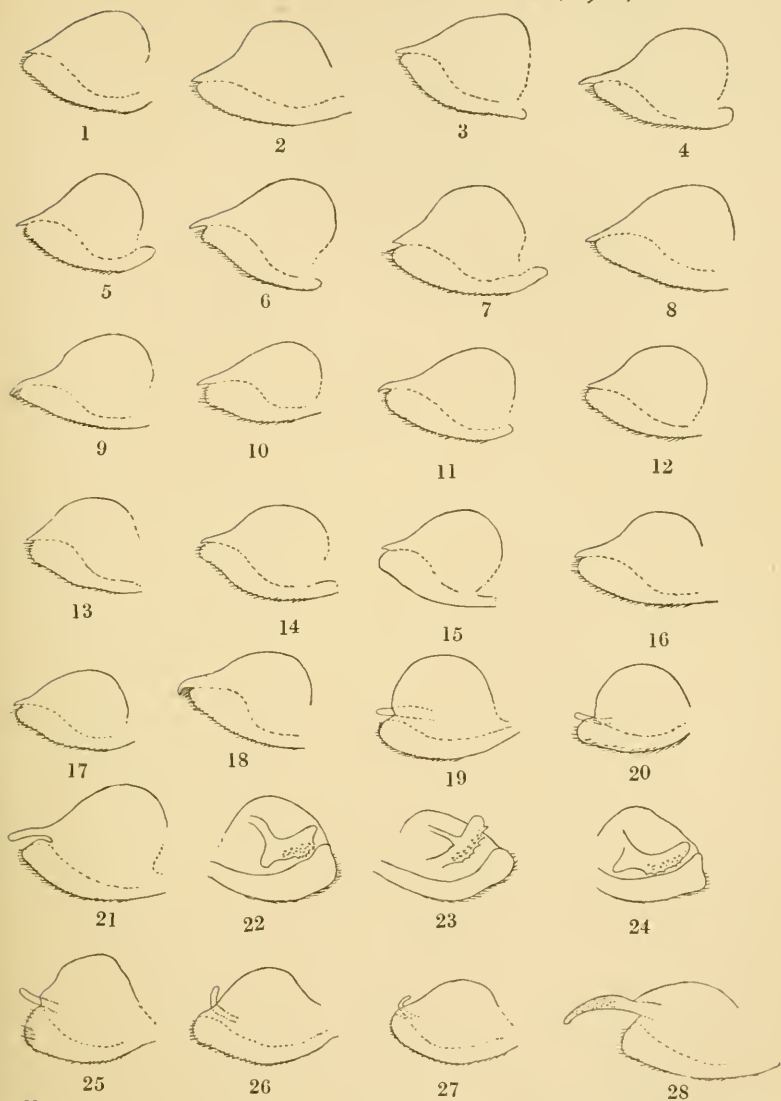
OUTLINES OF MALE CLASPERS OF *Heliconius*.

- FIG. 1. *anderida albucilla*.
2. „ *zuleika*.
3. „ *fornarina*.
4. *aulicus*.
5. *sergestus*.
6. *vetustus metellus*.
7. *ismenius ismenius*.
8. „ *faunus*.
9. „ *telchinia*.
10. „ *clarescens*.
11. „ *silvana* ” *metaphorus*.
12. „ *robigus*.
13. *atthis*.
14. *cydno cydno*.
15. „ *silvana* ” *ethra*.
16. *cydno cydno*.
17. „ *galanthus*.
18. „ *zelinde*.
19. „ *epicydnides*.
20. *weymeri gustavi*.

EXPLANATION OF PLATE XVI.

OUTLINES OF MALE CLASPERS OF *Heliconius*.

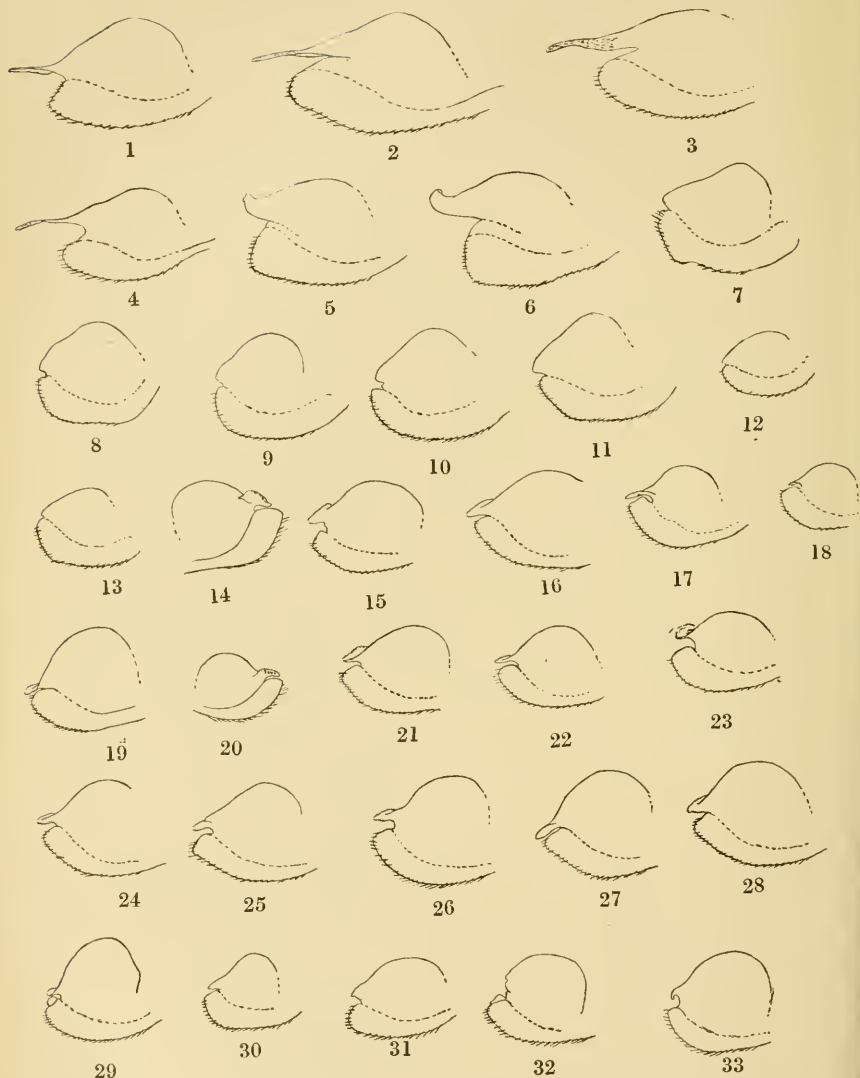
- FIG. 1. *pachinus*.
2. *heurippa*.
3. *melpomene melpomene*.
4. „ *thelxiope*.
5. „ „
6. „ *eulalia*.
7. „ *timareta contiguus*.
8. „ *funebri cybele*.
9. „ *thelxiope augusta*.
10. „ *adonis*.
11. *amaryllis euryades*.
12. „ *rosina*.
13. *vulcanus vulcanus*.
14. „ „
15. „ *cythera*.
16. *xenoclea*.
17. *nanna*.
18. *besckei*.
19. *hecuba*.
20. *choarinus*.
21. *hecalesia*.
22. *metharmé*.
23. *aoede*.
24. „ *astydamia*.
25. *xanthocles*.
26. „ *melior*.
27. *hierax*.
28. *egeria egerides*.



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CLASPERS OF HELICONIUS.



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CLASPERS OF HELICONIUS.

EXPLANATION OF PLATE XVII.

OUTLINES OF MALE CLASPERS OF *Heliconius*.

- FIG. 1. *burneyi*.
2. „ *hübneri*.
3. „ *catharinae*.
4. *wallacci*.
5. *doris doris*.
6. „ *delila*.
7. *hewitsoni*.
8. *congener*.
9. *sapho eleuchia*.
10. „ „
11. *antiochus alba*.
12. *leucadia*.
13. *sara*.
14. *himera*.
15. *notabilis microclea*.
16. „ *notabilis*.
17. *cyrbia cyrbia*.
18. *petiveranus petiveranus*.
19. *favorinus*.
20. *petiveranus tristis*.
21. *hydarus hydarus*.
22. „ *colombinus*.
23. „ *chestertoni*.
24. *erato erato*.
25. „ *amazona*.
26. „ *magnificus*.
27. „ *estrella*.
28. *amphitrite amphitrite*.
29. *hermathena*.
30. *charithonia*.
31. *telesiphe*.
32. *clysonimus*.
33. *hortense*.

V. *A reply to Dr. Eltringham's paper on the genus Heliconius.* By W. J. KAYE, F.E.S.

[Read April 5th, 1916.]

IN reviewing Dr. Eltringham's groupings of the species of *Heliconius* by their genitalia, it is necessary to be very cautious as to the classificatory value of these organs. In some cases close relationship is, on account of practically identical genitalia, liable to be mistaken for co-specificness. No doubt these dissections would be helpful, and where corroborative evidence was forthcoming with series of specimens showing every gradation the results might be regarded as proved. But even in the supposed identical species *melpomene*, *heurippa*, *amaryllis*, *vulcanus*, *xenoclea*, *nanna*, which Dr. Eltringham now considered should include even such hitherto supposed well-differentiated species as *cydno*, *weymeri* and *pachinus*, there is not enough evidence at present in the form of intergraded specimens to make that conclusion wholly acceptable, especially for the last. With the others I am disposed to agree they are probably one species. *Pachinus* seems to offer the greatest difficulty, as it only occurs in Chiriqui and Costa Rica and is there accompanied with *rosina* (without doubt a local form of *melpomene*), but the two show no tendency to unite. Here there would be two subspecies of the same species occurring side by side, which is an untenable position as we at present understand species and subspecies.

Similarly *cydno* and *hermogenes* occur together at Muzo in Colombia, but do not intergrade. *Cydno* always has a white band to the hindwing. It sometimes replaces the yellow band of forewing with a white band, and is then known as *chioneus*. *Hermogenes* always has a yellow band to the hindwing. *Temerinda* is no doubt a form of *hermogenes*, with the spots of the forewing united into a band. Both of these latter forms could have either white or yellow forewing bands or spots, but never, so far as is known, a white hindwing band.

The solving of the *tumatumari* mystery is very satisfactory. *Tumatumari* occurs with *pyrforus* and other

species in the Potaro district of British Guiana. When I described *pyrforus* as a subspecies of *vulcanus*, I did so feeling that it could not possibly be a subspecies of *melpomene*, as *tumatumari* appeared to be another subspecies linking on to *thelxiope*. More recently I have felt convinced that *vulcanus* and its subspecies were really forms of *melpomene*. Now Dr. Eltringham has made the discovery that *tumatumari* is a widely removed species, and thus the old difficulty of two co-existent subspecies vanishes. That *tumatumari* should show strong resemblance to the silvaniform genitalia is remarkable and almost unique among melpomeniform-looking insects. There are probably other species that are as yet undiscovered.

There is one other point in connection with all the forms proposed to be included under *melpomene*. It is somewhat anomalous if one united all the Melpomeniformes and Cydnoformes as one species that *besckeii* should be left out. It occurs only above 2500 ft. in S. Brazil, and is far commoner at 3000 ft. It is possible that it replaces *nanna* of a lower elevation, but intermediates between the two are apparently unknown. Moreover, *nanna* is always rare and *besckeii* very common. I feel disposed to think that Dr. Eltringham is right in separating it as distinct from *melpomene*, but this seems to rather weaken the case for all the other forms being one species, especially as *besckeii* is only slightly different.

The companion species of group II, viz. *erato*, which Dr. Eltringham thinks should include *himera*, *microclea*, *cyrbia*, *favorinus*, *petiveranus*, *hydarus*, and *amphitrite*, is very possibly and even probably true to a large extent, as intergrading series of several have already been found. On the other hand, there is the same difficulty with this group as with *melpomene*. In some cases, such as *cyrbia* and *himera*, we find two constant forms occurring together. Such is the case with these two at Loja in Ecuador. *Erato* is, however, locally so extraordinarily polymorphic, such as in East Bolivia, that it is quite likely intergrades of even *himera* and *cyrbia* will be found in some locality yet to be discovered.

In the Proc. Ent. Soc., 1907, p. xiv, I had already suspected *notabilis* of being an extreme form of *erato*. There is no longer any doubt that many *Heliconius* species can interchange the colours red, white and yellow, and as

plesseni can be found intergrading with *xenoclea* there is ground for supposing that the white-banded *cydno* could possibly intergrade with *heurippa*, which is half red and half yellow-banded, and even with *melpomene* itself. The extreme rarity in some cases of white-banded Heliconine forms in place of yellow-banded is a matter for future investigation. *H. telesiphe*, *clissonimus*, and *doris*, the last in both its red and blue form, very rarely occur with white bands on the forewing, yet a species like *antiochus* occurs white-banded over an immense area, and only in a few restricted areas at a considerable elevation is it yellow-banded.

It seems possible that in this case a varying intensity of light might account for the change, in just the same way as many flowers, seemingly white, under the influence of strong light develop a pink pigment. Such, for example, as some kinds of roses and tulips, which will remain white for some days before any colour appears and will even remain white if the weather be dull without sun.

The double spotting of *xenoclea*, *plesseni*, *adonides* and *niepelti*, etc., might be looked upon as another phase of the single spot of *melpomene* breaking up in just the same way as is now known the *thelxiope* spotting is a breaking up of the single spot. In *erato* also the same transitions could easily be traced between the solid spot of *magnifica* and the intermediate semi-broken spot of *calliste*, *callycopis*, *elimaea* and *udalrica*. Forms of *plesseni*, *notabilis*, *xenoclea* and *microclea* have been recorded and figured where the spots were confluent, at once suggesting a *melpomene*-like insect.

In looking at the wonderful changes which both *melpomene* and *erato* are known can undergo, there are some interesting comparisons to be made from fresh-caught specimens and specimens of the same form that are some years old. It is to be seen that in fresh examples of such insects as *feyeri*, *udalrica*, *andremona*, etc., the red markings are all uniformly brilliant. But after about two years the red at the base of the forewing and the streaking of the hindwing becomes brown-red, while the red of the band or blotch of the forewing retains its brilliant colour for some years longer. This no doubt indicates the ancestral character of the forewing blotch and the much more recent and less staple other red marks.

In some cases an approach of one to another form may

be an instance of mimetic approach. Such cases are common with the *Heliconii* such as *H. aoede astydamia*, *H. egeria egeria*, and *H. burneyi catharinae*, which all belong to group II and occur together in the Potaro district of British Guiana. The red marks on the undersides of all forms of *cydno* are sometimes reproduced on the underside of *weymeri*, but these might only be mimetic. *H. choarinus* shows this red marking beneath, but is in no way related to *cydno*, as it belongs to group II.

With the two groups of forms united respectively under *melpomene* and *erato* it is, however, just possible that Dr. Eltringham's contention of their respective co-specificness may be correct. But at present there is a great deal of proof still needed and several obstacles to be overcome.

With several of the other groupings I am afraid I could not agree. *Numata* and *silvana* are, I feel sure, always distinct, and although *numata* varies enormously it is easily separable from the much more stable *silvana*; in British Guiana they would form two subspecies occurring together. With part of the remainder of the forms which Dr. Eltringham groups together into (1), composed of *narcaea*, *ethilla*, *gradatus*, *sulphureus*, it is possible they might be the same, although *narcaea* does not come very close in fascies, but it is significant that going northwards from Rio its habitat, on arriving at Bahia the characteristic white apical patch has become yellow, while further north it is possible the yellow patch might be found broken up into a spotted band so characteristic of a number of the forms proposed to be united.

With Dr. Eltringham's group of species number (2) at the present time it seems impossible to unite *aristiona* with *ithaca* and *aulicus*. *Ithaca* in the female is no doubt a mimic of *aristiona messene*. The two sometimes occur together, but show no tendency to form one species. *Hecale*, *ithaca*, *quitalenus* and *anderida* are quite possibly the same, though the first two needed further proof. The form *fulvescens* figured in the P.Z.S., 1906, Pl. XXXIV, fig. 1, might be an aberration of *hecale (pasithoe)*, or, as has been suggested by Mr. P. I. Lathy, it might be a hybrid between *vetustus* and *hecale*. *Vetustus* occurs along several of the rivers of British Guiana, including the Demerara, while *hecale* is seemingly confined to the latter.

Atthis (4) is found to be indistinguishable from *aristiona lenaeus*. This must be only coincidence. No one could

ever suggest it was the same species. I do not think that it could ever even pair with any form of *aristiona*, being separated by the Andes. It occurs at from 1500 to possibly 3000 ft. on the Pacific slope of Ecuador, while *lenaeus* is on the eastern slopes.

Metharme Dr. Eltringham groups with *aoede*, and finds the claspers of these different from all others. This grouping together certainly looks wrong. The geographical distribution of these two is similar, but not identical. The former being more western, occurring at Ega on the Amazon, and stretching to Pebas and Iquitos into Colombia. It is never an abundant species and occurs only sparingly. The locality British Guiana often quoted must, I think, be an error. It is a very constant species, and practically no variation is found. With *aoede* very definite geographical races are found in British Guiana, the lower Amazon, the upper Amazon and Peru. The species is in some localities quite plentiful, as on the lower Amazon, especially about Para, which produces the typical form.

There is nothing beyond the genitalia to even suggest they might be the same. The body is entirely black in *metharme* except for a yellow streak below on the abdomen, while all the subspecies of *aoede* show the pairs of subdorsal yellow spots, and these show no sign of varying. Again, the apical yellow band of *metharme* is in quite a different position to any part of the group of yellow spots of *aoede*.

Then *sappho*, *antiochus*, *leucadia* and *sara* are found to be indistinguishable. *Leucadia* and *sara* might well be the same species, as some forms of *leucadia*, such as *pseudorhea*, are exceedingly like some forms of *sara*. But that *sappho* and *antiochus* could also be the same species seems improbable. *Antiochus* at low levels is exceedingly constant. At higher elevations it is very frequently yellow instead of white-banded, and at certain localities (always above 3000 ft., I believe) it is even constantly yellow-banded as in the form *aranea*. *Sara* is present frequently where *antiochus* is found, but there does not appear to be any cause to think they are the same. *Sara* is smaller, of a different shape, and is always yellow-banded from sea-level up to 3000 or 4000 ft., varying only geographically in the width of the band. *Sappho* has quite a different geographical range, and occurs in its varying geographical races from Guatemala to Colombia and Ecuador, not occurring on the east side of South

America. In shape and size it is also quite different. *Sappho*, like *antiochus* and one or two other Heliconines, occurs with white bands at sea-level and low elevations, while at higher elevation it becomes yellow-banded as in *primularis*. But this change from white to yellow is not universally true in passing from a low elevation to a higher one.

Of *burneyi* and *wallacei* Dr. Eltringham says, "Some of the forms of *burneyi* are rather variable. Those of *wallacei* exhibit a structure intermediate between the extremes of those of *burneyi*." This really amounts to the fact that it is impossible to separate these two by the genitalia. Apart from the quite different fascies these two species have different antennae. The whole of the long club on the underside is orange in the different forms of *burneyi*, but black in all the forms of *wallacei*. The antennae of *burneyi* are also longer, having 40 joints against 37 in *wallacei*. On the evidence that is to hand it is quite impossible to regard these as the same species. They frequently occur together in various localities, but never show any intermediates, and in fact have very little in common except the short red streaks on the underside of the hindwing.

H. ethra and *H. robigus* are found to be alike and of a distinctive type. These are quite likely the same. They have a similar brand on the underside of the inner margin of the forewing. *Ethra* is probably the more northern race of *robigus*. It occurs with *narcaea flavomaculata* at Bahia, while *robigus* flies with typical *narcaea* at Rio and southwards. By the additional evidence of the curious brand to that of the genitalia it looks as if it was wrong to in any way connect the two forms with *silvana*, which has no such brand.

In reviewing the classificatory results obtained by Mr. Eltringham from microscopical examination of the genitalia, it appears evident that these organs are not wholly reliable in differentiating species, and that to base a classificatory scheme on this one character alone would give results, which in the light of further evidence as to geographical range, etc., would be untrue. It would be far safer to unite only those species of which we have complete transitional series, when we could take as confirmation a wholly constant genitalia. It is very necessary to be on one's guard, with a group where so comparatively little variation is found in these organs, not to accept

as one species, without further proof, forms with identical genitalia. Among the moths *Zygaena lonicerae* and *Zygaena trifolii* in all its forms have the same genitalia, so also have *Plusia iota* and *Plusia pulchrina*, yet we know these to be distinct species, the two latter having distinct larvae besides well-differentiated imagines. On the other hand, where differences occur we doubtless have evidence of specific distinctness which in some of the Heliconine instances was not even suspected.

VI. *On the Pairing of the Plebeiid Blue Butterflies* (LYCAENINAE, tribe PLEBEIIDI). By T. A. CHAPMAN, M.D., F.Z.S.

[Read March 1st, 1916.]

PLATES XVIII-LXII.

IN the following notes I propose to describe some specialisations of both the male and female appendages in the tribe *Plebeidi* of the "Blues" (LYCAENINAE).

Much has been done in the description of the male appendages of the Lepidoptera, both from a morphological and a systematic point of view, though not perhaps much as compared with what remains to do. The female appendages have been less elucidated, and the precise correlation of the male and female appendages has barely been dealt with.

My observations refer to the latter aspect of the subject in a small tribe of the "Blue" butterflies, in which the specialisations seem at first sight quite paradoxical when compared with what is usual in the rest of the order. A few years ago on comparing notes with my friend the Rev. C. R. N. Burrows, it appeared that he had noted that there was something unusual in the pairing of these butterflies, and it is very probable that, like us, others were, broadly speaking, cognisant of this circumstance; but I have not met with any published account of the facts either generally or in detail.

It may be arguing in a circle, but I incline to define the *Plebeidi*, as those butterflies that possess this particular specialisation, and to assert that it does not exist outside the tribe. This, however, will not seem so irrational, in view of the fact that, with small specific variations, the structures throughout the tribe are very uniform, and that outside it there is a considerable gap between it and the nearest approach to it amongst related tribes.

The "Blue" butterflies (the sub-family LYCAENINAE) comprise a number of tribes; the one we are interested in, the PLEBEIIDI, is especially a Palaearctic (and Nearctic) one. For example, of the eleven Blues accredited to our British

list, six are Plebeïids, and of the other five, two, *argiades* and *boetica*, can hardly be called natives. Of European species there are nearly three Plebeïids to two of other tribes, and the same is about the ratio in the whole Palaearctic area. So far as my knowledge extends, no PLEBEIID are found south of the Palaearctic (and Nearctic) region, except the genus *Chilades*, a genus less typical of the tribe than any other. This is quite subtropical, if not tropical, in its distribution; (*Polyommatus?*) *martini* and *allardii*, occurring in Algeria though not in Europe, seem to be the most southern of typical species, but are always tabulated as Palaearctic.

I have no systematic objects, but shall for convenience adopt the genera given in Tutt's "British Lepidoptera."

The male appendages of the Plebeïids are remarkably similar throughout the tribe, both in the form and character of the clasps and of the dorsal armature, and differ very much from those of other "blues" in these structures. These are so frequently figured in papers of my own in our Transactions, in Tutt's "British Lepidoptera" and elsewhere, and by others, that I need not dilate on them.

Before describing the actual structural peculiarities of the Plebeïids, that bear most directly on the subject of this paper, it may be useful, as some basis of comparison, to say a few words as to what, so far as my meagre knowledge permits, is the most usual structure of these parts that obtains in other Lepidoptera, or rather to indicate something of the range of variation that obtains in those portions of the appendages that in the Plebeïids are at the extremity of the range in a certain direction.

The most characteristically specialised of these in the Plebeïids is the penis, which has to reach the bursa and provide it with the product of the male glands.

The penis consists usually of two portions—the aedeagus, a solid, basal, highly chitinised portion, and the eversible membrane (*vesica*, Pierce); the latter often armed with spines, etc. (*cuneus*, Stitz, *cornuti*, Pierce).

When pairing takes place the *bursa copulatrix* is reached either by the aedeagus, or by the extension of it constituting the eversible membrane.

A conclusion one early arrives at in examining these structures is that the aedeagus and the eversible membrane are continuous portions of one structure (or tube), as is,

of course, obvious when the membrane is everted; but beyond this, that the external portion of the aedeagus only differs from the membrane by being chitinised, and that the length of the external portion of the aedeagus varying in different species, and often greatly in closely

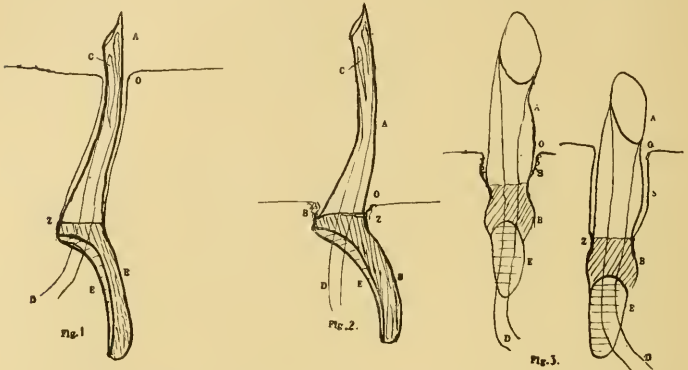


FIG. 1.—Diagram of aedeagus (founded on *Thecla*) when retracted.

FIG. 2.—Diagram of aedeagus when exerted.

FIG. 3.—Similar diagrams of aedeagus in an *Erebia*. The lettering indicates:—

- A. Chitinous tube of the aedeagus, external portion.
- O. The opening in the floor of the genital cavity, through which the aedeagus is advanced and retracted.
- S. Membranous sheath, sinus (Kusnezov), derived from floor of cavity, that permits this movement, stretched in fig. 1 during retraction, gathered together in fig. 2.
- Z. The zone at which S is attached to the aedeagus.
- B. Internal portion of aedeagus continuous with A, but having an outer layer continuous with S.
- E. Internal opening of aedeagus, where the two layers are reflected into each other.
- D. *Ductus ejaculatorius*, continuing upwards into A, and reflected from it at its free margin, *i. e.* continuous with it, forming in this region the eversible membrane (*vesica*, Pierce) armed with *C* (*cuneus*, *cornuti*).

The same explanations apply to fig. 3, which gives advanced and retracted positions of the aedeagus.

allied species, does not depend altogether on a greater or less development of a special portion of the aedeagus, *viz.* that beyond the zone, but in the greater or less extent of the *azygos* (Sharp) tube that is chitinised to become aedeagus or remains membranous as eversible membrane.

I have, for convenience, applied the name *zone* to that line where the internal and external portions of the aedeagus meet, a line by which the aedeagus is attached to the floor of the genital cavity—the circumstance which renders the outer portion “external” and the inner one “internal.” I shall return immediately to a fuller discussion of the zone, since it is of importance in the homologies and morphology of the aedeagus, and an important item in the specialisation of the Plebeiid aedeagus.

In most Lepidoptera the aedeagus is more or less retractile, or, conversely, one may say exsertible. In text fig. 1, a diagrammatic view of the aedeagus in *Thecla*, only a small portion of the aedeagus projects beyond the floor of the genital cavity when the parts are at rest, the greater part is retracted into a membranous tube (*sinus**) extending from the opening in the floor of the genital hollow to the zone. In action the aedeagus can be exserted as in fig. 2, the tube in which it rested being shortened and its walls gathered together.

The external portion of the aedeagus, that beyond the zone, is almost evidently a portion of the azygos tube, or ductus, everted and chitinised; but the internal portion, that is, that that is basal to the zone, consists not of a simple internal prolongation of the external portion, but has also fused to its external surface a prolongation of the sheathing tube, these being reflected into each other at the internal aperture of the aedeagus. This interpretation of the actual structure is so nearly self-evident, that it seems in the highest degree likely to be correct. But a further speculation as to which is the point at which the floor of the genital cavity meets the extremity of the ductus has very few data on which to reach a conclusion. Is it the zone, is it the internal opening of the aedeagus, or is it the external opening of the membranous sheath? There is here a possibility of confusion from the use of the term sheath; penis-sheath has been used as a name for the aedeagus, and penis-sheath (*penis-tasche*) has been the name applied to structures of the floor of the genital cavity surrounding the opening of what I have called the membranous sheath (*sinus*). There is in the Plebeïds no penis-sheath as a structure immediately surrounding the aedeagus.

There is one fact that goes a long way to show, one

* I find this term used by Kusnezov, whether on his own or some other authority, I don't know.

may say to prove, that the membranous sheath (sinus) is not a portion of the ductus, but is an invagination of the floor of the genital cavity.* In many cases, I cannot say in a majority, still less in all cases, though it may be so, the sheath has a sparse armament of hairs, such as are only found on external cutaneous surfaces, whence it follows that it must be a portion of the surface of the 9th or 10th abdominal segment, or possibly of the membrane between them; the latter is very unlikely. My own opinion is that it belongs to the 10th abdominal segment, and that the opening of the ductus in the male corresponds to that of the oviduct in the female on that segment. There is never any trace of a hair or hairlike structure on the aedeagus itself; the aedeagus is therefore an internal structure (a portion of the ductus). It is hardly necessary to say that the cornuti are not in any way hairs, though some of their forms are very similar to some forms of hairs.

I was for long ignorant of this armament of hairs on the membranous sheath, due no doubt to several reasons; that they are often absent is probably one. If one removes the aedeagus from the rest of the appendages, it is apt to be separated at the zone, and the sheath is not seen with it, and when examining the parts undisturbed the hairs are obscured behind other parts, and, if seen, it is not at all clear what their origin is. Nevertheless, when one is aware of their existence, it is often possible to make them out satisfactorily. In Pl. XXIII are two specimens of the aedeagus of *Curetis bulis*; on one of them the sheath is left uninjured, on the other only a portion of it remains. The hairs on the sheath are in this instance very obvious.

The wall of the internal portion of the aedeagus is not a simple internal chitinous structure, but arises from the fusion of two layers, which we may for the moment assume to be an outer one belonging to the general surface, an inner derived from the azygos tube; the fusion being, of course, of their opposed outer surfaces. It would, however, equally meet the case if both the layers were of the external surface, or both of the azygos tube. The reflection from the one layer to the other occurs at the opening in the base of the aedeagus, frequently placed some way from the extremity through which the azygos tube ("eversible

* Diaphragm is a term that has been applied to the membrane forming this floor.

membrane," *vesica*) passes from the visceral cavity into the interior of the aedeagus.

We may assume the initial structure to be a membranous tube opening on the surface (between segment 9 and 10 ventrally). A portion of this tube remains more or less in its primary condition as the *ductus ejaculatorius* (Auct.). Beyond this is the eversible membrane, which in some species barely exists, the extremity of the aedeagus reaching the bursa; in other species, those on which our usual conception of it is formed, it is contained within the aedeagus. There are, however, many species in which it is of great length and extends back beyond the aedeagus into the abdominal cavity, and except that it is eversible and usually armed with cornuti, it might be regarded as a portion of the *ductus ejaculatorius*. The eversible membrane is, in fact, a portion of the ductus. Beyond this I regard the external portion of the aedeagus as simply a portion of the same duct, permanently everted and chitinised. The internal portion of the aedeagus, as I have said above, being a double inversion from the margin of the original orifice.

What one may call the usual or average length of the extrusible portion of the aedeagus is somewhere probably between that in *Thecla*, illustrated in fig. 1 on Pl. XVIII and XIX, and that in *Melitaea*, Pl. XXI.

There are not a few cases and whole groups in which the aedeagus is much longer than this, as, for instance, in *Apatura*, and very markedly in many species of *Acraea* (Eltringham, Trans. Ent. Soc. 1912, Pl. XI-XII); in a whole group of *Tineae* (Bankes, E.M.M. 1910, Pl. V. and 1912, Pl. IV). See Pl. XXII. In all these cases of great length in the aedeagus, there is a corresponding lengthening of the saccus, no doubt to give a proper origin to the retracting muscles.

In fig. 4 I have (with *Thecla* as a basis) made a diagram of an arrangement which one would suppose possible, and which for all I know may actually occur, but which I believe does not exist, and of which I have met with no trace in any preparation I have examined, though it is possible by undue violence to cause the membranous sheath to be more or less everted. It is supposed to show that the aedeagus might be advanced by the eversion of the sheath by a length approximate to that for which it provides a retreat. I don't know of any case in which

the zone rises above the floor of the cavity. My observations are, of course, meagre, and this opinion can only go for what it may be worth.

The same proviso probably applies, though not quite as strongly, as the observations are more definite in character, to my statement that the reverse condition, found in the Plebeiid Blues, does not occur elsewhere.

If we follow the surface from the genital hollow to the interior of the ductus (*azygos*, Sharp) we first reach the opening of the membranous sheath; continuing down this, we reach the zone; here the membrane of the sheath becomes attached to the external surface of the aedeagus, and seems clearly to be an addition to it—that is, the

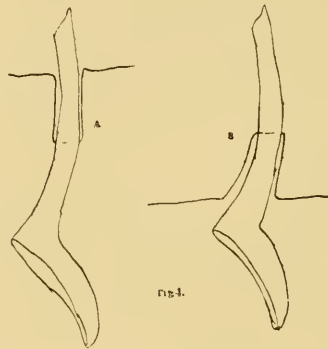


FIG. 4.—Suggests that the aedeagus might be advanced by the eversion of the membranous sheath; this does not, apparently, in fact, ever occur.

aedeagus here becomes suddenly thicker and denser, and the membranous sheath has all the appearance in most cases of being the outer layer of this portion of the aedeagus set free from the inner; a little further on, however, they seem to be completely fused. Following them on, assuming however, that we are following the outer layer, we arrive at the internal opening of the aedeagus, where the one layer is reflected into the other; and now returning on our journey, but following the inner layer, we arrive again at the zone and pass on to the free external portion of the aedeagus, and reaching its extremity, return down its interior, along the ductus proper, in which there is no definite line of demarcation between the eversible portion

(*vesica*, Pierce) and the more internal portion which is never everted.

In some species with longer external portions to the aedeagus (as in *Thecla*) there is, strictly speaking, no eversible membrane, the extremity of the aedeagus appears to reach the bursa and there expands, by the spreading

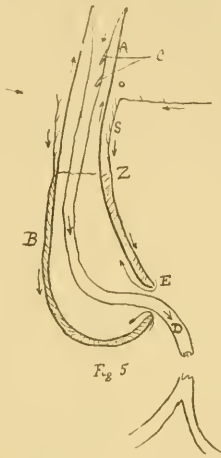


FIG. 5.—A diagram to show the continuity of the azygos duct with the cutaneous surface (floor of genital cavity). The arrows indicate the route from the external surface by way of the membranous sheath (sinus*), the surface so far, often bearing hairs, to the zone, thence, fused to its returning layer, to the internal opening of the aedeagus and back again, continuing then as the external portion of the shaft of the aedeagus, and at its extremity returning as eversible membrane and ductus.

of portions of its extremity and stretching of the adjacent membrane; this membrane and the movable portions at the extremity of the aedeagus are, however, no doubt, homologous with the eversible membrane and cuneus (*cornuti*, Pierce).

* Zander, *Zeitsh. fur. Wiss. Zool.* 1903, applies the term *penis-tasche* to the sleeve for which I have accepted the name *sinus*, but extends the said *penis-tasche* not only to the base of the aedeagus but right away beyond the aedeagus along the *ductus ejaculatorius*, where it is quite free from the aedeagus in the abdominal cavity. He uses *ringwall* for the armature that often surrounds the aedeagus on the floor of the genital cavity (diaphragm), and which other authorities call *penis-tasche*.

There can, it seems, be no doubt that the membranous sheath of the aedeagus is a portion of the external surface, probably of the 10th abdominal segment, and still more certainly that the free (external) portion of the aedeagus is of internal origin, *i. e.* a portion of the azygos duct. The internal portion, consisting of two fused layers, may present material for doubt, but the doubt has no particular bearing on the subject of this communication, though of morphological interest and suggesting further investigations.

For my own part I incline to the opinion that the zone represents the circle of the original opening of the ductus on the surface, and that the aedeagus consists of reflections and invaginations of the ductus only, without any surface structures being incorporated.

The period before the evolution of the aedeagus, when the ductus opened simply on the surface must be very remote, certainly before the Lepidoptera originated, possibly antecedent to the Insecta.

Whenever it may have been, the date was so ancient that one is astonished to find the aedeagus and ductus still so plastic, and capable of so rapidly (as between two closely related species) changing their form. No doubt the selection that evolved species also insisted throughout on the plasticity of these structures, without which new species would frequently have failed to establish themselves; since a fixity of structure, such as is usual in most other portions of the organism, would easily have led to syngamic absorption of the new species before its segregation was sufficiently prolonged to give real specific separation. In other words, a species in which these organs refused to vary, would on meeting with an incipient species derived from it simply absorb it, *i. e.* it could not meet new conditions by offsets of new species, and could only vary *en masse*, and would be very likely to become extinct. The incipient species could not avoid absorption unless its segregation (in whatever way) had been sufficiently prolonged to make it no longer incipient.

It is difficult to suppose, in the case of such groups as our Plebeïidi, that segregation could often have been so prolonged, so many of the species having such similar habits and habitats.

In the Plebeïids, the relation of the aedeagus to the genital cavity is reduced to its simplest elements. The floor of the cavity is a simple smooth screen, reaching from

the dorsal armature above to the margin of the ring and bases of the clasps below, pierced by the anal aperture and by the aedeagus, without any trace of scaphium or any anal armament, no *gnathos* and no sinus or armament of any sort round the aedeagus.

The aedeagus is thus held practically in one spot, with no antero-posterior movement, and only some possibility of varying in direction, considerable in the separated parts on a slide, but probably little or nothing in the living animal. Besides this fixity the Plebeiid aedeagus has another peculiarity—the free portion, that beyond the zone, is extremely short. This is most extreme in the genera *Polyommatus* and *Agriades*, apparently least so in *Plebeius*

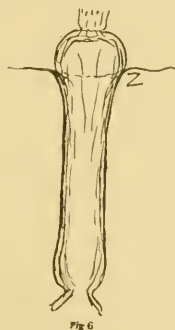


FIG. 6.—Diagram of aedeagus of *Agriades bellargus*, showing absence of sinus and brevity of free extremity.

(*aegon*) and *Aricia (astrarche)*, in which there is a considerable external portion, chitinous, however, only on one aspect, in which it ends in a point; the other aspect is membranous (eversible), reaching up, in a sharp angle, close to the zone. (Pls. XXVII, XXVIII, XXIX, also see figs. 1 and 4, Pl. V, p. 101, Ent. Rec., vol. xxii.)

One must, therefore, take this prolongation to be merely the extremity and not part of the shaft. The peculiar specialisations of the male appendages in the Plebeiids appear to be, as regards the aedeagus, its fixity by the zone being in the floor of the genital cavity without any sinus, and probably its fixity in direction also, during life, however much it may appear movable on a slide; its position close under the dorsal armature, and its separation from the clasps by a large smooth area of the floor of the

genital cavity, and the extreme shortness of the free portion of its shaft beyond the zone. These limitations prevent it making any approach to the female parts during pairing, a defect that is made good by the specialisation of the female, enabling the approach to be made by the female and not by the male. The great uniformity of the clasps in the group is no doubt related to this female specialisation; the fairly uniform dorsal armature has also, no doubt, some special correlated relationship, possibly with the extremity of the ovipositor, but as to this I can make no definite suggestion.

The figures given of the male genitalia and of the aedeagus separately are more specially referred to in the "Explanations of Plates," and need not be detailed again here. As to the Plates, it seemed desirable to restrict their number, else one would have desired to give figures—of a larger number, if not of all the species of the tribe—of both the male and female structures.

As regards the corresponding female structures, there is in the *Plebeidi*, apparently, an even greater departure from the normal structure than obtains in those of the male.

Considering for a moment the more usual form of these parts we find that in species where the aedeagus is long, it is usual for the cervix * to be long also, and to be, moreover, often chitinised into a solid tube for some distance. This may be seen in many *Theclas* (*e.g.* Pl. XVIII and XIX), in *Apatura* (Pl. XXIII), and in a less degree in many species in which the aedeagus is of average length. In the case of *Acraea natalica* (Pl. XXII), with a very long aedeagus there is also a very long cervix, but it is not very solidly chitinised, and in the photograph it will be seen to have twisted somewhat in the specimen, possibly from having been too much macerated.

It leads to another subject, with which I am not at present anxious to deal—namely, the segmentation of the abdomen in the females of Lepidoptera, but it may often be observed that the ostium is withdrawn (not invaginated) within the margin of the 7th abdominal segment, as may, for example, be observed in SCOPARIA (see *Trans. Ent. Soc. Lond.* 1911, Pl. XXXV, et seq.); in these cases there is generally no armature. When the ostium has an armature, it generally remains outside the 7th segment.

* Cervix, or ductus, the duct between the *ostium* (external opening) and the *bursa copulatrix*.

In most of these cases the ostium and its armature, if any, is all that there is to represent the 8th abdominal segment. Nor, indeed, is there often any chitinous plate to represent either the 9th or the 10th abdominal sternites.

In all cases ("all" must be understood to mean merely within my observations and experience) in which the ostium is within the margin of the 7th segment, it appears to be the outer end of a chitinous cervical tube (Pl. XVIII and XIX).

When there is any armature it appears to fix the ostium more or less just outside the margin of the 7th segment (Pl. XXI and XXII, fig. 2).

The peculiarity in the Plebeiids is that the ostium is carried by a small chitinous plate; but there is a special extensible structure by which this plate may be extruded as far or further than the end of the ovipositor.

When at rest the plate occupies the usual position of the ostium, viz. at the margin of the 7th segment, but behind it is the apparatus for its projection.

In Pl. XXXI the parts are shown as they are when at rest. In Pl. XLII they are seen partially extruded. In the majority of the figures they are shown fully extruded, or as nearly so as is easily obtainable in making the preparations.

It is seen that the small terminal plate is carried at the end of a long membranous tube, when this is extended, and the appearance at first sight suggests that the function of the eversible membrane of the aedeagus has somehow been transferred to the female structures. This is, of course, absurd; its real function is to carry the ostial plate to the fundus of the male genital cavity so that it may meet the very short and immovable aedeagus. A function almost as surprising as the impossible one mentioned, and, so far as I know, without any parallel amongst other Lepidoptera.

This eversible structure consists of two portions—the outer one, that is often simply membranous, but carrying the terminal plate, and an inner one, that is reversed by invagination when it is retracted, and which is strengthened by a loop of chitin; this may be seen in the Pl. XXXI to XLVII.

I have named these two portions, the inner the "prop" (*hypostema*), and the outer the "rein" (*henia*). (By a misprint in Trans. City of London Ent. Soc. *heina*.)

In evagination the prop begins the eversion at its outer margin; phases in the process may be noted in various of the Plates, as *e. g.* XXXII, fig. 1; XL, fig. 2; XLI, fig. 1; XLVIII, fig. 2.

Within the rein may usually be easily seen the cervix (Stitz), passing backwards from the terminal plate to the *bursa copulatrix*; it is sometimes possible by traction basad on the bursa to withdraw the rein within the prop, which at the same time, of course, invaginates; the opportunity to do this often occurs in preparing the specimens.

What are these eversible structures, the prop and the rein? What segments do they belong to, and what parts of the segments are they? I have been able to discover only one detail in their structure that seems to throw any light on this. The membranous surface of the basal portion, the prop, is apparently simple and free from any cutaneous structures such as hairs, skin-points, etc. The rein, however, is regularly studded with points that have all the appearance of abortive hairs or scales, *i. e.* they are something more than mere skin-points, though if they were the latter their significance would be the same.

The membrane forming the tube of the rein must therefore be a portion of the sternite of the 8th abdominal segment, that of the prop a portion of the membrane between the 7th and 8th segments. The chitinous loop in the prop is possibly not easy to explain on this hypothesis, but its explanation on any other seems equally difficult.

The terminal chitinous plate containing the ostium is surrounded by the hair-point-studded tube, *i. e.* by the surface of the 8th abdominal sternite; it must therefore be situated *in* the sternite and not at either margin. This is an interesting conclusion to arrive at, as the usual evanescence of both plates of this segment, in practically nearly (or quite) all other cases, leaves us without any data on this point.

It is a secondary, but useful, circumstance, that each species of Plebeiid butterfly seems to have a distinctive form for the small terminal plate. This appears in most of the photographs presented herewith, though in some cases the smallness of the differences, the occasional variation by the plate not being exactly in the plane of the picture, and the loss of definition in reproducing the photographs, may prevent this being evident.

This is so, as far as I have observed, though I have not prepared long series of specimens in more than two or three species.

The extraordinary extensibility afforded by the prop and rein does not occur, I think, elsewhere; I can, however, rely only on my own small knowledge of these structures, which may easily be at fault. Some other groups of the LYCAENINAE show what we may regard as initial stages of the Plebeiid structure. For example, *Lampides boeticus* (Pl. LV. LVI), which has an immense terminal armature to the ostium extremely unlike anything in the Plebeiids, nevertheless retracts and extends this mass for a distance equal to its own length, as is seen by comparing the photographs on Pl. LVI. *Iolas* (Pl. LIII), again, on the other hand, with an equally large armature, seems to have it much less movable. *L. argiolus* (Pl. LIV) also has the armature slightly movable, but apparently not retractile.

L. alcon and *euphemus* (Pl. LVII) seem to be retractile. *T. telicanus* and *E. argiades* (Pl. XLVIII) are also apparently retractile, but none of these to more than a small amount.

I have put on the same plate as the two last (Pl. XLVIII) a photograph of *P. martini*; this is quite a typical Plebeiid, but in the specimen, the parts are only partially exerted, the prop perhaps one-third extended, and the rein therefore equally enclosed. In this species the rein is chitinised near its extremity, as in the species shown on Pl. LIV, in *zephyrus* (Pl. XLIV), in *meleager* and *admetus* (Pl. XLI), in *pylaon* and *candalus* (Pl. XXXVI). The result is to give the two specimens in Pl. XLVIII—*martini*, fig. 2, and *argiades*, fig. 3—the appearance of being of very closely related structure, which is not really the case.

With this reference to chitinisation of the extremity of the rein, it may be as well to include the circumstance that in other species there is a chitinisation towards its base. This occurs in *C. semiargus* (Pl. XLVI), *A. isaurica* and *donzeli* (Pl. XLV), *A. escheri* (Pl. XL), and to a trifling extent in some others, in which it may or may not be really part of the loop of the prop.

I have frequently observed these structures in the field, when functionally active, and have for several years made efforts to secure specimens preserved for observation and examination in that state, but have always failed, though on several occasions I felt sure up to the last moment that I had succeeded.

In some groups success in this matter is easy, why it should be so difficult here is not quite self-evident. It so happens, however, that in several of my preparations I had so nearly succeeded that they practically demonstrate the conditions almost as satisfactorily as had they been quite successful. They demonstrate that the prop and rein are fully extended, that the terminal plate carrying the ostium reaches the extremity of the fixed aedeagus and is penetrated by the eversible membrane therefrom. In examining living specimens, the two insects seem held together by nothing except the pale slender thread of the prop and rein. How this is held firmly to the aedeagus is not very evident, whether it be merely by the eversible membrane that penetrates the ostium, or whether, as the structure of the extremity of the aedeagus seems to suggest, the terminal plate of the rein is held by certain curved and spring-like processes that are very evident in such species as *pheretes*, *semiargus*, *orbitulus*, etc. The clasps do not seem to be used for prehension, at least at the times when my observations were made. Yet their special structure, very nearly identical throughout the tribe, and different from those of any other Lycaenines, show them to have some important function peculiar to this tribe. It seems that this can hardly be other than to take temporary prehension, by grasping the 7th abdominal segment, at the same time causing or assisting the eversion of the prop and rein.

It may be noted in most of the photographs submitted that these parts are compressed antero-posteriorly and so remain straight, the prop and rein in the same apparent straight line. But in others where they are compressed laterally, of which one of the photographs of *hylas* (Pl. XXXIX) is as good an example as any, there is seen to be a sharp angulation between the prop and rein when they are fully exerted and expanded; the effect of this would be, that the angle would reach the inferior angle of the male genital cavity at the base of the clasps, whence the rein would be of just the length to reach along the floor of the cavity to the extremity of the aedeagus, which in the Plebeïids is fixed close to the dorsal margin of the floor and close under the dorsal armature.

When living specimens are examined, all prehension seems in abeyance except by the rein and aedeagus. Whether this is natural, or a result of inhibition by the

captor's interference, may be doubtful, but there can be little doubt that prehension by the clasps takes place in the first stages of pairing.

There is a very curious fact, that I suppose to be of constant occurrence, though I have not observed it much more than about a dozen times. This is, that at the end of the pairing the rein is surrounded by a cylinder of amorphous material, certainly not scales or any similar structures, whether a secretion by the male or female, I don't know (see Pl. LXI and LXII). It easily slips off and is lost; on Pl. LXI it had left the rein, which retained no evidence of having accommodated so curious an accretion. Whether this ought to be called a *sphragis*, and whether it is homologous with that structure in Papilionids and Nymphalids I cannot say.

EXPLANATION OF PLATES XVIII-LXII.

PLATE XVIII. Appendages of *Thecla spini*.

FIG. 1. ♂, showing free portion of aedeagus to be long and its position close to the clasps, × 25.

FIG. 2. ♀, showing ostium (8) and chitinous duct, corresponding in length to the free portion of the aedeagus leading to the bursa, × 25.

PLATE XIX. Appendages of *Thecla pruni*, showing similar parts to Pl. XVIII, × 25.

PLATE XX. Appendages of *Selenia illustraria*, ♂ and ♀, showing the chitinised duct to bursa (with a hair passed through it) closely corresponds in width and length to the free portion of the aedeagus, × 25.

PLATE XXI. *Melitaea athalia*, showing large external armature of the ostium, and correspondence between the free portion of aedeagus and the duct with hair passed through it to bursa, × 20.

PLATE XXII. FIG. 1. Appendages of male of *M. pallescentella*, shows corresponding length of aedeagus and saccus, and position of aedeagus close to clasps, $\times 45$.

FIG. 2. Appendages of *Acraea natalica*. Aedeagus and saccus both very long. In ♀ the ductus is seen to be very long; it is twisted in the preparation; it is very weakly chitinised, $\times 5$.

PLATE XXIII. FIG. 1. Two specimens of the aedeagus of *Curetis bulis*; in the upper one, the membranous sheath and a small portion of the floor of the genital cavity have been kept with it. The length of the sheath (sinus) corresponds with that of the free portion of the aedeagus, *i. e.* that beyond the zone *Z*. In the lower figure only a portion of the sinus remains, but this is more than usually remains with the aedeagus when it is dragged out for separate examination. The clothing of hairs on the sinus is well seen in both preparations, $\times 24$.

FIG. 2. Female appendages of *apatura iris*. The figures refer to the numbers of the abdominal segments. 8 is opposite the ostium, leading to the long chitinous portion of the ductus, corresponding to the lengthy aedeagus in this species.

MALE APPENDAGES OF PLEBEIIDS.

PLATE XXIV. FIG. 1. *Agriades thetis*, $\times 45$, shows the bulbous-ended aedeagus fixed close to the dorsal armature.

FIG. 4. *Agriades escheri*, shows also the long space between the place where the zone is fixed and the origins of the clasp, whose bases only just appear at bottom of figure, $\times 30$. In both these figures, the preparations being pressed flat, the aedeagus appears to be in the same plane as the ring, instead of nearly at

right angles to it; the zone remains fixed, and on it the aedeagus is rotated to the position shown.

FIG. 2. Aedeagus of *Agriades thersites*, $\times 40$.

FIG. 3. Aedeagus of *Agriades damon*, $\times 40$. These two figures show the swollen end characteristic of *Agriades*, the zone right up on the bulb has attached scraps from the floor of the cavity, the shortness of the portion beyond this is obvious, there is hardly a trace of everted membrane.

PLATE XXV. FIG. 1. *P. sieversi*, $\times 30$; 2. *P. hyrcana*, $\times 30$; 3. *C. semiargus*, $\times 45$. These show the dorsal position of the aedeagus, and the zone close to its free extremity.

PLATE XXVI. FIG. 1. *A. amanda*, aedeagus, $\times 40$.

FIG. 2. *V. optilete*, aedeagus, $\times 40$.

FIG. 3. *V. optilete*, ♂ appendages, except part of clasps, $\times 30$. These show the zone, with portions of floor membrane attached, the short portion of aedeagus beyond differing in structural detail from that of *Agriades*. Fig. 3 shows very well how the floor membrane attached to the zone is taut enough to restrain any forward movement of the aedeagus; a contrary impression might arise from Fig. 2, where a good deal of floor membrane remains attached, limp and crumpled, being torn loose from its other attachments.

Figures on Pl. XXIV, XXV and XXVI show also the unusual length of flat, smooth (*i. e.* free from any sort of armature) field afforded by the floor of the genital cavity between the aedeagus and the base of the clasps.

PLATE XXVII. FIG. 1. ♂ appendages of *Pl. evermanni*, and Fig. 2 of *Pl. pheres*, $\times 30$. These both show a greater length of aedeagus

beyond the zone, but with oblique opening reaching down to that point, and in the case of *Pl. eversmanni* the preparation happens to show a considerable exertion of the eversible membrane; this accident is very rare in preparations of Plebeiid appendages.

These figures and those on the two following and other plates illustrate the large area between the aedeagus and clasps, as referred to under Pl. XXVI.

- PLATE XXVIII. FIG. 1. Aedeagus of *Pl. aegon*, $\times 40$.
 FIG. 2. Aedeagus of *Pl. argyrognomon*, $\times 40$.
 FIG. 3. Aedeagus with dorsal armature, etc., of *Pl. argyrognomon*, $\times 45$. These demonstrate the oblique opening of the aedeagus beginning at the zone, and that this external portion is less chitinised than the inner piece, and is of pointed dagger form.

- PLATE XXIX. FIG. 1. Aedeagus of *Aricia idas*, $\times 40$.
 FIG. 2. Aedeagus of *Albulina pheretes*, $\times 40$.
 FIG. 3. Aedeagus of *Aricia medon*, $\times 40$.
 FIG. 4. Appendages of *Aricia donzelii*, $\times 20$.
 These show the long slender, pointed end of the aedeagus, with oblique opening beginning at the zone; in *Aricia* and *Albulina* the genitalia do not support generic differentiation from *Plebeius*.

- PLATE XXX. FIG. 1. Male appendages (except clasps) of *P. icarus*, $\times 30$.
 FIG. 2. Aedeagus of *P. eros*, $\times 40$.
 FIG. 3. Aedeagus of *A. coridon*, $\times 40$.
 FIG. 4. Aedeagus of *Aricia isaurica*, $\times 40$. In Fig. 3 there is some eversion of the eversible membrane. Fig. 4, *isaurica*, is not a typical *Aricia*, a group to which it appears otherwise to belong.

FEMALE APPENDAGES.

PLATE XXXI. Shows the position of the hypostema (prop) and henia (rein) in the position of repose.

FIG. 1. *Thetis*, shows them in lateral view.

Fig. 1 shows that they are within the seventh ventral sternite, and Fig. 2 that they may retreat even to within the sixth. Pl. XLII shows the parts partially extended. Also Pl. XL, Fig. 2. Many figures show not quite complete eversion, as referred to in more detail under Pl. XXXII.

FIG. 2. *Coridon*, shows them on ventral view (though the dorsal portion of the preparation is almost in lateral view).

PLATE XXXII. *Aricia eumedon*, $\times 25$. Fig. 1 shows the prop not fully everted; this is often so in my preparations in which the parts are twisted to get an antero-posterior view of them; by holding the prop and rein in a straight line, the prop cannot be fully extended without some twisting or crushing elsewhere. The reason for this is seen in Fig. 2, where the view is lateral and the angle between the rein and prop when fully extended is allowed to obtain. It would appear that the prop is more or less between the clasps, whilst the rein reaches dorsally from their bases along the smooth floor of the σ genital cavity to the aedeagus. See Pl. XXXIX and LIV.

PLATE XXXIII. FIG. 1. *A. actis*, $\times 25$.

FIG. 2. *A. coridon*, $\times 25$.

PLATE XXXIV. FIG. 1. *P. icarus*, $\times 25$.

FIG. 2. *A. pheretes*, $\times 25$. These two species have the terminal plate carrying the ostium reduced more than in most other species I have examined; they are, in fact, almost evanescent. See also Pl. XLIII.

PLATE XXXV. FIG. 1. *A. amanda*, $\times 25$.

FIG. 2. *A. hopfferi*, $\times 25$. The black patch on the rein of the latter is a foreign body, probably a group of half-macerated scales.

PLATE XXXVI. FIG. 1. *A. pylaon*, $\times 25$.

FIG. 2. *A. candalus*, $\times 25$. These have unusual chitinisation of the rein. In each specimen there is eversion of the rectum or oviduct.

PLATES XXXVII and XXXVIII. In each plate Fig. 1 is $\times 25$, and Fig. 2 shows the prop, $\times 50$. The small chitinous plate at the base of the rein is seen, but the object of the figures is to show the duct to the *bursa copulatrix* running backwards (backwards should strictly be forwards !!) from the terminal plate of the rein; this is very distinct on Pl. XXXVII. This duct is seen in several other preparations, but may probably hardly come out very distinctly when the photographs are reproduced. Both specimens are *A. thetis*.

PLATE XXXIX. Two specimens of *A. hylas*, $\times 25$, demonstrating the same point as in Pl. XXXII (*A. eumedon*) and Pl. LIV. The one a dorsal, the other a lateral view.

PLATE XL. FIG. 1. *A. escheri*, $\times 25$.

FIG. 2. *A. damon*, $\times 25$. The duct is well seen in Fig. 2.

PLATE XLI. FIG. 1. *P. meleager*, $\times 25$.

FIG. 2. *A. admetus*, $\times 25$. Distal portion of rein somewhat chitinised in both.

- PLATE XLII. FIG. 1. *A. thersites*, $\times 25$.
 FIG. 2. *P. eros*, $\times 25$. These show the prop and rein only partially exerted. The eversion begins at the attached end of the prop, the end carrying the rein is the last portion to be reversed.
 Compare with Pl. XXXI.
- PLATE XLIII. FIG. 1. *Pl. aegon*, $\times 25$.
 FIG. 2. *Pl. argyrognomon*, $\times 25$. The latter shows the duct very plainly and also the want of a strong terminal plate. Refer also to Pl. XXXIV.
- PLATE XLIV. FIG. 1. *Pl. zephyrus*, $\times 25$.
 FIG. 2. *Pl. cleobis*, $\times 25$. Fig. 1 illustrates a circumstance not at present before us, viz. that an egg reaches sometimes the end of the ovipositor, at the death of the butterfly, probably as a detail of dying, and then afterwards matures, but being within the ovipositor cannot emerge. In macerating the specimen the egg and larva is apt to be lost, unless specially looked for; without looking for it I have met with it often enough to believe that it is really a very frequent occurrence.
- PLATE XLV. FIG. 1. *Plebeius isaurica*, $\times 25$.
 FIG. 2. *Aricia donzelii*, $\times 25$.
- PLATE XLVI. FIG. 1. *Aricia medon*, $\times 25$.
 FIG. 2. *Cyaniris semiargus*, $\times 25$. The form of the terminal plate in *medon* much resembles that in *Chilades*.
- PLATE XLVII. FIG. 1. *L. orbitulus*, $\times 25$.
 FIG. 2. *V. optilete*, $\times 25$. These two preparations are badly cleaned of scales, etc.
- PLATE XLVIII. FIG. 1. *T. telicanus*, $\times 25$.
 FIG. 2. *P. martini*, $\times 25$.
 FIG. 3. *E. argiades*, $\times 25$. Fig. 2 is a fairly normal *Polyommatus*, but being only partially expanded—compare with Pl. XXXI and XLII—it has a curious

resemblance to the Everid, *E. argiades* (Fig. 3).

Figs. 1 and 3 illustrate the small amount of eversion (as distinct from mere retraction, which is very frequent in most Lepidopterous Families) that occurs in non-Plebeiid Lycaenines, perhaps more marked than usual in *L. boetica* (Pl. LVI).

PLATE XLIX. *Chilades trochilus*, ♂ and ♀, × 25.

PLATE L. *Chilades cnejus*, ♂ and ♀, × 25.

PLATE LI. *Chilades laius*, ♂ and ♀, × 40.

PLATE LII. *Chilades pandava*, ♂ and ♀, × 40. These are the only species of this genus I happen to know; I illustrate them because they are very interesting as the only tropical group of Plebeiids (that I know of). That CHILADES was Plebeiid, was, I think, first stated by Tutt, on my authority, in Brit. Lep., vol. x, p. 157.

In the ♀♀ the terminal plate is lozenge-shaped (refer Pl. XLVI), this is hardly exceptional, and otherwise the ♀ parts are typically Plebeiid. The ♂♂ are less typical. The hard process of the clasp is long and curved, the dorsal processes and hooks are slender and curiously like each other, and the aedeagus has a more elaborate terminal armature than usual; one supposes this may have some relation to the special form of the terminal plate of the rein. It would perhaps be going beyond the subject of the present paper to discuss the matter of two of these species having long rested in the genus *Catachrysops*, on the ground of their having tails. No other Plebeiids are tailed—still, the question of tails amongst the Blues has had too much weight attached to it. Some species have both tailed and tailless forms; a tailed species or two, therefore, within the tribe of Plebeiidi, which we conceive as tailless, ought not to surprise us, as I admit as to myself it does to some extent. Whatever the subjective conditions may be, it is certain that the four species here noted are congeneric. I have, however, so far as possible avoided, in this paper, systematic questions.

PLATE LIII. *Iolana iolus*, ♂ and ♀, × 25. The ♂ preparation is spread and shows the several parts excellently, but hardly their natural relations to each other. This species gives perhaps the largest ♀ external armature I know of amongst Lycaenines, in that respect resembling *L. boetica*; it appears, however, not to be retractile, not to say eversible; it contrasts well with the Plebeids. I am unable to refer it to any recognised tribe of Lycaenines.

PLATE LIV. FIG. 1. I am not quite sure of the species; I give the figure as another one illustrating the point brought out in Pl. XXXII and again in Pl. XXXIX.

FIG. 2. *L. argiolus*, another Lycaenine to compare with the Plebeids; the armature appears to be slightly retractile, but in no degree eversible (as in the prop in Plebeids).

PLATE LV. FIG. 1. *L. boetica*, ♂, × 35, given as the ♀ is illustrated on next plate.

FIG. 2. *L. prosecusa*, ♀, has a very large armature and seems to be very close to *L. boetica* as regards its retractility (and eversibility as regards its proximate section).

PLATE LVI. *L. boetica*, ♀, × 25.

FIG. 1. Armature extended.

FIG. 2. Armature retracted. The structure here seems almost identical with that in the Plebeids. In Fig. 1 a "prop" is very evident, but the terminal mass is so large that there is room for little if any rein.

This specimen appears to show that the Plebeiid structure is only an extreme form of what obtains more or less in many Lycaenine tribes.

PLATE LVII. FIG. 1. *Lycaena alcon*, × 25.

FIG. 2. *Lycaena euphemus*, × 25. These appear to be similarly eversible with an invaginable prop, and support the conclusion expressed under Pl. LVI.

The following Plates show efforts to preserve specimens *in cop.*, all of which were more or less failures, yet something is demonstrated.

PLATE LVIII. Shows two preparation of *A. thetis* in which an effort was made to preserve the parts in the natural positions when *in cop.* with small success. To diminish manipulations and undue softening of parts by maceration, the scales were not removed or bleached. This much obscures appearances, and even so Fig. 2 shows that the parts have been twisted in handling, the dorsal side of one sex being in line with the ventral of the other. In both preparations the conjunction of the specimens is, however, still probably intact, though the dark scales prevent this being seen. In neither specimen does the prop (hypostema) appear to be fully extended. In Fig. 2 the rein is seen to include sundry tracheae. In Fig. 1 it is enclosed in the adventitious coating illustrated on Pl. LXI.

PLATE LIX. FIG. 1. *A. thetis*, shows the rein still extended towards the aedeagus, but withdrawn from it.

FIG. 2. *A. thetis*, similar result to Fig. 1.

PLATE LX. FIG. 1. *A. coridon*, $\times 20$.

FIG. 2. *A. thetis*, $\times 14.5$. These separated in preparation and are placed as seen quite arbitrarily; both, however, show the extension of the eversible membrane of the aedeagus, as it is rare to find it in ordinary preparations.

PLATE LXI. All figures, *A. coridon*. Figs. 1 and 2 as in Pl. LX. Fig. 3 shows a remarkable coat, found after pairing, surrounding the rein. Here it has slipped off in preparing specimen. It is by no means always found, why I don't know, in the following.

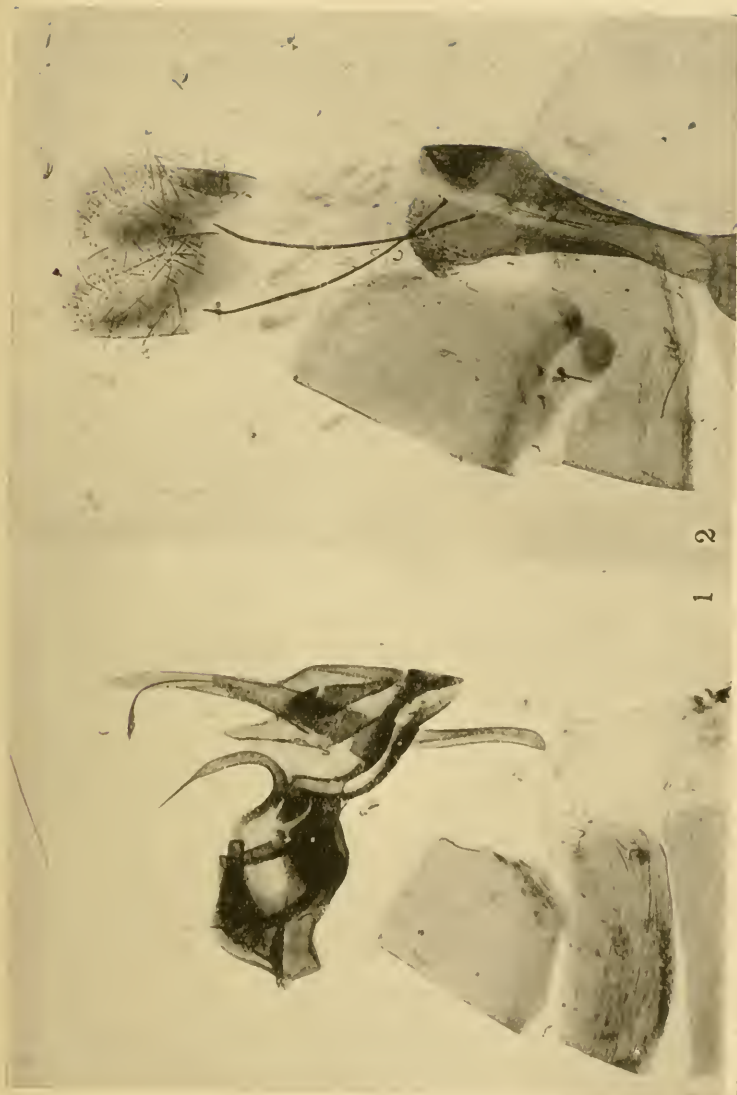
PLATE LXII. FIG. 2 shows it as found *in situ*, in a specimen of *A. coridon* taken *in cop.*, and Fig. 1 in a specimen of *P. evermanni* out of the cabinet, so that it is not always got rid of at once.



Photo, A. E. Tonge.

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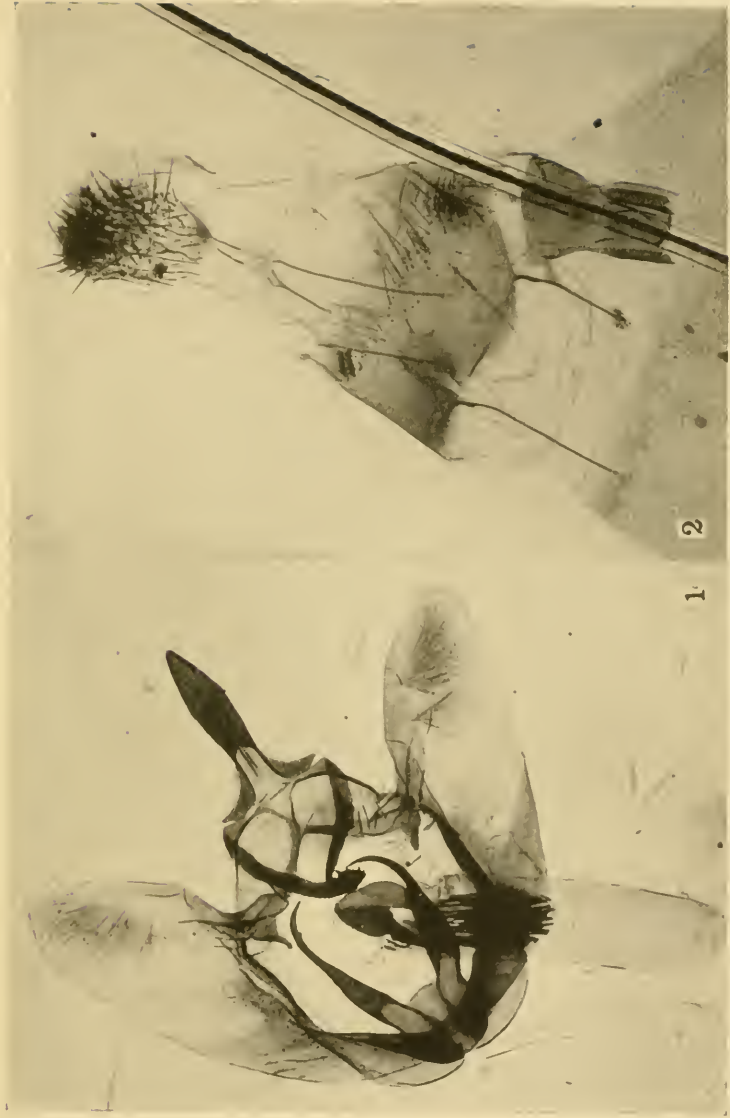
MALE AND FEMALE APPENDAGES OF STRYMON SPINI × 25.



Photo, A. E. Tonge.

Andre, Steigh & Angle, Ltd.

MALE AND FEMALE APPENDAGES OF STRYMON (THECLA) PRUNI × 25.



Photo, F. N. Clark.

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(1) MALE AND (2) FEMALE APPENDAGES OF *SELENIA ILLUSTRARIA* × 25.



2 1

Photo, F. N. Clark.

APPENDAGES OF *M. ATHALIA*. 1. MALE; 2. FEMALE $\times 25$.

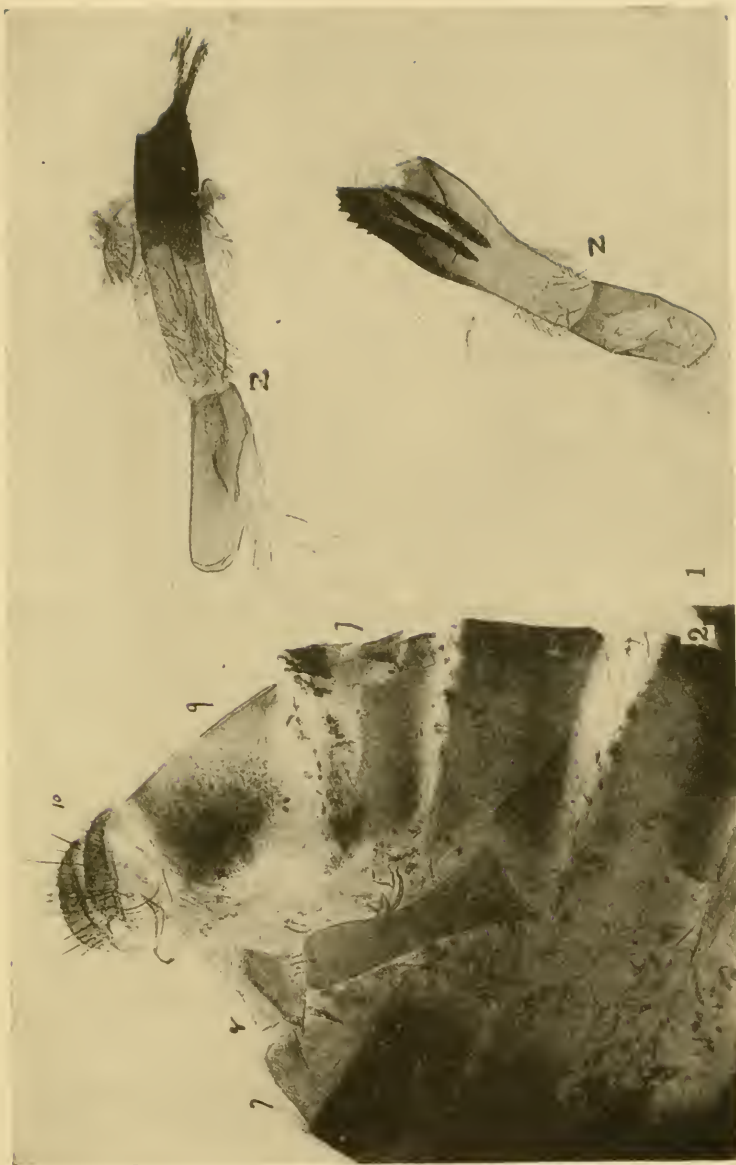
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Photos, (1) F. N. Clark and (2) A. E. Tonge.

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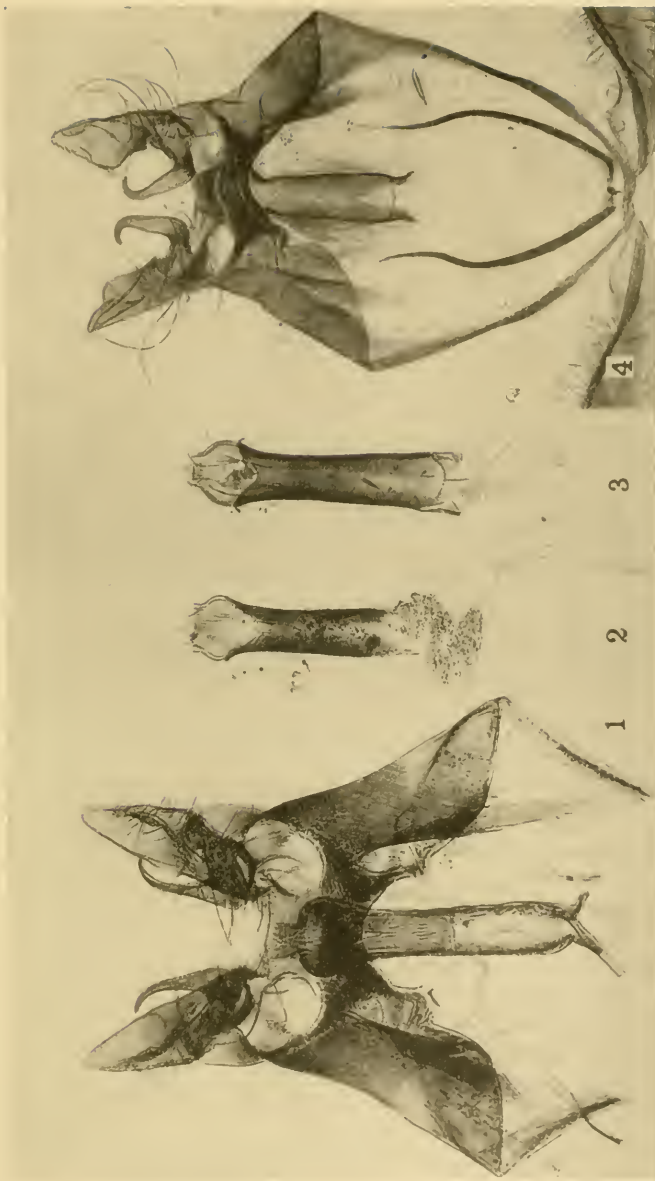
1. M. PALLESCENTEELLA, $\delta \times 45$. 2. ACRAEA NATALICA, $\delta \varphi \times 5$.



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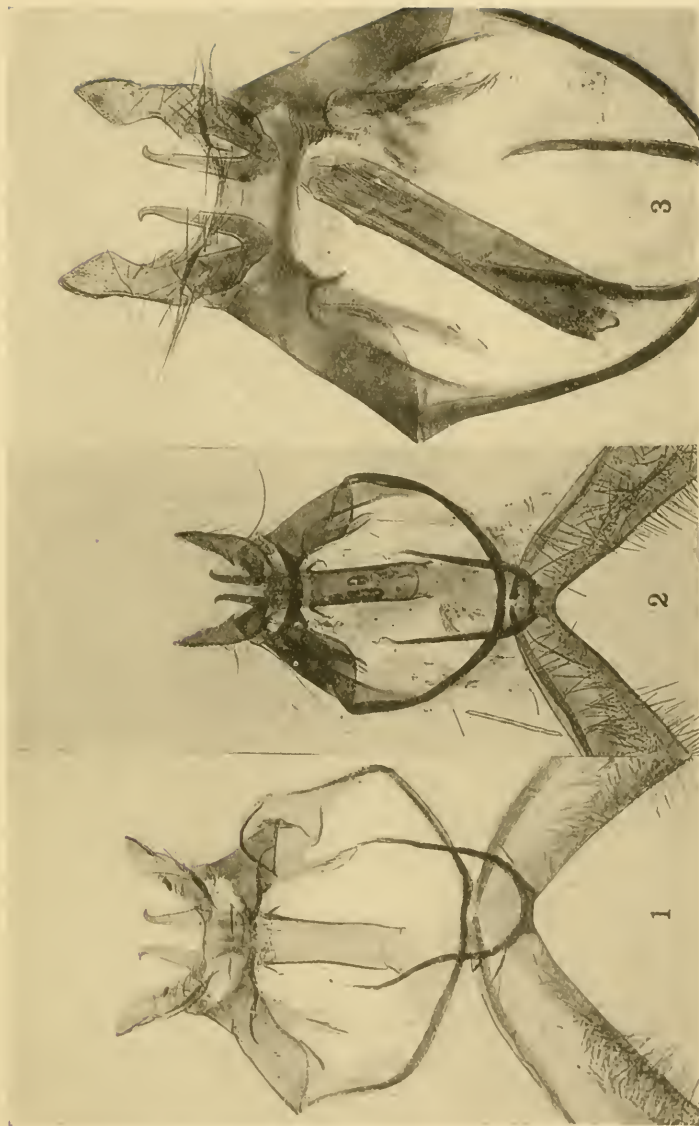
1. AEDEAGUS, ETC., CURETIS BULIS $\times 24$. 2. FEMALE APPENDAGES, A. IRIS $\times 12$.



Photo, F. N. Clark.

AEDEAGUS *in situ*. 1. **A. THETIS** $\times 45$; 4. **A. ESCHERI** $\times 30$, SEPARATE; 2. **A. THERSITES** $\times 40$;
3. **A. DAMON** $\times 40$.

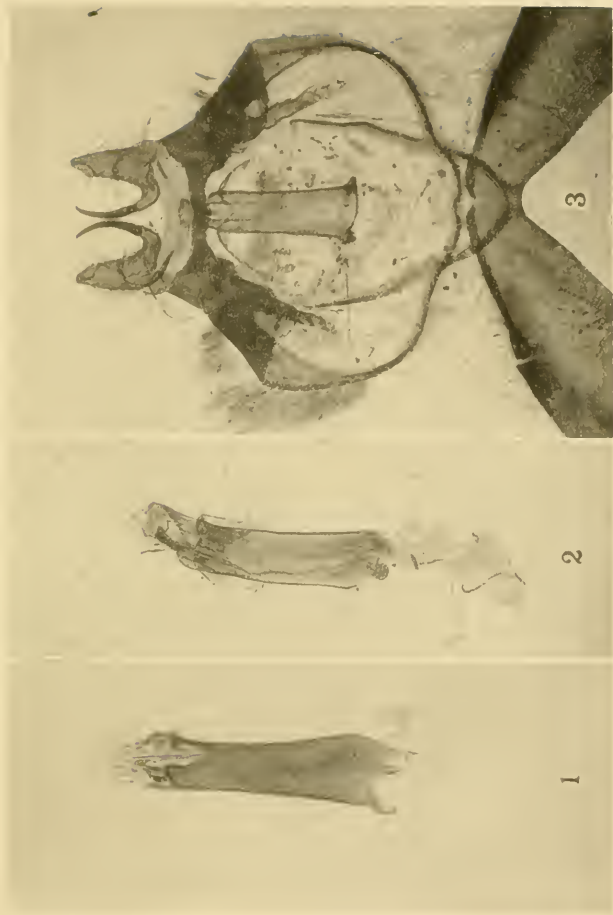
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AEDEAGUS IN NATURAL POSITION IN (1) *P. SIEVERSI* $\times 30$; (2) *P. HYRCANA* $\times 30$;
(3) *C. SEMIARGUS* $\times 45$.



Photo, F. V. Clark.

**AEDEAGUS OF (1) A. AMANDA $\times 40$; (2) V. OPTILETE $\times 40$; (3) V. OPTILETE
IN RELATION TO OTHER APPENDAGES $\times 30$.**

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Photo, F. N. Clark.

MALE APPENDAGES OF (1) P. EVERSMANNI; (2) P. PHERES × 30.

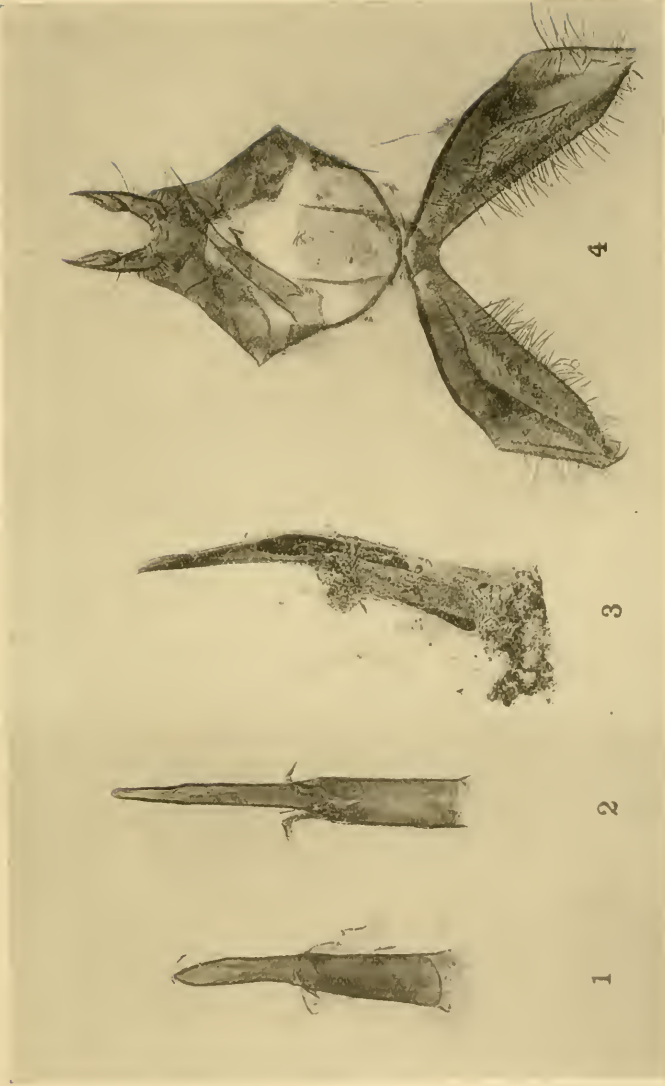
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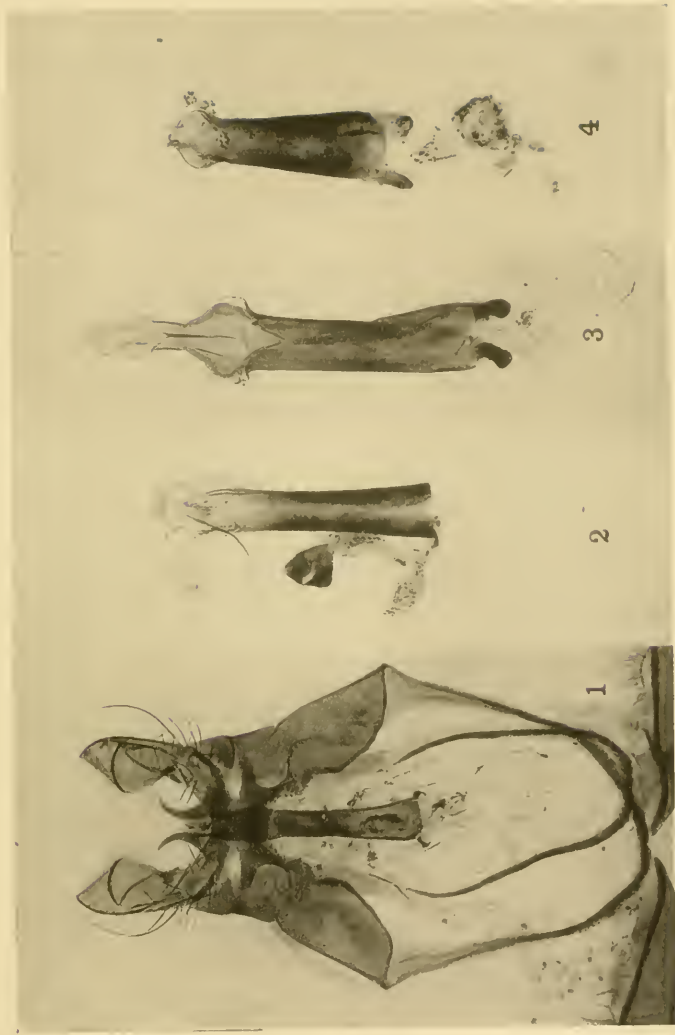
**AEDEAGUS OF (1) P. AEGON ; (2) P. ARGYROGNOMON \times 40 ;
(3) P. ARGYROGNOMON \times 45.**



Photo, F. N. Clark.

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AEDEAGUS OF (1) A. IDAS; (2) A. PHERETES; (3) A. MEDON $\times 40$; (4) A. DONZELII,
WITH APPENDAGES $\times 20$.



Phot., F. N. Clark.

APPENDAGES (AEDEAGUS).

1. *P. icarus* × 30. 2. *P. eros* × 40. 3. *A. coridon* × 40. 4. *A. isaurica* × 40.

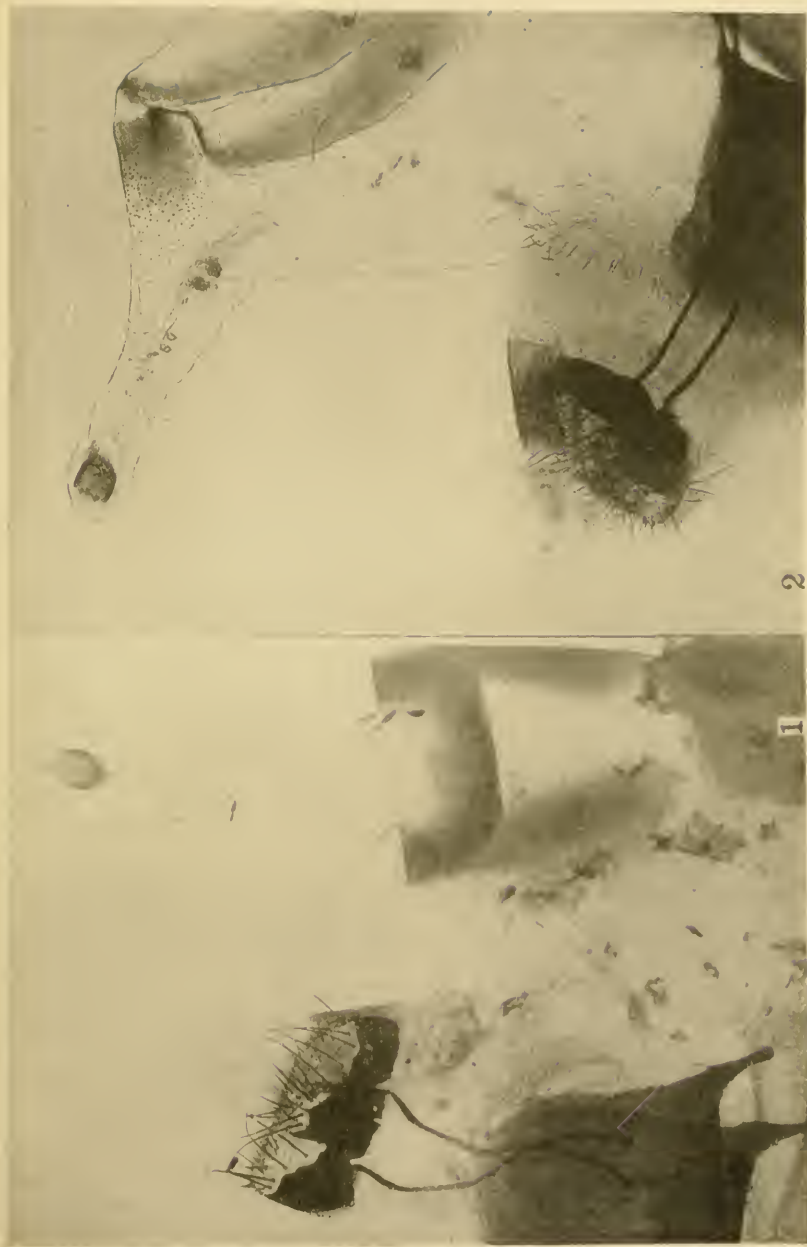
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FEMALE APPENDAGES OF (1) A. THETIS; (2) A. CORIDON × 25



Photo, F. V. Clark.

FEMALE APPENDAGES OF *A. EUMEDON*.

1. Not fully everted. 2. Fully everted, lateral view $\times 27$.

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FEMALE APPENDAGES OF (1) A. ACTIS; (2) A. CORIDON × 25.



Photo, F. V. Clark.

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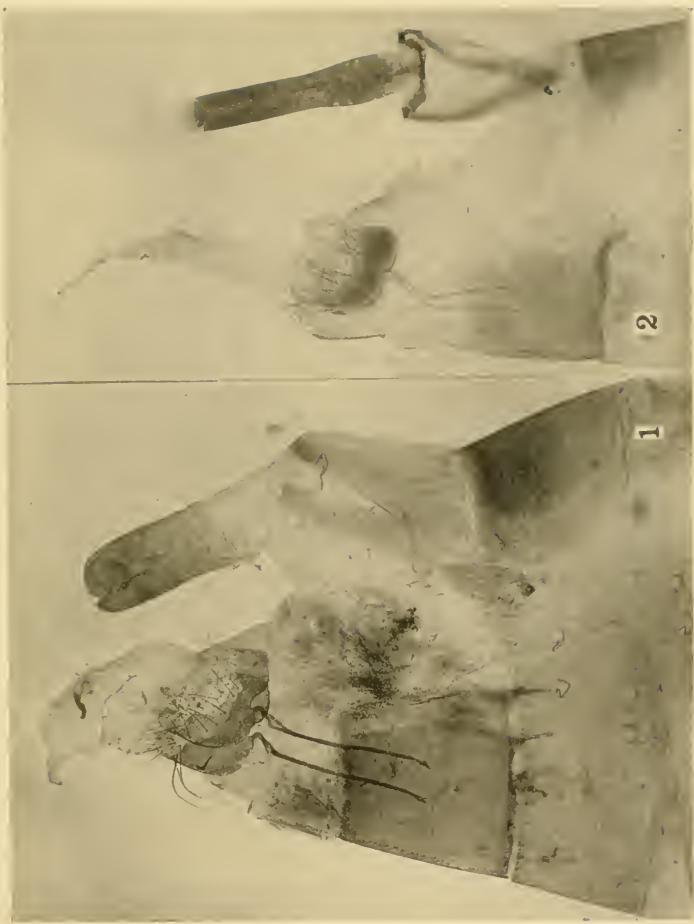
FEMALE APPENDAGES OF (1) *P. ICARUS*; (2) *A. PHERETES* × 25.



Photo, F. N. Clark.

FEMALE APPENDAGES OF (1) A. AMANDA ; (2) A. HOPFFERI × 25.

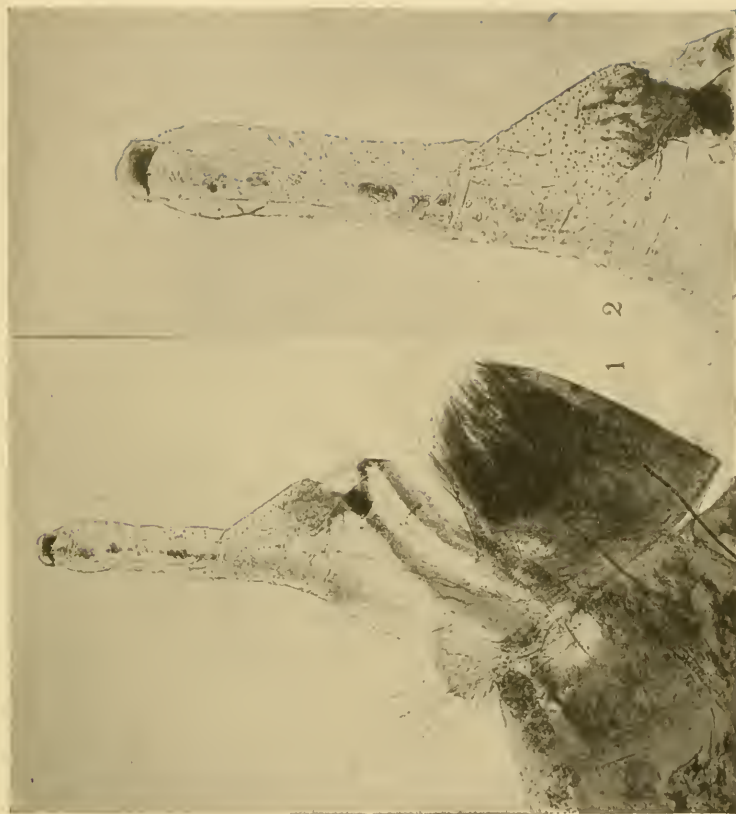
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Photo, F. N. Clark.

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FEMALE APPENDAGES OF (1) A. PYLAON ; (2) A. CANDALUS × 25.



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A. THETIS, FEMALE APPENDAGES. 1. $\times 25$,

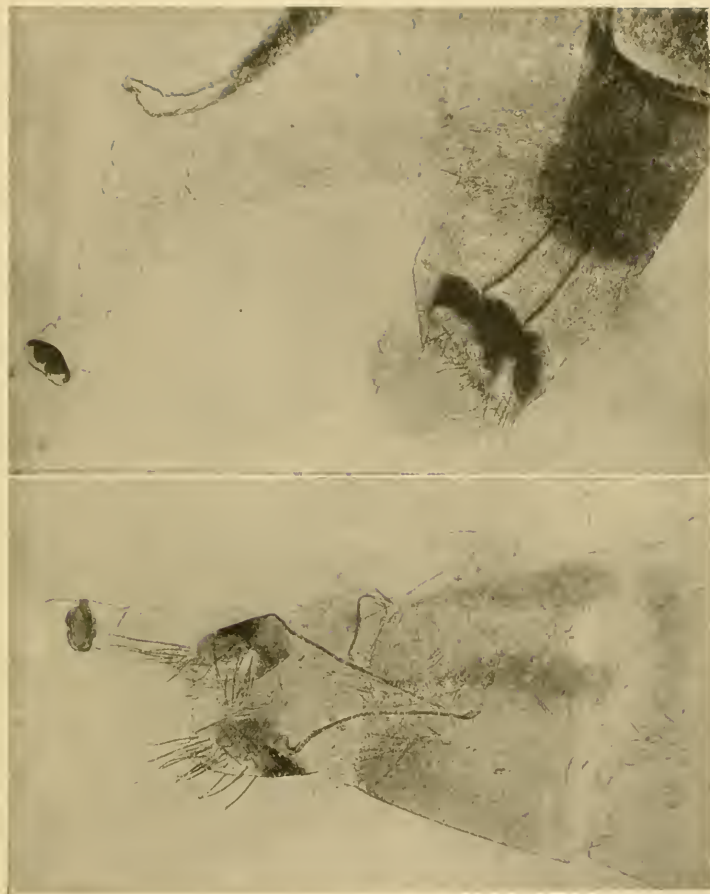
2. REIN SEPARATELY $\times 50$.



Photo, F. N. Clark.

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FEMALE APPENDAGES OF A. THETIS $\times 25$, AND OF REIN $\times 50$.



Photo, F. N. Clark.

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FEMALE APPENDAGES OF A. HYLAS, DORSAL AND LATERAL ASPECTS $\times 25$.



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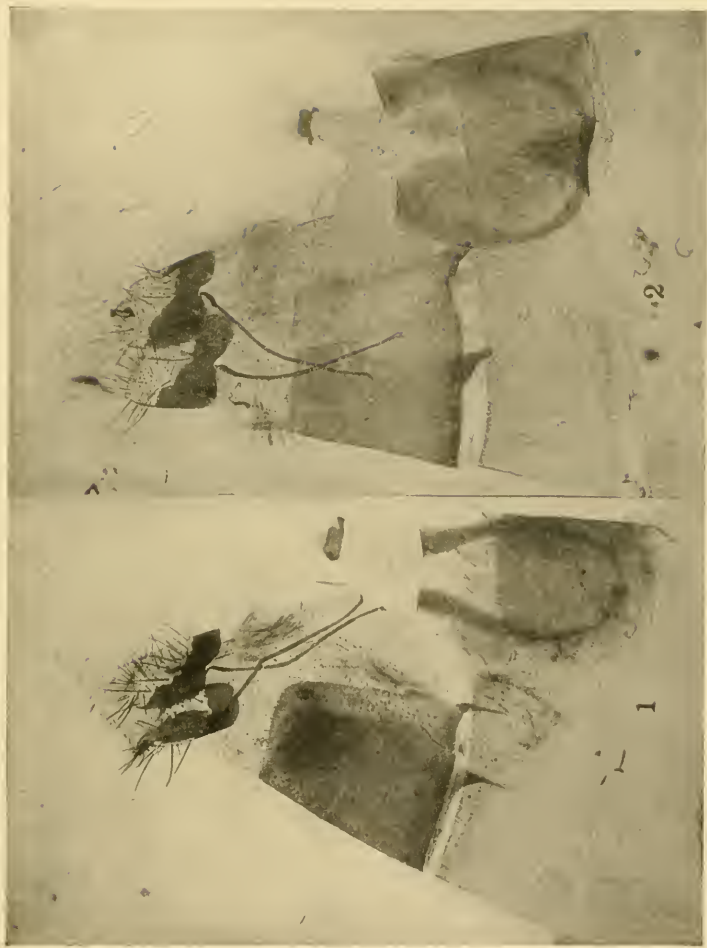
FEMALE APPENDAGES OF (1) A. ESCHERI; (2) A. DAMON $\times 25$.



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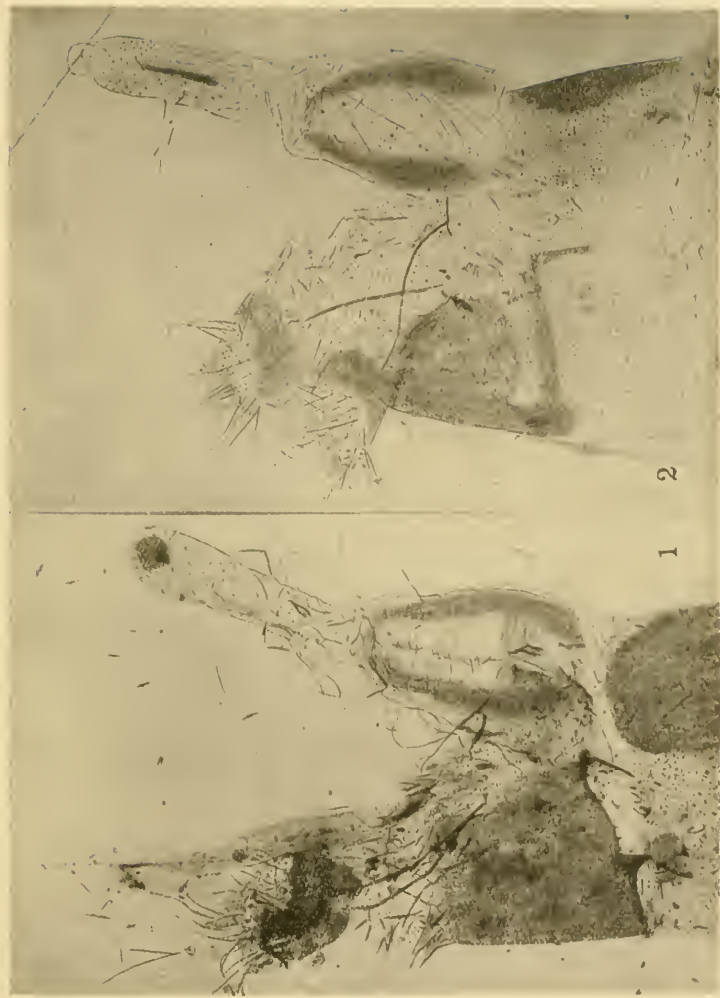
FEMALE APPENDAGES OF (1) *P. MELEAGER*; (2) *A. ADMETUS* $\times 25$.



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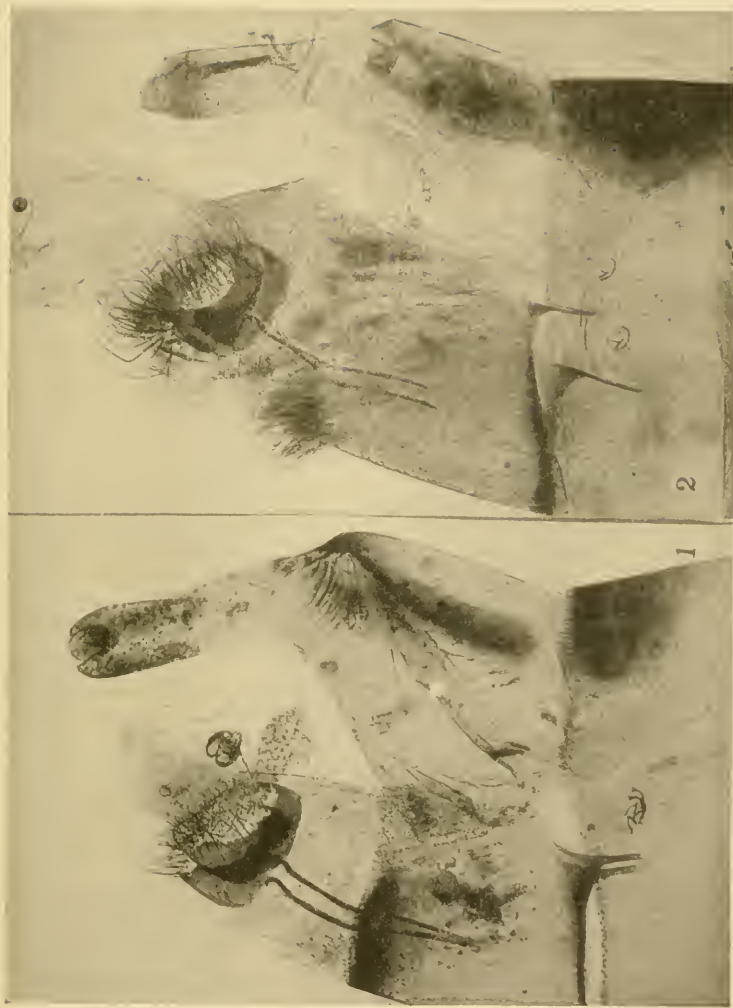
FEMALE APPENDAGES OF (1) *A. THERSITES*; (2) *P. EROS* × 25



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FEMALE APPENDAGES OF (1) *P. AEGON*; (2) *P. ARGYROGNOMON* × 25.



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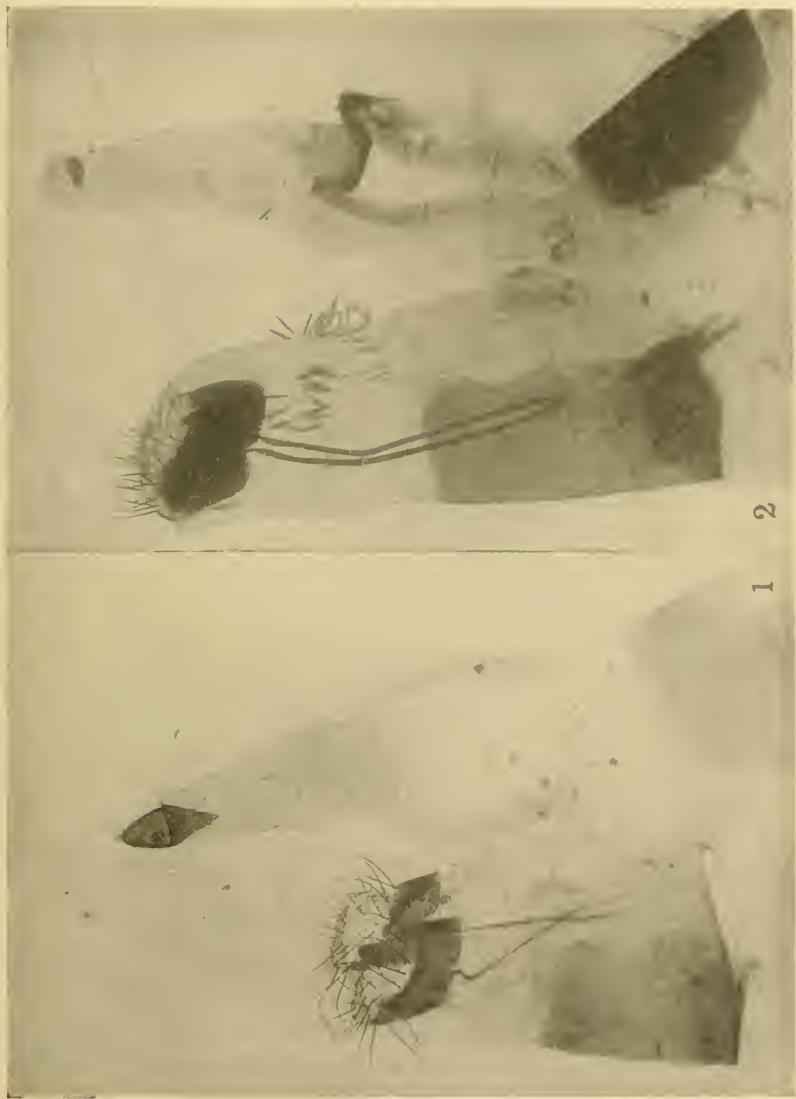
FEMALE APPENDAGES OF (1) *P. ZEPHYRUS*; (2) *P. CLEOBIS* $\times 25$.



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FEMALE APPENDAGES OF (1) P. ISAURICA; (2) A. DONZELII $\times 25$.

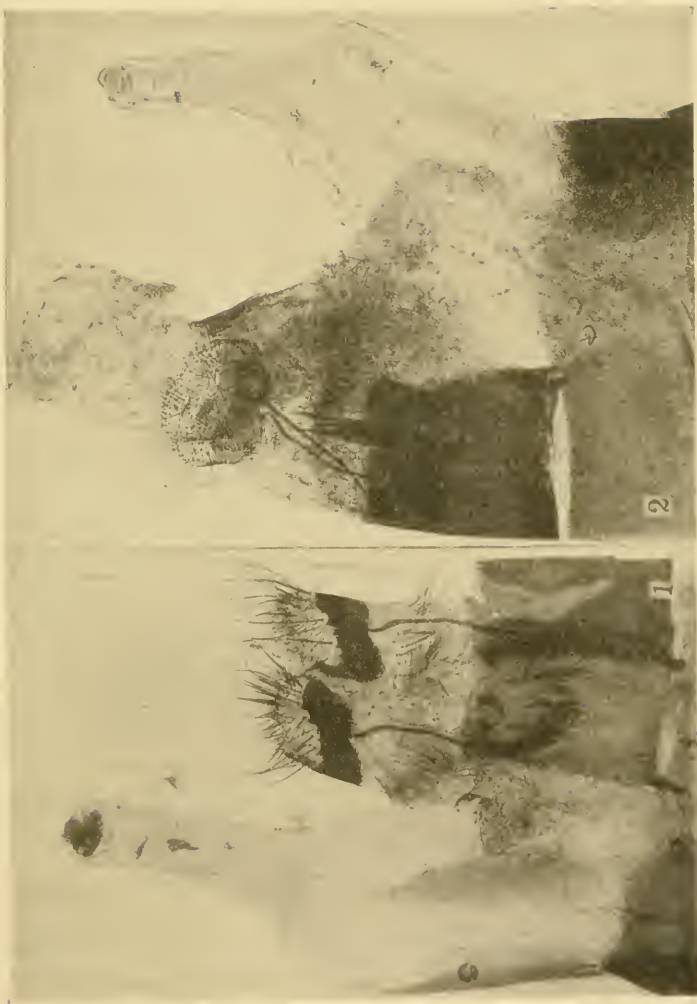


1 2

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FEMALE APPENDAGES OF (1) *A. MEDON* ; (2) *C. SEMIARGUS* $\times 25$.



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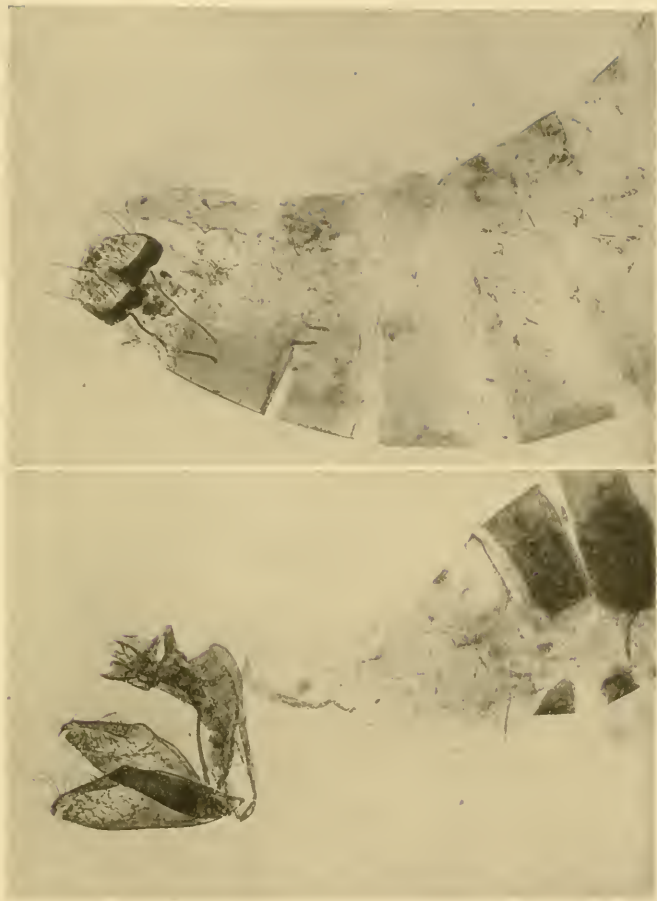
FEMALE APPENDAGES OF (1) LAT. ORBITULUS; (2) V. OPTILETE $\times 25$.



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FEMALE APPENDAGES OF (1) *T. TELICANUS*; (2) *P. MARTINI*; (3) *E. ARGIADES* $\times 25$.

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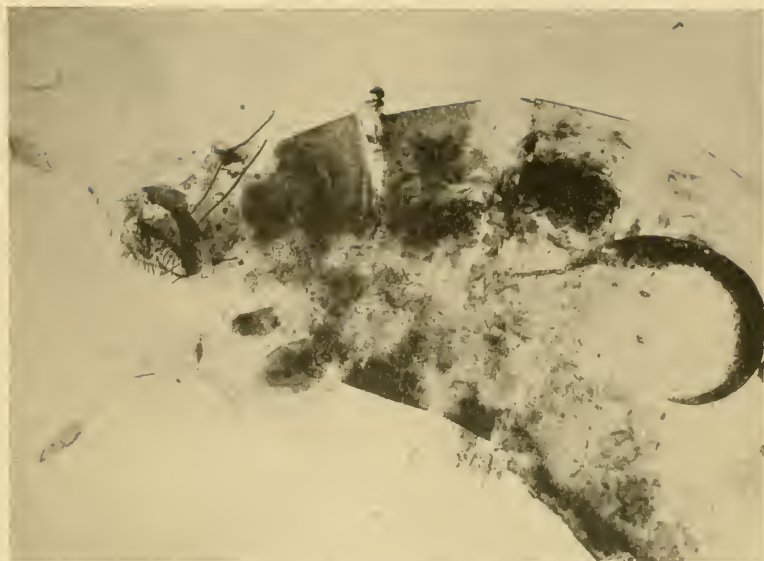
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MALE AND FEMALE APPENDAGES OF CHILADES TROCHILUS × 25.

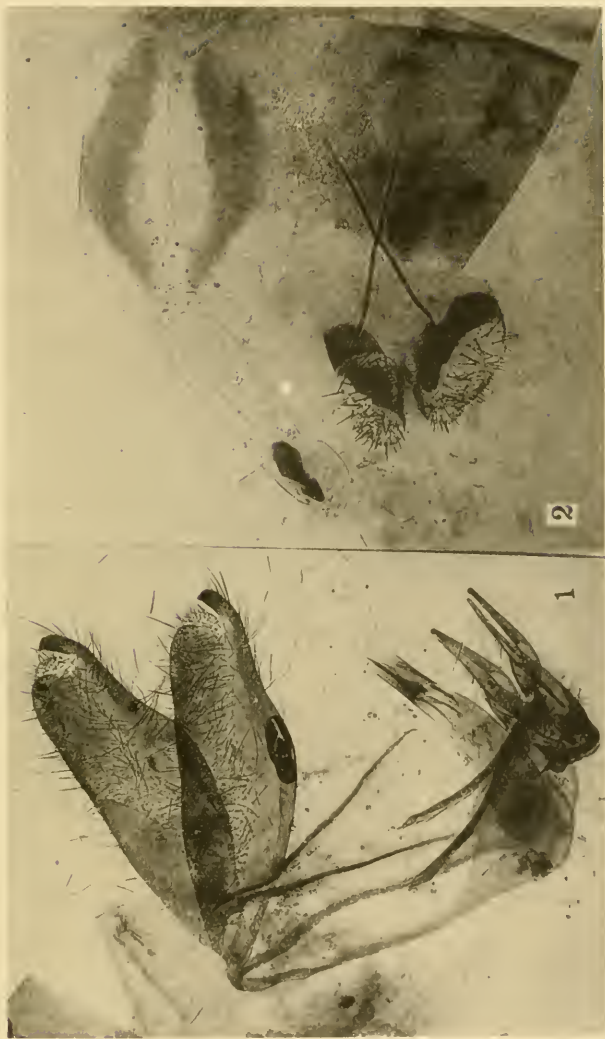


Photo, F. A. Clark.



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CHILADES CNEJUS, MALE AND FEMALE APPENDAGES × 25.



Photo, F. N. Clark.

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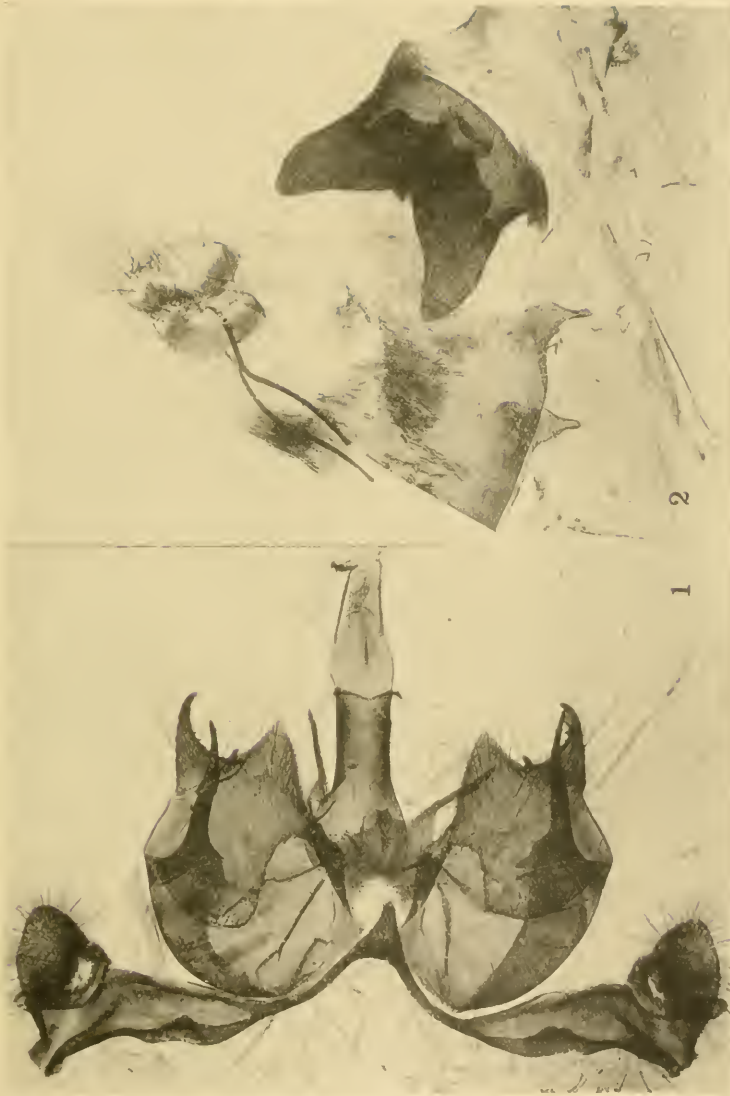
(1) MALE AND (2) FEMALE APPENDAGES OF CHILADES LAIUS $\times 40$.



Photo, F. N. Clark

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APPENDAGES 1) MALE AND 2) FEMALE OF CHILADES PANDAVA $\times 40$.



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MALE AND FEMALE APPENDAGES OF *I. IOLAS* × 25.



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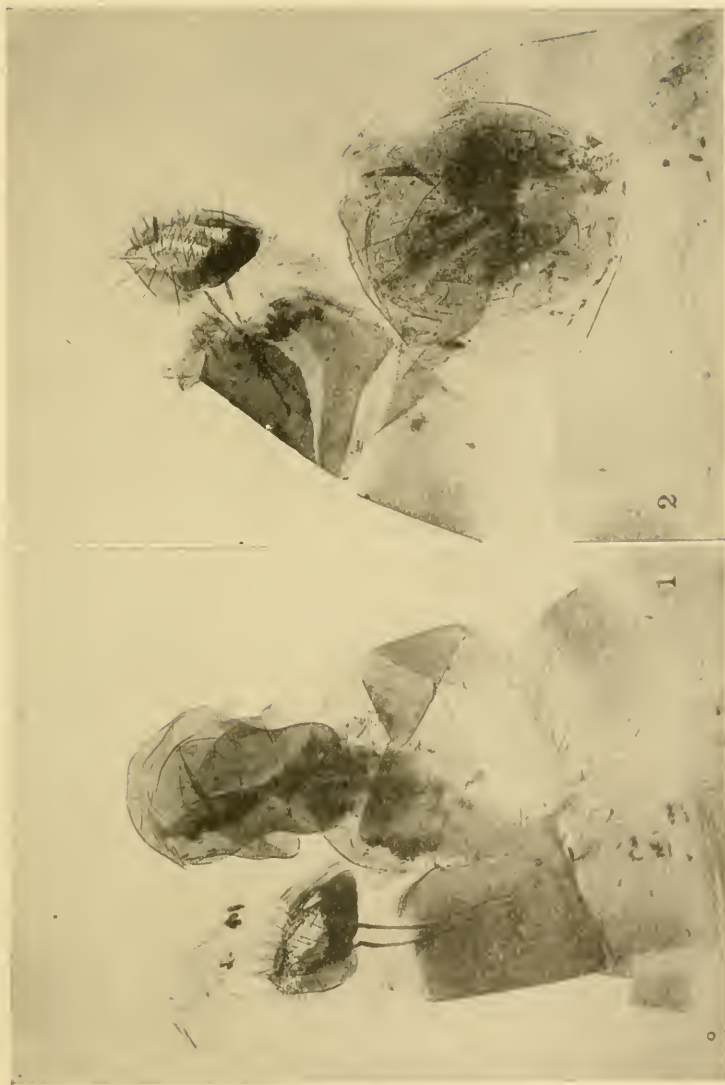
FEMALE APPENDAGES OF (1) *P. CANDALUS* (?); (2) *LYCAENOPSIS ARGIOLUS* × 25.



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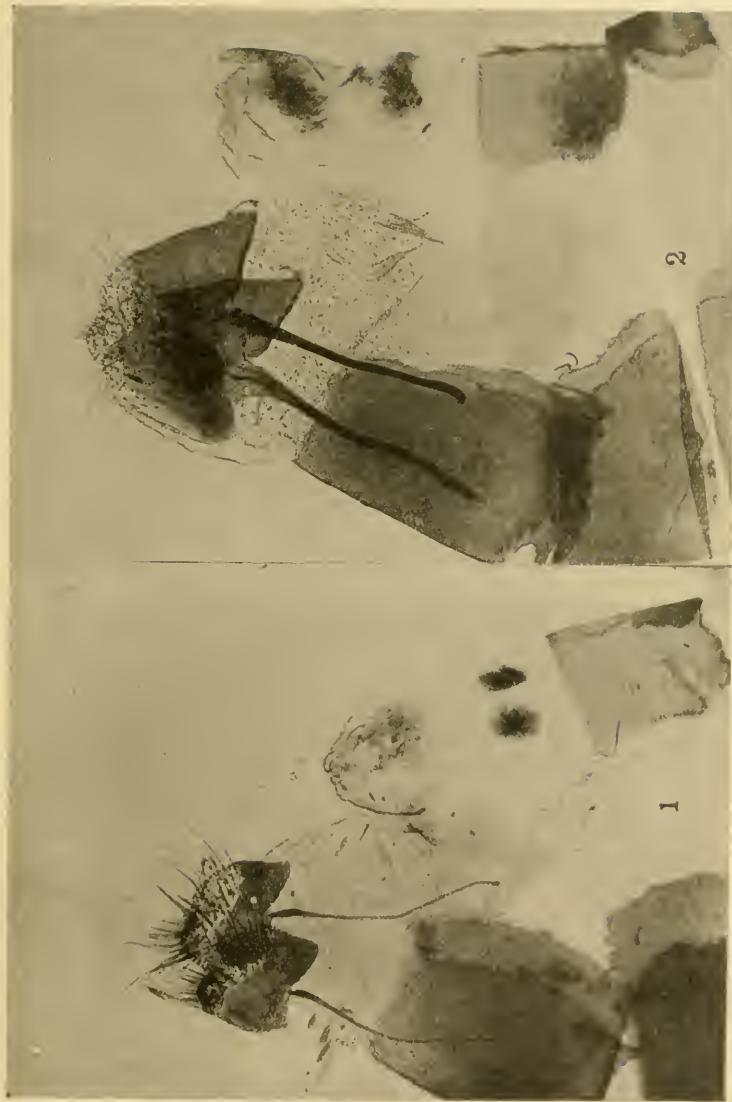
(1) MALE APPENDAGES OF *L. BOETICA* $\times 35$; (2) FEMALE OF *L. PROSECUSA* $\times 25$.



Photo, F. N. Clark.

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FEMALE APPENDAGES OF LAMPIDES BOETICA: (1) EXSERTED, (2) RETRACTED $\times 25$.



Photo, F. N. Clark.

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FEMALE APPENDAGES OF (1) LYC. ALCON; (2) LYC. EUPHEMUS $\times 25$.



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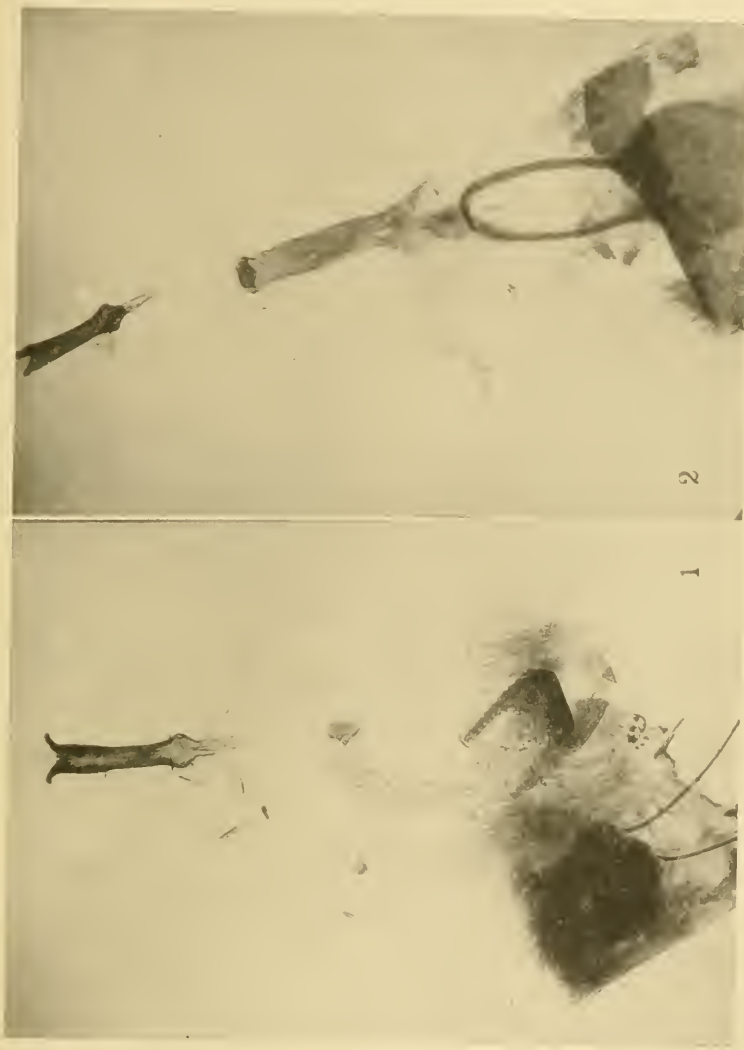
A. THETIS. TWO EXAMPLES OF PAIRED SPECIMENS $\times 25$.



Photos, (1) *A. E. Tonge* and (2) *F. N. Clark*.

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A. THETIS, MALE AND FEMALE APPENDAGES, JUST SEPARATED.



Photos, (1) F. N. Clark and (2) A. E. Tonge.

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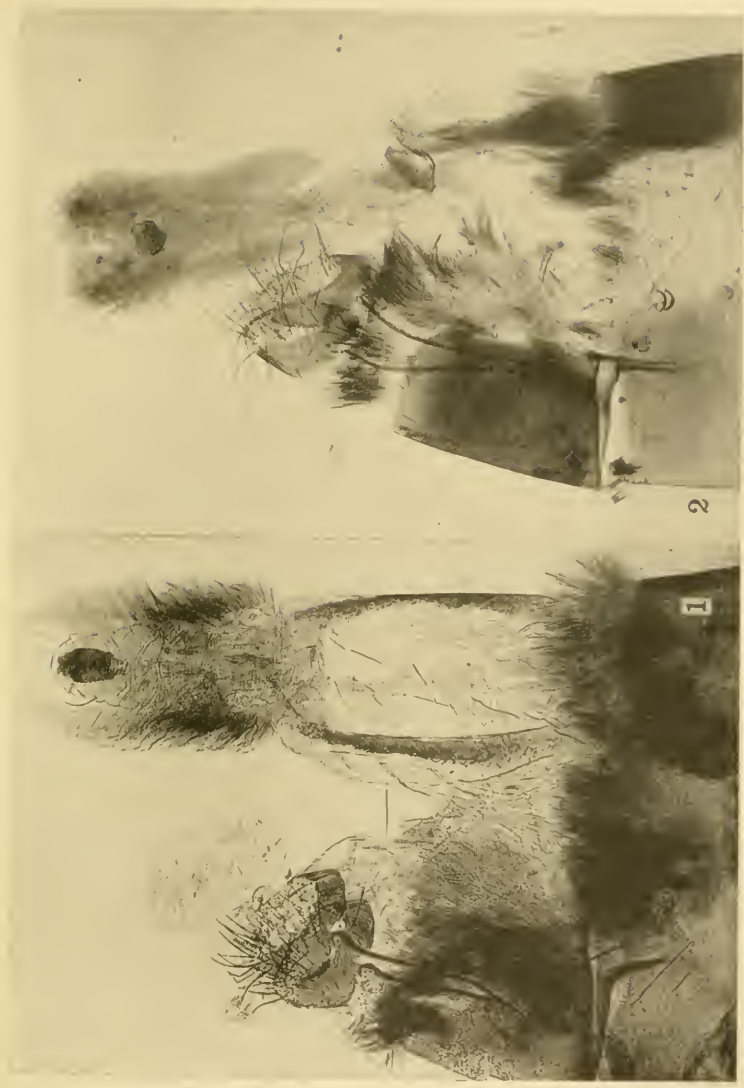
(1) **A. CORIDON** $\times 20$; (2) **A. THETIS** $\times 14.5$.



Photo, F. N. Clark.

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AGRIADES CORIDON, DETAILS AS TO PAIRING $\times 15$ and $\times 20$.



Photo, F. N. Clark.

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FEMALE APPENDAGES OF (1) *P. EVERSMANNI* $\times 25$; (2) *A. CORIDON* $\times 20$.
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11, CHANDOS STREET, CAVENDISH SQUARE, W.

SESSION 1916-1917.

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"	"	18
"	November	1
"	"	15
"	December	6

1917.

"	January	(ANNUAL MEETING)	17
"	February	7

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VII. On new and little-known Lagriidae and Pedilidae.
By GEORGE CHARLES CHAMPION, F.Z.S.

[Read June 7th, 1916.]

PLATES LXIII, LXIV.

THE present paper, based upon material in the British Museum, contains descriptions of various new genera allied to *Ictistygna*, *Diacalla*, and *Egestria*, Pascoe. Five species are added to the first-named genus and three to *Eurygenius*, Laferté, and the very numerous unidentified *Macratræ* in the same collection are named or described. Specimens captured by Mr. H. L. or H. E. Andrewes in India, by Commander Walker in China and Australia, and by Mr. G. E. Bryant in Australia, Borneo, Brazil, etc., have also been examined, as well as a few interesting forms belonging to the Oxford University Museum and some others recently sent me by Mr. H. J. Carter of Sydney. *Ictistygna* and the genera with closed anterior acetabula, *i. e.* with the cavities closed by the inward extension of the prothoracic epimera, are retained for the present under Lagriidae, though in other respects they are extremely like *Eurygenius*, *Stereopalpus*, and other Pedilids, all of which have definitely open coxal cavities. *Egestria* forms a sort of connecting-link between the Lagriidae and Pedilidae, as it has the inferior basal margin of the prothorax extending inward behind the anterior coxæ; but the prothoracic epimera do not meet, and therefore the cavities, it seems to me, must be regarded as open. This character, however, cannot be seen till the prothorax is completely detached.

NEW GENERA AND SPECIES DESCRIBED.

LAGRIIDÆ.

- Egestriomima* (n. gen.), for *Egestria albilineata*, Carter, Australia.
 „ *fulvipennis*, Australia.
Ictistygna macleayi, Queensland.
 „ *fasciata*, Australia.
 „ *biformis*, N.S. Wales.
 „ *laticollis*, Australia.
 „ *tenuis*, W. Australia.
Ictistygna (n. gen.) *filicornis*, Brazil.
Diacallina (n. gen.) *multiforis*, W. Africa.

PEDILIDÆ.

- Egestrina* (n. gen.) *canescens*, W. Australia.
Macratræmima (n. gen.) *lobigera*, New Guinea.
Eurygenius villosus, Colombia.
 „ *arizonensis*, Arizona.
 „ *scoparius*, Nilgiri Hills.
Macratræa teallaceti, Waigiu.
 „ *giloloana*, Gilolo.
 „ *leucozona*, Borneo.
 „ *albofasciata*, Assam.

NEW GENERA AND SPECIES DESCRIBED (*continued*).

PEDILIDAE.		
<i>Macratia lineata</i> , Ceylon and ? Java.		<i>Macratia atricolor</i> , Burma.
„ <i>dichroa</i> , Bengal		„ <i>pumilio</i> , Borneo.
„ <i>punctigera</i> , Borneo.		„ <i>parvula</i> , Philippine Is.
„ <i>flavipalpis</i> , Philippine Is.		„ <i>erythrocephala</i> , Victoria.
„ <i>flavicornis</i> , Assam.		„ <i>macrophthalma</i> , Queensland.
„ <i>dilatocollis</i> , Perak and Penang.		„ <i>carteri</i> , N.S. Wales.
„ <i>cirrata</i> , Perak.		„ <i>duboulayi</i> , Champion Bay.
„ <i>ruginosa</i> , Perak.		„ <i>permagna</i> , Natal.
„ <i>rufescens</i> , Burma.		„ <i>rugulipennis</i> , Mashonaland.
„ <i>nilgirica</i> , Nilgiri Hills.		„ <i>cordata</i> , Natal.
„ <i>semperi</i> , Philippine Is.		„ <i>ruficollis</i> , Natal.
„ <i>dentipes</i> , Macassar and Celebes.		„ <i>complanata</i> , Colombia.
„ <i>celebensis</i> , Celebes.		„ <i>scabrida</i> , Brazil.
„ <i>marginata</i> , Perak.		„ <i>fissiceps</i> , Colombia.
„ <i>setigera</i> , Darjeeling.		„ <i>egaensis</i> , Amazons.
„ <i>longipennis</i> , Burma.		„ <i>truncata</i> , Brazil.
„ <i>rugerrima</i> , Burma.		„ <i>crassimanus</i> , Brazil.
		„ <i>frontalis</i> , Amazons.

LAGRIIDAE.

EGESTRIOMIMA, n. gen.

Head oblong-subquadrate, abruptly constricted into a short neck behind, the anterior portion short and obliquely narrowed, the epistoma confused with the front; labrum prominent, transverse; eyes finely faceted, distant from one another and from the base of the head, feebly sinuate in front, oblique as seen in profile; terminal joint of maxillary palpi long, cultriform, that of the labial palpi small, oval, obliquely truncate at tip; antennae slender, the terminal joint not elongated; prothorax long, constricted into a short neck in front, and transversely grooved within the basal margin; scutellum triangular; elytra elongate, confusedly punctate; anterior coxae large, conical, contiguous, the cavities rather broadly closed behind by the inward extension of the prothoracic epimera; intermediate coxae well separated; ventral segments 1-5 subequal in length; legs long, rather slender; tibiae with short strong spurs; penultimate tarsal joint bilobed, the claws long, simple; body elongate, narrow, villose and setose.

Type, *Egestria albilineata*, Carter.

This genus includes an insect agreeing with the description of the species selected as the type and an allied form, both Australian. *E. albilineata* superficially resembles the type of *Egestria*, *E. taeniata*, Pasc., from Queensland; but the former has the anterior acetabula completely closed behind, and it must therefore be transferred to Lagriidae. The head, moreover, is longer than in any of the Pedilids known to me, and the eyes are placed far from the base.

1. *Egestriomima albilineata*. (Plate LXIII, figs. 1, ♂;
1a, genital armature.)

Egestria albilineata, Carter, Proc. Linn. Soc. N.S.W. xxx,
p. 189 (1905).

Hab. NEW SOUTH WALES (*Mus. Brit.*), Gosford [type
in coll. Carter], Clarence River (*ex coll. Pascoe*).

A narrow, elongate, shining, bronze-black insect, with the antennae in great part testaceous; thickly clothed above with white or cinereous and blackish-brown, adpressed, pubescence intermixed with long, erect, blackish hairs, the white pubescence on the elytra condensed into a narrow, sharply defined, sutural stripe and an oblique, broader vitta extending from the shoulder to near the apex, the broader stripes usually coalescent with the sutural one posteriorly; the under surface closely set with long, decumbent, white hairs; the legs villose. The head is rounded at the sides posteriorly, and broadly depressed in the middle anteriorly. The antennal joints decrease a little in length towards the tip, 11 being about as long as 10. The prothorax is arcuately dilated at the sides before the middle and subcylindrical thence to the base, the fine median groove being usually traceable. The elytra are gradually narrowed from the base in ♂, and subparallel in ♀; rather coarsely, confusedly punctate, the interspaces closely, minutely punctulate. The fifth ventral segment is emarginate at the apex in ♂, and the penis-sheath is bisagittate (somewhat as in *Eurygenius arizonensis*, Champ.), when viewed in profile.

2. *Egestriomima fulvipennis*, n. sp.

♂. Elongate, narrow, shining, black, the antennae in part and the elytra testaceous; thickly clothed above with long, adpressed, fulvous pubescence, with longer, erect, bristly hairs intermixed, the latter black on the head and prothorax and pallid on the elytra; the long hairs on the under surface whitish, those on the legs in great part fuscous. Head oblong-subquadrate, broadly depressed in the middle anteriorly, with intermixed minute and larger punctures; antennae slender [outer joints missing]. Prothorax narrower than the head, elongate, subcylindrical, arcuately dilated at the sides before the middle, punctured like the head, obsoletely canaliculate on the disc. Elytra long, narrowed from the base; rather coarsely, confusedly punctate, the interspaces minutely punctu-

late. Fifth ventral segment emarginate. Penis-sheath bisagittate, the upper portion strongly acuminate at the tip.

Length 7, breadth 2 mm.

Hab. AUSTRALIA, Queensland border (*Blackburn*).

One male, sent me many years ago by Blackburn. Two similarly-coloured examples—one in the Museum labelled "Melbourne," acquired in 1853, the other from Inverell, N.S.W. (*J. Stephen*), recently received from Mr. Carter—with the elytra subparallel in their basal half, are probably females of the same species; but they have the fifth ventral segment deeply excavate down the middle, a character usually indicative of the male.

ICTISTYGNA, Pascoe.*

Eurigeniomorphus, Pic, Le Naturaliste, 1897, p. 25.

This genus was based upon a single species, several others being now known, all Australian, the sexes of some of them being very different. Pascoe noted the closed anterior coxal cavities, and for that reason referred *Ictistygna* to Lagriidae. The resemblance to the Pedilid genera *Diacalla* and *Egestria* is certainly very striking, and unless the coxae are pushed forward it is scarcely possible to see whether the acetabula are closed or open. The tibiae are conspicuously denticulate or setulose externally in all the species, this being especially noticeable on the intermediate pair. The six before me may be tabulated thus:—

- a. Tibiae denticulate externally; head and prothorax more coarsely punctate.
- a¹. Body black in ♂ (the elytra reddish-brown in *I. adusta*, type), brown in ♀.
- a². Head and prothorax more coarsely punctate.
- a³. Legs red; elytra coarsely, rugosely punctate; antennae long in ♂ *adusta*, Pasc.
- b³. Legs black; elytra coarsely, subconfluently punctate; antennae shorter in ♂; [♀ unknown] *macleayi*, n.sp.
- b². Head and prothorax finely punctate.
- c³. Elytra fasciate, dull *fasciata*, n. sp.
- d³. Elytra with suture infuscate, shining *biformis*, n. sp.

* Incorrectly placed by me as a synonym of *Eurygenius*, Laf., in Ann. Soc. Ent. Belg. xlii, p. 77 (1898).

- a². Body black, elytra in both sexes reddish brown, the latter foveolato-punctate . . . *laticollis* n. sp.
- b. Tibiae setulose externally; head and prothorax densely, finely punctate; antennae slender; body brown in both sexes *tenuis*, n. sp.

1. *Ictistygna adusta*. (Plate LXIII, fig. 2, ♂, var. *rugosa*, Pic.)

♂. *Ictistygna adusta*, Pasc., Journ. Ent. ii, p. 492 (1866).

♀. *Ictistygna vetula*, Pasc., loc. cit.

♂♀. *Eurigeniomorphus rugosus*, Pic, Le Naturaliste, 1897, p. 25.

? *Egestria rubicunda*, Mael., Proc. Linn. Soc. N.S.W. (2) ii, p. 323 (1888).

Var. ♂. Elytra black with a slight brassy lustre.

Hab. NEW SOUTH WALES [types of Pascoe and Pic], Sydney district, Manly, Richmond River, Illawarra, Caramba, Springwood.

Pascoe's types are the sexes of the same species, these differing in colour, and in the shape of the elytra, as in *I. biformis*. The males are sometimes almost wholly black (the ferruginous legs excepted), as in Pic's type of *E. rugosus*, that of *I. adusta* and of another specimen sent me by Mr. Carter having reddish-brown elytra as in the female, which has the body entirely of that colour. The elytra are narrowed from the base in the male, and broader and subparallel in the female. Pic's description of the tarsal claws is obviously due to an error of observation.* The elytral sculpture is very coarse and subconfluent. The fifth ventral segment is angularly produced and ciliate in the middle at the apex, and the penis-sheath long and slender in the male. The intermediate tibiae are curved and coarsely denticulate externally in both sexes. The four females from Richmond River are larger and duller than the rest, and have a broader head and a longer third joint to the antennae: they may belong to a different species. The length varies from 6½–13, and the breadth from 2 (♂)—4 (♀) mm. *E. rubicunda*, Mael., from Cairns (length 3½ lin.), may be a ♀ of *I. adusta*?

* The broad terminal tarsal joint mentioned by him must be the lobed penultimate one.

2. *Ictistygna macleayi*, n. sp.

♂. Elongate, narrow, robust, shining, thickly clothed, the legs included, with long, soft, erect cinereous hairs intermixed with scattered decumbent pubescence; black, the elytra with a faint brassy lustre, the antennae in part and the tips of the tarsi ferruginous. Head transverse, moderately large, hollowed at the base, densely, confluent punctate, the eyes large, distant, the head well developed behind them; antennae slender, joints 2 and 4-8 sub-equal in length, 3 more elongate [9-11 missing]. Prothorax transversely globose, slightly wider than the head, the neck-like anterior portion moderately long, the transverse basal groove deep; closely impressed with shallow, rounded, umbilicate punctures. Elytra long, narrowing from the base, somewhat produced at the tip; closely impressed with longitudinally confluent, coarse, foveiform punctures, the narrow interspaces almost smooth. Tibiae denticulate on their outer edge, the intermediate pair curved.

Length 6-7, breadth $1\frac{2}{3}$ -2 mm.

Hab. QUEENSLAND (*Mus. Brit. and ex coll. F. Bates*).

Two males. About the same size as *I. adusta* (♂), the prothorax shaped much as in *I. laticollis*. The shorter and more slender antennae, the more transverse prothorax, the larger and less confluent foveiform punctures on the elytra, and the black legs, separate *I. macleayi* from the same sex of *I. adusta*. A longer and more robust insect than *I. bififormis*, with the upper surface more coarsely sculptured. The elytra are relatively narrower at the base than in *I. laticollis*; the punctures are a little smaller than in the latter, and here and there confluent as in *I. adusta*. *Egestria hirtipennis*, Macl., from Russell River (length 2 lin.), must be an allied form, but it can scarcely be the female of the present species. The Moreton Bay female provisionally referred to *I. laticollis* has larger and less confluent punctures on the elytra.

3. *Ictistygna fasciata*, n. sp.

Moderately elongate, opaque, the elytra somewhat shining, thickly clothed with adpressed pallid pubescence intermixed with long, soft, erect, yellowish and brown hairs; black, the head in front and at the sides rufous, the elytra reddish-brown, the apical half nigro-piceous in ♂, each with a patch near the suture just below the base and a transverse post-median fascia (widening outwards and not reaching the suture) fuscous in ♀, the antennae (the extreme tip excepted), palpi and legs testaceous or ferruginous, the femora in

great part nigro-piccous, the tibiae infuscate towards the apex in ♂; the head and prothorax densely, finely, the elytra coarsely, punctate, the interspaces on the latter closely punctulate. Head subquadrate, broadly extended on each side behind the eyes, the latter prominent and rather large; antennae slender, moderately long, joints 3-10 very gradually decreasing in length, 2 shorter than 3, 11 slightly longer than 10. Prothorax about as wide as the head (with the eyes), transverse, rounded at the sides anteriorly and rapidly narrowed to the transverse basal groove, the neck in front narrow and sharply defined, the disc with an indication of a smoother median line. Elytra moderately long, much wider than the prothorax, narrowing from the base in ♂, subparallel in their basal half in ♀, transversely depressed below the base, the punctures well separated. Legs rather short; tibiae denticulate externally.

Length 6-7, breadth $1\frac{3}{4}$ - $2\frac{1}{10}$ mm. (♂ ♀.)

Hab. NEW SOUTH WALES (*ex coll. Pascoe*: ♂, type); QUEENSLAND (*ex II. J. Carter*: ♀).

Two specimens, the female received from Mr. Carter in time to be included in this paper. This insect has the general facies of a Clerid. It is the only known species with fasciate elytra. *I. fasciata* is a little larger than *I. biformis*, ♀, and has the prothorax less narrowed posteriorly, the eyes more prominent, and the elytra less shining, with the puncturing more diffuse. The prothoracic epimera do not quite meet along the median line, nevertheless the cavities cannot be described as open.

4. *Ictistygna biformis*, n. sp. (Plate LXIII, figs. 3, ♂; 4, ♀.)

♂. Elongate, narrow, shining, clothed (the legs included) with intermixed decumbent hairs and long, erect or laterally projecting, bristly hairs; black with a greenish or aeneous lustre, the two basal joints of the antennae testaceous. Head large, transverse, densely punctate, transversely depressed in front, well developed behind the eyes, the latter moderately large, distant, small as seen from beneath; maxillary palpi long, stout, the terminal joint securiform; antennae moderately long, slender, slightly tapering outwards, joint 2 shorter than 3, 3-11 subequal in length. Prothorax convex, transversely cordate, about as wide as the head, and with a rather long, narrow, abrupt neck in front, densely punctate, the basal groove conspicuous. Elytra moderately long, narrowed from the base, transversely depressed on the disc anteriorly, coarsely, closely, confusedly punctate. Beneath more shining, sparsely, minutely punctate. Legs rather slender; tibiae irregu-

larly denticulate externally; tarsi with the penultimate and antepenultimate joints widened.

♀. Broader and larger, the elytra (the suture excepted), palpi, legs, and about joints 1-4 of the antennae, reddish-brown or testaceous; the eyes smaller; the elytra subparallel in their basal half.

Length 4-7, breadth $1\frac{1}{10}$ - $2\frac{1}{10}$ mm. (♂ ♀.)

Hab. NEW SOUTH WALES, Sydney, Botany, Mosman, Illawarra, National Park.

Not uncommon in the Sydney district, in August, September, and October, to judge from the numerous specimens captured there by Mr. H. J. Carter, Commander J. J. Walker, and Mr. G. E. Bryant. In the series in the Museum there is a pair still "in copula," and a male received more than fifty years ago. This species is much smaller than those named by Pascoe, and apparently undescribed. *Egestria hirtipennis*, and *E. rubicunda*, Macl., are of about the same size as *I. biformis*, and dark brown in colour; but they could not be females of the present insect, as they are each described as having an elongate apical joint to the antennae.

5. *Ictistygna hirtipennis*.

Egestria hirtipennis, Macl., Proc. Linn. Soc. N.S.W. (2) ii, p. 322 (1888).

"Very dark brown, subnitid, very roughly punctured and clothed with soft, erect, cinereous hairs. Head square; eyes prominent; labrum very short; antennae slender, last joint longer than the others; maxillary palpi long, joints triangular with apical angles inwards, last joint longer. Neck narrow, well defined. Thorax transverse, rounded at anterior angles, truncate behind. Elytra broader than thorax, more than three times its length. Base of thighs, tibiae, tarsi, and palpi yellow. Length 2 lin."

Hab. QUEENSLAND, Russell River, in the Cairns district.

Evidently an *Ictistygna* (♀), to judge from the description, but apparently not represented in the material before me. The specimens from Sydney (♂ ♀) sent me by Mr. H. J. Carter under the name *E. hirtipennis* are referable to *I. biformis*. The much smaller size separates *E. hirtipennis* from *I. adusta*.

6. *Ictistygna laticollis*, n. sp.

Elongate, robust, the elytra somewhat shining; clothed with long, soft, erect, brownish and cinereous hairs intermixed with

scattered, short, decumbent pubescence, the legs thickly set with intermixed long and shorter whitish hairs; black, the elytra brown or reddish brown, the basal margin of the prothorax and the tibiae and tarsi (in part) similarly coloured in ♀, the mandibles rufous at the base. Head transverse, large, broadly subtruncate at the base, densely, confluent punctate, the eyes moderately large and somewhat prominent; antennae slender, joints 2 and 4 subequal in length, 3 longer than those following, 11 longer than 10. Prothorax comparatively short, transversely globose, fully as wide as the head, strongly rounded at the sides, the tubulate anterior portion narrow and rather long, the basal groove deep; closely impressed with shallow, rounded umbilicate punctures. Elytra long, rapidly narrowed from the base in ♂, subparallel in ♀, conjointly rounded at the apex, transversely depressed on the disc anteriorly; closely impressed with rather large foveiform punctures which are separate one from another, the narrow, irregularly raised interspaces shining and almost smooth. Tibiae strongly denticulate, all more or less curved in ♀, straighter in ♂.

Length $7\frac{1}{2}$ –11, breadth 2–3 mm. (♂ ♀.)

Hab. NEW SOUTH WALES, Tweed River (*W. W. Froggatt*: ♂, type), Richmond River (*Mus. Brit.*: ♀); QUEENSLAND, Moreton Bay (*Diggles, in Mus. Oxon.*: ♀).

Described from two ♂♂ and one ♀ from N.S. Wales, the Queensland example having testaceous antennae, but doubtless belonging to the same species. Near *I. adusta*, Pasc., but with a much broader and more transverse prothorax, a larger head, larger eyes, shorter antennae, and less confused, foveiform elytral punctuation. *I. (Egestria) rubicunda*, Macl. (type, ♀), from Cairns, must have a longer prothorax.

7. *Ictistygna tenuis*, n. sp. (Plate LXIII, fig. 5, ♂.)

Elongate, narrow (♂), broader (♀), dull, the elytra and under surface shining; brown or ferruginous, the femora and tibiae in part, and the head, prothorax, antennae, metasternum, and abdomen, often more or less infusate; finely cinereo-pubescent, with scattered, intermixed, long, erect, soft hairs, the cinereous pubescence condensed into a narrow median vitta on the prothorax; head and prothorax densely, finely, the elytra coarsely and irregularly, punctate. Head about as wide as the prothorax, well developed behind the moderately large eyes, rounded at the sides posteriorly; antennae very slender, subfiliform, joints 4–10 slightly decreasing in length, 2 shorter than 3, 3 and 4 subequal, 11 scarcely longer

than 10. Prothorax convex, transversely cordate, deeply grooved at the base, narrowly and sharply tubulate in front. Elytra long, narrowed from the base in ♂, subparallel in ♀, depressed on the disc anteriorly, the punctures confusedly arranged and separate one from another. Beneath, minutely punctate; fifth ventral segment emarginate, and the penis-sheath narrow and acuminate, in ♂. Legs long, slender, the tibiae setulose externally.

Length $4\frac{1}{2}$ –9, breadth $1\frac{1}{10}$ – $2\frac{1}{2}$ mm. (♂ ♀.)

Hab. W. AUSTRALIA (*Mus. Brit.*), Champion Bay (*Duboulay*), Swan River (*ex coll. F. Bates*), S. Perth (*H. J. Carter*), Fremantle (*J. J. Walker*: vii. '01).

A long series, including two specimens received by the Museum in 1844. The description is mainly taken from the numerous examples captured by Commander Walker in 1901. It is separable from all the allied forms by the very fine, dense puncturing of the head and prothorax, its elongate, narrow shape, and the comparatively slender limbs. The apical joint of the antennae is not elongated in either sex, the antennae themselves being very slender and subfiliform. It is somewhat remarkable that the species has remained so long undescribed.

ICTISTYGNINA, n. gen.

Head with an abrupt narrow neck; eyes in ♂ extremely large, occupying the whole of the sides of the head, in ♀ much smaller, feebly sinuate in front; mandibles unemarginate at tip; maxillary palpi long, narrow, joint 4 elongate, cultriform, as long as 2; antennae filiform, very long in both sexes, joint 2 extremely short; prothorax transversely cordate, immarginate laterally, narrowly, abruptly tubulate in front, deeply grooved within the basal margin; elytra long, subparallel, confusedly punctate, the epipleura very narrow, incomplete; anterior coxae large, conical, contiguous, the cavities narrowly closed behind by the inward extension of the prothoracic epimera; intermediate coxae separated anteriorly by an extremely narrow laminiform process, the posterior pair also narrowly separated; ventral segments 2–5 subequal in length; legs long, rather slender; tibiae asperate, the spurs short; tarsi with the penultimate joint broadly lobed, the claws rather small, widened at base; body elongate, villose.

Type, *I. flicornis*.

The type of this genus, from Brazil, may be described as a Pediliform Lagriid, the narrowly closed anterior coxal

cavities bringing it into the family Lagriidae, as at present defined in our text-books. The extremely elongate antennae, large eyes, and general facies are suggestive of the Oedemerid genus *Calopus*. The difference in the size of the eyes in the two sexes is somewhat remarkable, as is also the very small second joint to the unusually elongate, filiform antennae, these characters separating the present genus from *Ictistygna*, Pasc., all the species of which are Australian.

1. *Ictistygna filicornis*, n. sp. (Plate LXIII, figs. 6, ♂; 6a, antenna.)

Elongate, rather narrow, somewhat flattened above, the head and prothorax opaque, the rest of the surface shining, clothed with intermixed decumbent pallid pubescence and long soft erect hairs; obscure ferruginous, the elytra, palpi, antennae, and legs testaceous or brownish-testaceous, the eyes black. Head narrowed behind the eyes, densely scabroso-punctate; eyes coarsely faceted, nearly reaching the base of the head and almost contiguous above in ♂, much smaller and separated by fully half their own width as seen from above in ♀; antennae shortly pilose, slender, as long as the body in ♂, shorter in ♀, joints 3-10 elongate, equal in length, 11 longer than 10 and constricted at about one-third from the tip. Prothorax barely as wide as the head in ♂, along the median line (with the narrow neck) about as long as broad, densely, finely, scabroso-punctate, much rounded at the sides before the middle, narrowed behind, the hind angles obtuse. Elytra long, much wider than the prothorax, gradually narrowed from the base in ♂, subparallel in their basal half in ♀, coarsely, closely punctate. Beneath sparsely, finely punctate; fifth ventral segment deeply arcuato-emarginate in ♂.

Length $7\frac{1}{2}$ - $8\frac{1}{2}$, breadth $1\frac{9}{10}$ - $2\frac{1}{10}$ mm. (♂ ♀.)

Hab. BRAZIL, Rio de Janeiro (*Fry*: ♂ ♀), Tejuca (*J. Gray*, 1857: ♀).

Two males and two females, the latter now wanting a portion of the antennae. *I. filicornis* superficially resembles a large pallid example of *Ictistygna tenuis*, from W. Australia, and it is similarly sculptured above; the prothorax, too, is of the same shape, except that the narrow basal portion is less dilated laterally in the American insect. The Indian Pedilid here described under the name *Eurygenius brunneus* is also not unlike *I. filicornis*, but the latter has the anterior coxal cavities closed behind,

DIACALLINA, n. gen.

Head moderately large, feebly developed behind the eyes, with a stout, sharply defined, cylindrical neck, the epistoma confused with the front; labrum short, broad; eyes very large, transverse, subapproximate above, distant beneath, feebly sinuate in front; mandibles bent inward from about the middle, stout, unemarginate at tip; maxillary palpi stout, joints 2 and 3 triangular, 4 broad, securiform; antennae slender, joint 11 constricted beyond the middle and slightly elongated; prothorax subcordate, immarginate laterally, margined at the base, constricted and tubulate in front; elytra long, closely seriato-punctate, the epipleura narrow, complete; prosternum not separated from the propleura; anterior coxae large, conical, contiguous, the cavities closed behind by the inward extension of the prothoracic epimera; intermediate coxae almost contiguous; metasternum deeply sulcate from before the middle to the apex; ventral segments subequal in length, the intercoxal process narrow, lanciform; legs stout; tibiae asperate, with strong spurs; tarsi with a broadly lobed penultimate joint, the claws long, widened at the base; body villose, coarsely sculptured.

Type, *D. multiforis*.

The W. African species forming the type of this genus has the general facies of a Clerid. It is very like *Diacalla*, type *D. comata*, Pasc., from Queensland; differing from that insect in the closed anterior coxal cavities, the very large eyes, the stout maxillary palpi, the stronger tibial spurs, the broadly lobed penultimate joint to the tarsi, and the seriate arrangement of the closely packed foveiform punctures on the elytra. The whole insect is strongly villose. The roughened tibiae are suggestive of *Ictistygna*.

1. ***Diacallina multiforis***, n. sp. (Plate LXIII, figs. 7, ♂;
7a, antenna.)

Elongate, robust, rather convex, moderately shining; piceous or reddish-brown, the prothorax, antennae, tibiae, tarsi, and metasternum nigro-piceous or piceous, the femora ferruginous at the base; sparsely clothed with long, decumbent, fulvous or cinereous hairs, those on the head and prothorax still longer and erect, the legs with numerous very long hairs intermixed. Head densely, rugosely punctate, arcuately narrowed behind the eyes, the latter extremely large in ♂, a little smaller in ♀, somewhat narrowly separated; antennae moderately long, joint 2 shorter than 3, 3-10 long, obconic, subequal, 11 considerably longer than 10, con-

stricted at a little beyond the middle. Prothorax transversely cordate, wider than the head in ♂, transversely depressed before the basal groove, closely impressed with rather large, rounded, umbilicate punctures. Elytra elongate, much wider than the prothorax, subparallel in ♀, gradually narrowed from the base in ♂; with closely packed rows of coarse, deep, foveiform punctures, the narrow interstices shining and transversely confluent. Beneath closely, the ventral segments more sparsely, punctate; fifth ventral segment slightly emarginate in ♂; aedeagus broad, deeply sulcate above, produced into a narrow, dorsally thickened knob at the tip. Tibiae coarsely asperate, the intermediate pair feebly curved.

Length 9-12, breadth $2\frac{1}{2}$ -3 mm. (♂ ♀.)

Hab. W. AFRICA, Old Calabar (*ex coll. Murray*), Sierra Leone (*Mus. Brit.*).

Five specimens, including two males, the examples from Sierra Leone acquired by the Museum in 1867, all somewhat broken.

PEDILIDAE.

DIACALLA, Pascoe.

This genus, type *D. comata*, Pasce., was at first referred to *Lagriidae*, and subsequently, on account of the widely open anterior coxal cavities, transferred (in 1871) by the author to *Pedilidae*. The diagnosis was made from a single ♀ example, and a ♂ mentioned as possibly belonging to the same species. Both sexes are represented in the material before me, showing that *Diacalla* is scarcely distinguishable from *Egestria*, except by general facies (the entire upper surface being very coarsely punctate in *Diacalla*), and by the form of the terminal joint of the maxillary palpi—seeuriform in *Diacalla*, long and cultriform in *Egestria*—and the still longer apical joint of the antennae in the male.

1. *Diacalla comata*. (Plate LXIII, figs. 8, ♂; 8a, antenna.)

Diacalla comata, Pasce., Journ. Ent. ii, p. 46, pl. 2, fig. 6 (♀), (1863).

♂. Antennae with joint 11 fully as long as 8-10 united, somewhat bent at the middle; elytra rapidly narrowed from the base. Aedeagus thickened at the tip above.

Hab. QUEENSLAND, Moreton Bay.

I have seen six specimens of this species: the type, a similarly-coloured castaneous ♀ from "Queensland," and four from Moreton Bay (♂ *in Mus. Oxon.*, ♂♂♀ *in Mus. Brit.*), almost wholly black. The sexes differ like those of *Egestria taeniata*, except that the apical joint of the ♂ antenna is much more elongate in *D. comata*. Pascoe's rough figure gives no idea of the very coarse puncturing of the upper surface, the punctures on the head and prothorax being rounded and umbilicate. The length varies from $7\frac{1}{4}$ –11 mm.

EGESTRIA, Pascoe.

The type of this genus is *E. taeniata*, the second species, *E. suturalis*, Pasc., the two sexes of which are now known, having the terminal joint of the antennae very little longer than the tenth. Both have a long, cultriform apical joint to the maxillary palpi, the only character separating them from *Diacalla*, the supposed differences in the form of the intercoxal process of the abdomen having no real existence. *E. hirticollis* and *rubicunda*, Macl., as stated above, are certainly referable to *Ictistygna*, Pasc., which has the anterior coxal cavities closed behind by the inward extension of the prothoracic epimera; *E. albilineata*, Carter, and *E. sulcicollis*, Blackb., are also here transferred to other genera. In both species of *Egestria*, but more distinctly so in *E. suturalis*, the inferior basal margin of the prothorax is seen to be complete, when the prothorax is completely detached.

1. *Egestria taeniata*.

♂♀. *Egestria taeniata*, Pasc., Ann. and Mag. Nat. Hist. (4) viii, p. 358, pl. 14, fig. 9 (♂) (1871).

♀. *Egestria griseolineata*, Fairm., Le Naturaliste, i, p. 70 (1879).

Egestria pallitibra, Fairm., loc. cit.

Hab. QUEENSLAND, Rockhampton, Peak Downs, Gawler.

A variable insect, the males averaging much smaller than the females and having the elytra narrowed from the base. The oblique stripe of pallid pubescence on each elytron, which is usually confluent with the one on the opposite wing-case before the apex, varies in development;

and in a large nearly black female from Gawler (*ex coll. Pascoe*) it is only just traceable. In a male sent me many years ago by Blackburn the stripes are broad and separate throughout. The median groove on the prothorax is sometimes obsolete. The penis-sheath of the ♂ is distinctly angulate at some distance before the apex beneath, showing an approach towards the sagittiform structure observable in *Eurygenius*. The apical joint of the antennae is considerably elongated, and constricted at the middle, in both sexes.

2. *Egestria suturalis*. (Plate LXIII, fig. 9, ♂)

♀. *Egestria suturalis*, Pasc., loc. cit., p. 359.

Hab. N. AUSTRALIA [type] and NEW SOUTH WALES.

Described from a single example, ♀. There are two males of it in the Museum, from the F. Bates collection, labelled N.S. Wales, and Mr. Carter has recently sent me another from the same locality. The apical joint of the antennae is not elongated in this insect in either sex. The penis-sheath of the ♂ is more distinctly angulate beneath than in the same sex of *E. taeniata*.

EGESTRINA, n. gen.

Terminal joint of maxillary palpi oblong-subtriangular; antennae short, the outer joints obconic, the apical one ovate; head broad, well developed behind the widely separated, rather prominent eyes, the latter subtruncate in front; prothorax oblong-cordate, constricted at the middle, with a very short neck in front; elytra long, confusedly punctate; legs moderately long; anterior coxal cavities open behind; the other characters as in *Egestria*, Pasc.

Type, *Egestria sulcicollis*, Blackb.

If *Egestria* is to be retained as distinct from *Diacalla*, *E. sulcicollis*, and an allied form from Swan River, cannot be included in the same genus, on account of the less elongate apical joint of the maxillary palpi. This character also separates the two Australian insects from *Stereopalpus*, Laf., the typical N.-American species of the latter having a similar uniform vestiture. *Egestrina* is not unlike the Chilean genus *Mitraelabrus*, Sol.; but the latter has a much longer head, a cultriform apical joint to the maxillary palpi, a small penultimate joint to the tarsi, etc.

1. *Egestrina sulcicollis*. (Plate LXIV, fig. 10, ♂.)

Egestria sulcicollis, Blackb., in Horn's Exped. pt. 2, p. 281 (1896).

Hab. CENTRAL AUSTRALIA, Ayer's Rock [type]; WEST AUSTRALIA (*Duboulay*).

The type of this species is now in the British Museum, which also possesses two similar examples (♀) from W. Australia. The specific name is misleading, the median groove on the prothorax being only just traceable.

2. *Egestrina canescens*, n. sp.

Moderately elongate, rather broad, robust, shining (when denuded); black, with a greenish lustre above, the basal joints of the antennae in part and the anterior tarsi rufescent; thickly and uniformly clothed with rather long, decumbent pubescence, which is flavo-cinereous above and whitish on the under surface and legs, the head and prothorax also with a few intermixed long, erect, fuscous hairs; the head and prothorax densely, finely, the elytra more coarsely, punctate. Head broad, the eyes moderately large; antennae rather slender, about reaching the humeri, joint 3 much longer than 2, 4-10 gradually becoming stouter, 11 ovate, a little longer than 10. Prothorax as wide as the head, about as long as broad, the sides rounded and somewhat dilated before the median constriction, subparallel at the base, the basal groove narrow. Elytra much wider than the prothorax, moderately long, subparallel in their basal half. Legs rather stout.

Length 7, breadth 2 mm. (♀?)

Hab. W. AUSTRALIA, Swan River (*ex coll. Pascoe*).

One specimen, somewhat imperfect. Broader and more robust than *E. sulcicollis*, Blackb., the vestiture denser, the elytra more closely and not so coarsely punctate, the eyes larger, the femora and tibiae almost black. The upper surface has a greenish lustre in *E. canescens*, instead of cupreous or brassy as in *E. sulcicollis*. This is doubtless one of the unnamed insects mentioned by Pascoe in 1871 in his remarks on *Egestria*.

MACRATRIOMIMA, n. gen.

Head small, flattened, truncate behind, and with a rather narrow, short neck, the frontal suture distinct, the eyes small, widely separated, distant from the base; terminal joint of maxillary palpi ovate, the

other joints narrow; antennae short, slender, the terminal joint ovate; prothorax long, abruptly constricted at the middle, with a very short neck in front; elytra long, confusedly punctate; anterior coxal cavities open behind; tarsi about as long as the tibiae, the penultimate joint short, lobed, not wider than the preceding, the basal joint of the posterior pair about as long as 2-4 united, the claws simple.

Type, *M. lobigera*.

A single species from New Guinea forms the type of this genus. It superficially resembles a *Macratrìa*, but is more nearly related to *Egestria* and *Egestrina*. The comparatively small head, with rather narrow neck; the short, slender antennae, with a slightly elongated, ovate apical joint; the simple maxillary palpi, with ovate terminal joint; the mesially constricted, long, convex prothorax, with short neck in front; and the peculiarly armed posterior tibiae of the male, are its chief characters.

1. *Macratrìomima lobigera*, n. sp. (Plate LXIV, fig. 11, ♂.)

♂. Elongate, rather convex, shining, thickly clothed (the legs included) with long decumbent hairs, the head and prothorax also with long, scattered, erect or projecting setae intermixed, those behind the eyes very conspicuous, the hairs on the elytra brown, the others cinereous; nigro-piceous with a slight brassy lustre, the palpi, the basal half of the antennae, and the tarsi in part, testaceous. Head closely, finely punctate, smoother in the middle posteriorly; antennae about reaching the base of the prothorax, joints 3-5 subequal, longer than those following, 2 a little shorter than 3, 6-10 subtriangular, equal in length, 11 one-half longer than 10, ovate. Prothorax slightly wider than the head, the posterior portion subparallel-sided and narrower than the transversely globose anterior portion; densely, roughly punctate, finely but distinctly canaliculate down the middle, and with a complete narrow basal groove. Elytra somewhat convex, flattened on the disc anteriorly, moderately elongate, rather broad, widest at the middle; closely, coarsely, confusedly punctate, without trace of striae. Legs long, the femora moderately clavate; posterior tibiae bowed, broadly and obliquely lobed at the base within, and also armed with a compressed sharp tooth just below this. Penis-sheath stout, long, acuminate.

Length (excl. pygid.) 5, breadth $1\frac{1}{2}$ mm.

Hab. NEW GUINEA (*Sayer, ex coll. Sharp*).

Described from a single male, remounted many years ago for examination by Dr. Sharp. A second somewhat

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crushed male from the same source, apparently not quite mature, has the anterior and intermediate legs and the base of the posterior femora testaceous, the elytra dark brown, and the vestiture paler. These insects appear to have been obtained by the expedition sent to New Guinea by the Australian botanist Baron von Mueller in the early "eighties."

EURYGENIUS, Laferté.

Species from America, E. Africa, India, Madagascar, etc., have been referred to this genus, which doubtless now requires revision. Casey restricted it, in 1895, to the type, *E. reichei*, Laf., from Brazil, and placed the various N.-American forms under three new generic names. Five species from Central America were described by myself in 1890, one of which (*E. uniformis*) would doubtless be better placed elsewhere. Two now added are closely related to the type. One other, from the Nilgiri Hills, is provisionally referred to the same genus.

1. *Eurygenius villosus*, n. sp.

♂. Elongate, depressed, moderately shining (when denuded), clothed with scattered, adpressed, pallid hairs, which are condensed into a few small spots on the elytra, and also thickly set (the legs included) with long, soft, pallid, erect or projecting setae; reddish-brown, the head, prothorax, and under surface a little darker, the antennae (the infusate joints 1 and 2 excepted) and legs ferruginous. Head narrowed and feebly developed behind the eyes, densely, the neck coarsely, punctate; eyes extremely large, slightly sinuate in front, somewhat narrowly separated anteriorly; terminal joint of maxillary palpi long, stout, securiform; antennae slender, extending to a little beyond the humeri, joint 1 long, 2 much shorter than 3, 3-11 moderately elongate, slightly decreasing in length. Prothorax about as long as broad, barely as wide as the head, rounded at the sides anteriorly and gradually narrowed posteriorly, densely punctate, except along the narrow smooth median groove, the basal groove placed very near the margin, the neck in front narrow. Elytra long, much wider than the prothorax, depressed, closely, coarsely punctate throughout, the punctures becoming a little larger and more oblong towards the base.

Length 8, breadth $2\frac{1}{2}$ mm.

Hab. COLOMBIA (*ex coll. Fry*).

One specimen. Very near the North Mexican *E.*

horridus, Champ., ♂, but with more approximate eyes, the maxillary palpi stouter, and with a longer terminal joint, the elytra shorter, more depressed, and more coarsely punctate posteriorly; the vestiture a little sparser.* The head and eyes are shaped much as in the Brazilian *E. reichei*, Laf., as figured by its describer.

2. *Eurygenius arizonensis*, n. sp.

♂. Elongate, depressed, moderately shining, clothed with rather long, fine, decumbent, cinereous pubescence which is here and there condensed into small patches on the elytra, the head and prothorax with intermixed long, soft, erect hairs; piceous, the elytral epipleura and tarsal claws, and sometimes the antennae and palpi in part, testaceous. Head broad, densely punctate, feebly developed behind the eyes, the latter extremely large, slightly sinuate in front, and separated by a little less than the width of one of them as seen from above; antennae rather short, very slender, joint 2 obovate, stouter than 3, 3-10 decreasing in length, 3 twice as long as 2, 11 a little longer than 10; terminal joint of maxillary palpi narrow, long, subultriform. Prothorax nearly as wide as the head, along the median line about as long as broad, rounded at the sides anteriorly and gradually narrowing thence to the base, the hind angles obtuse, the collar sharply defined; closely, confluent punctate, without trace of median groove. Elytra moderately long, very gradually narrowed from the base, coarsely, confusedly punctate. Fifth ventral segment emarginate at the tip. Penis-sheath sagittiform at the tip beneath. Tibial spurs short. Penultimate tarsal joint very small, triangular.

Length $5\frac{1}{2}$ -7, breadth $1\frac{1}{2}$ -2 mm.

Hab. NORTH AMERICA, Florence, Arizona (*C. R. Biederman*: vii. '03).

Four males, sent me by Dr. Skinner in 1913, and subsequently presented to the British Museum. Smaller and less elongate than *E. mexicanus*, Champ., the head much less developed behind the eyes, the latter extremely large, the antennae shorter, the palpi more slender, the elytra more shining and not so closely punctate. The Guatemalan *E. crinitus* has the head broader at the base than in the present species and the prothorax canaliculate. *E. arizonensis* approaches Casey's section *Retocomus*; but as the

* A smaller and narrower ♂ (now without antennae), from the Bowring collection, labelled "N. Hebrid.," with the eyes less approximate and not so large, probably belongs to the same species: this insect is almost certainly of American origin.

latter is described as having prominent tempora, deeply emarginate eyes, a triangular apical joint to the maxillary palpi, etc., the insect before me cannot be very nearly related to any of the five species he placed under that name.

3. *Eurygenius scoparius*, n. sp. (Plate LXIV, figs. 12, ♂; 12a, abdomen.)

Elongate, depressed, moderately shining, clothed with rather long, fine, decumbent, cinereous pubescence, the head and prothorax with intermixed longer erect hairs; reddish-brown or obscure ferruginous, the femora, antennae, and tarsi usually paler, the eyes and the tips of the mandibles black. Head narrowed and feebly developed behind the eyes, rugosely punctate, the eyes very large, feebly arcuato-emarginate in front, separated by about their own width as seen from above; joint 4 of maxillary palpi oblong-subtriangular; antennae pilose, long, slender, joint 2 much shorter than 3, 3-11 long, subequal. Prothorax about as wide as the head, transversely cordate, deeply grooved within the basal margin, the hind angles obtuse, the short collar in front rounded anteriorly; closely impressed with small, rounded, umbilicate punctures, and sometimes with an indication of a smooth median line. Elytra long, flattened, much wider than the prothorax, subparallel, rounded at the tip, densely, finely, confusedly punctate. Beneath closely, finely, the sides of the metasternum coarsely, punctate; abdomen in ♂ with a broad, oblong brush of long, decumbent fulvous hairs arising from before the middle of the first ventral segment and extending down the second segment to its hind margin. Tarsi with a broadly lobed penultimate joint, the claws rather small.

Length 7-10½, breadth 2-3 $\frac{1}{10}$ mm. (♂ ♀.)

Hab. INDIA, Nilgiri Hills (*Andrewes*).

Six specimens, varying in size, including two males. This species differs from *Eurygenius*, as figured by Laferté, in having a broader penultimate joint to the tarsi and smaller claws; nevertheless, it can remain under the same genus for the present. The dense, fine punctuation of the upper surface is suggestive of *Scraptia*, and the ♂-ventral brush is very like that of *Eurypus* and its allies. *Steriphodon* (?) *indicum*, Pic, from Ramnad, is probably an allied smaller form.

MACRATRIA, Newman.

Fifty-four species of this genus are here enumerated or described, thirty-nine being treated as new, and remarks

are made upon the additional material examined of some of the known forms. A fresh description is given of such species of which the identification is at all doubtful.* The Central-American *Macratræ* (10) were dealt with by me in 1890, and those of Japan (5) by G. Lewis in 1895. From that date onwards about fifty species of the genus have been named or described by Pic, in innumerable scattered papers. Very few of these insects appear to be represented in the collections before me. The genus *Macratræ* is a particularly difficult one to deal with, owing to the great similarity of the species from widely distant regions, and to the absence in most of them of external sexual characters. In three, however, the anterior or posterior tibiae are toothed or modified in the ♂, and the prothorax in one of these is also deeply excavate on each side on the anterior part of the disc in the same sex. A few others have the apical joint of the ♂-antenna elongated, as in *Lagria*. The greatly thickened basal joint of the anterior tarsi (looking at first sight like a fractured portion of the tibia), not necessarily a ♂-character, in some of the Tropical American forms is noteworthy, and is doubtless indicative of arboreal habits. The males dissected exhibit remarkably specific distinctions in the genital armature; but no attempt has been made to examine these characters generally, the material being much too scanty for the purpose. A trifold apex to the pygidium in the ♀ of one species was noticed by me in 1890, and two others with a somewhat similar structure are here recorded. *M. fulvipes*, Pasc., described in 1860, still remains unique in the Museum.

Oriental, Indo-Malayan, or Austro-Malayan Species.†

The numerous forms enumerated from these regions may be grouped thus:—

- a. Antennal joints 9-11 elongated: species larger, upwards of 3 mm. in length.
- a¹. Elytra with definite rows of punctures.
- a². Body black, with metallic lustre. . . . Nos. 1, 2.

* The (pinned) type of the genus, *M. linearis*, Newm., badly figured by the author, is contained in the Museum, but I have not ventured to examine it thoroughly.

† Including New Guinea.

- b*². Body black, subopaque; antennae long and stout No. 3.
- c*². Body black, more or less shining; elytra cinereo- or albo-fasciate, or with denser pubescence in the post-basal depression*. Nos. 4-9.
- d*². Body partly rufescent; elytra more or less fasciate or maculate Nos. 10-13.
- e*². Body black, shining; elytra not maculate . Nos. 14-17.
- f*². Body piceous, brown, or ferruginous.
- a*³. Elytral interstices without setigerous punctures.
- a*⁴. Elytra unicolorous Nos. 18-30.
- b*⁴. Elytra testaceous, with suture darker; head and prothorax narrow No. 31.
- b*³. Elytral interstices with conspicuous setigerous punctures No. 32.
- b*¹. Elytra without definite rows of punctures; body black. Nos. 33-35.
- b*. Antennal joints 9-11 shorter, 10 transverse: species small, length not over $2\frac{4}{5}$ mm.; elytra not or feebly striate Nos. 36, 37.

1. *Macratris beccarii*.

?*Macratris beccarii*, Pic, Ann. Mus. Genova, xl, p. 597 (1900).

Elongate, moderately robust, shining, sparsely clothed with long, adpressed, cinereous hairs; black, with a metallic blue lustre in certain lights, the maxillary palpi (the infusate apical joint excepted) and mandibles, the antennal joints 1-6 or 7 (in one specimen, ♀, at the base only), and the tips of the tarsi, more or less testaceous, the femora sometimes ferruginous at the base. Head a little longer than broad, nearly or quite as wide as the prothorax, considerably developed behind the moderately large eyes, rounded and emarginate at the base, closely, minutely punctate; antennae long, slender, with joints 9-11 stouter and greatly elongated, 3-8 decreasing in length in ♂, 9 about three times the length of 8, 11 slightly longer than 10. Prothorax elongate, strongly attenuate anteriorly, not compressed on the flanks posteriorly, closely, finely punctate, the basal groove sharply defined. Elytra moderately long, much wider than the prothorax, gradually narrowed from the base, flattened on the disc; closely punctate, the punctures on the anterior half coarse,

* Except in *M. bicincta*, Mars., var.

shallow, and arranged in regular rows, becoming fine towards the apex, the narrow interspaces somewhat convex. Pygidium in ♀ (?) deeply notched at the tip and subcarinate down the middle in front of the emargination, that of ♂ (?) subtruncate at the tip, simple. Legs stout; basal joint of anterior tarsi much thickened in both sexes.

Length $4\frac{3}{4}$ –6 mm.

Hab. NEW GUINEA, Korido, Geelvink Bay (*Beccari*: type); MORTY; BATCHIAN; GILOLO.

The above description is taken from six specimens in the Museum, all probably collected by Wallace, including a pair from Batchian, those with a truncated pygidium assumed to be males. They differ from *M. beccarii*, according to Pic's diagnosis, in having much darker legs; but as these limbs frequently vary in colour in the allied species, no importance need to be attached to this character. His variety *submetallica* is said to be larger, and to have a more robust, broader prothorax, and therefore seems to be more nearly related to *M. wallacei*, from Waigiou, which has joints 1–8 of the antennae much stouter and almost wholly black, the prothorax rounded and less attenuate in front, etc.

2. *Macratria wallacei*, n. sp. (Plate LXIV, fig. 13, ♂, antenna.)

Elongate, robust, shining, sparsely clothed with rather long adpressed, brownish-cinereous hairs; black, with a metallic bluish lustre in certain lights, the legs nigro-piceous, the mandibles and the maxillary palpi, and the basal joints of the antennae in part, testaceous. Head as long as broad, much narrower than the prothorax considerably developed behind the comparatively small eyes, rounded at the sides posteriorly, and feebly emarginate at the base, closely, minutely punctate; antennae rather long, comparatively stout, joints 4–8 gradually widened, slightly longer than broad, 9–11 elongate and much thickened, together about the length of 3–8 united, 9 more than twice the length of 8, 11 very little longer than 10. Prothorax convex, greatly developed, oblong-oval, not compressed on the flanks posteriorly, rather coarsely, closely punctate, the basal groove sharply defined. Elytra moderately long, much wider than the prothorax, narrowed from the base, separately rounded at the apex, flattened on the disc; rather sparsely punctate, the punctures on the anterior half coarse, shallow, and arranged in regular rows, becoming fine towards the apex, the narrow interstices

somewhat convex. Pygidium feebly sinuate at the tip. Legs stout; basal joint of anterior tarsi much thickened, that of the posterior pair curved.

Length $6\frac{2}{3}$ mm. (δ ?)

Hab. WAIGIOU (Wallace).

One specimen. A robust, submetallic, black insect, with a narrow, basally emarginate head, rather small eyes, an oblong, broad, non-constricted prothorax, peculiarly formed, almost wholly black antennae, stout legs, and distinctly striato-punctate, posteriorly narrowed elytra. *M. beccarii*, v. *submetallica*, and *M. lorise*, Pic, from New Guinea, must come near the present insect.

3. *Macratia forticornis*,

? *Macratia forticornis*, Pic, Le Naturaliste, 1897, p. 159.

Elongate, robust, broad, subopaque, thickly clothed with adpressed brown hairs, the vestiture of the legs and under surface cinereous; black, the two basal joints of the maxillary palpi testaceous, the anterior and intermediate femora to near the apex, and the posterior femora in front, testaceous or rufescent. Head about as long as broad, much narrower than the prothorax, considerably developed behind the comparatively small rounded eyes, subtruncate and feebly emarginate at the base, closely, minutely punctate; antennae setulose, long, stout, widened and compressed from the third joint, joints 3-8 about as broad as long, 9-11 subequal and greatly elongated, each about three times the length of 8; apical joint of the maxillary palpi very long, cultriform. Prothorax oblong-oval, broad, not compressed on the flanks posteriorly, densely scabroso-punctate and obsoletely canaliculate, the basal groove well defined. Elytra long, much wider than the prothorax, gradually narrowing from the base, hollowed along the suture posteriorly; very densely scabroso-punctulate, and also with rows of fine punctures to beyond the middle, the interstices obsoletely costate externally. Pygidium broad, trifold at the apex, and with a deep fovea on each side before the tip, the foveae limited inwards by a short longitudinal ridge. Legs stout.

Length $[5\frac{1}{2}-]6\frac{1}{3}$ mm. (♀ ?)

Hab. NEW GUINEA, Andai [type].

The example now described, from the Pascoe collection, was probably found by Wallace, but the locality-label attached to it is illegible. The insect agrees, however, so

nearly with Pic's description of *M. forticornis* that there can be little doubt as to its identification. *M. wallacei*, from Waigiou, has a similarly shaped head and prothorax, and black antennae, these organs being longer and broader in the present species; *M. forticornis*, moreover, is a longer and larger insect, with the upper surface densely sculptured and subopaque, instead of shining and submetallic as in *M. wallacei*.

4. *Maeratria subguttata*.

♀. *Maeratria subguttata*, Pascoe, Journ. Ent. i, p. 56 (1860).

♂. Elongate, narrow, shining, rather sparsely clothed with long, fine, adpressed, cinereous hairs, the elytra with a faint transverse fascia of whitish hairs at some distance below the base; black, the labrum, palpi, antennae (the infusate joints 9-11 excepted), and tarsi in part (joint 1 of the posterior pair excepted), testaceous, the rest of the legs in great part piecous. Head rather large, rounded posteriorly, without occipital groove, closely, minutely punctate, with a narrow smooth space down the middle; eyes very large, oval, distant; antennae very long, slender, joints 9-11 moderately thickened, 9 and 10 subequal, each slightly longer than those preceding, 11 straight, nearly three times as long as 10. Prothorax narrower than the head, convex, elongate-oval, obliquely compressed on the flanks posteriorly, the basal groove deep; closely, finely punctate. Elytra moderately long, considerably wider than the head, gradually narrowing from the base, transversely depressed anteriorly; closely, finely punctate, finely striato-punctate to about the middle, the submarginal stria nearly reaching the apex. Lateral lobes of aedeagus long, parallel-sided, obtuse and undilated at tip. Legs long, rather slender, the femora strongly clavate; joint 1 of the anterior tarsi thickened and that of the posterior pair curved; posterior tibiae simple.

Length $4\frac{1}{2}$ mm.

Hab. BATCHIAN (*Wallace*).

Pascoe's diagnosis of this species is almost too brief for the purposes of identification. The ♂, now described in detail, received by the Museum in 1862, is narrower than the ♀ type from the same island, and wants the faint second whitish fascia on the elytra; the ♀ also has shorter antennae, with joint 11 not longer than 9 and 10 united. The genitalia are partly extruded in the ♂, a pair of long, straight, widely-separated processes being visible, these partly covering two shorter curved appendages.

5. *Macratría gestroi*. (Plate LXIV, fig. 14, ♂, head in profile.)

? *Macratría gestroi*, Pic, Ann. Mus. Genova, xl, p. 598 (1900).

Elongate, narrow, very shining, rather sparsely clothed with fine, adpressed, yellowish or cinereous hairs, the elytra with a denser transverse fascia of white hairs at about the basal third (not reaching the suture) and an evanescent patch of similar hairs on the disc towards the apex, the prothorax also with some white hairs at the base; black, the labrum, palpi, antennae (the more or less infusate apical three joints excepted), tarsi (joint 1 of the posterior pair excepted), and in one specimen the anterior and intermediate femora and pygidium also, testaceous. Head about as long as broad, moderately large, rapidly narrowing behind the large eyes, very sparsely minutely punctate, smooth down the middle, arcuately (♀) or subangularly (♂) produced at the base, without trace of occipital sulcus; antennae long, very slender, joints 9–11 thickened and elongated in ♂, 11 nearly as long as 9 and 10 united. Prothorax a little narrower than, in the ♀ about as broad as, the head, convex, oblong-oval, attenuate in front, obliquely compressed on the flanks posteriorly, the basal groove deep; sparsely, minutely punctate. Elytra comparatively short, gradually narrowing from the base; rather sparsely, finely punctate, the punctures coarser and seriatly arranged down the anterior half, the interstices feebly costate externally. Lateral lobes of aedeagus long, widened outwards, bifurcate at tip. Legs long, rather slender, the femora strongly clavate; basal joint of anterior tarsi subcylindrical; posterior tibiae slightly sinuate within in ♂.

Length 4–4½ mm. (♂♀)

Hab. NEW GUINEA (*Wallace, in Mus. Oxon.*, ♂♀, and *Mus. Brit.*, ♂), Dilo (*Dr. Loria*: type).

The three specimens obtained by Wallace seem to be referable to *M. gestroi*, Pic, or its var. *obscuripes*,* so far as can be judged from the brief description. They are smoother, more shining, and a little less elongate than *M. subguttata*, Pasc., from Batchian; the head is more rapidly narrowed behind the eyes, and more or less produced in the middle at the base, the basal portion being subangular and polished in the male; the antennae are less elongate; the prothorax is more sparsely and much more finely punctate, etc.

* Nec *M. obscuripes*, Pic, *Mélanges exot.-entom.* iv, p. 12 (1912).

6. *Macratria giloloana*, n. sp. (Plate LXIV, fig. 15, ♂, posterior leg.)

♂. Elongate, rather narrow, very shining, sparsely clothed with fine, adpressed, brownish and cinereous hairs, the elytra with a faint whitish fascia on the disc below the base; black, the labrum, mouth-parts, palpi, antennae (the infusate terminal three joints excepted), and tarsi in part, testaceous. Head as long as broad, rapidly, arcuately narrowing behind the very large eyes, rounded at the base, sparsely, finely punctate, smooth along the middle, the occipital groove wanting; antennae long, slender, joints 9-11 slightly thickened, 9 and 10 not longer than those preceding, 11 nearly as long as 9 and 10 united. Prothorax convex, narrow, elongate-oval, attenuate in front, obliquely compressed on the flanks posteriorly, the basal groove deep; finely punctate. Elytra moderately long, much wider than the prothorax, gradually narrowing from the base; finely punctate, and also rather coarsely striatopunctate to near the apex, the interstices feebly costate externally. Pygidium entire. Lateral lobes of aedeagus angularly dilated at the apex within, truncate and feebly emarginate at the tip. Legs very long; basal joint of anterior tarsi narrow, subcylindrical, that of posterior pair much elongated; posterior tibiae subangularly dilated before the middle within, and there bearing several long projecting hairs.

Length 5 mm.

Hab. GILOLO (Wallace, in *Mus. Oxon.*).

One male, in good condition, acquired in 1868 by the Hope Museum at Oxford. Larger and more elongate than *M. gestroi*, with longer limbs, the head (♂) differently shaped, the eyes larger, the posterior tibiae subangularly dilated before the middle and bearing several long projecting hairs. The lateral lobes of the aedeagus are very similarly shaped in the two insects, and quite different from those of *M. subguttata*, Pasc., the last-named species having still longer antennae, with a more elongate apical joint, a shorter head, more closely punctured upper surface, simple posterior tibiae, etc.

7. *Macratria bicincta*.

♂. *Macratria bicincta*, Mars., Tijdschr. voor Ent. xxv, p. 56 (1881).

Terminal joint of antennae in ♂ about as long as 8-10, in ♀ not longer than 9 and 10, united, 8 and 9 each elongate and equal in

length in the two sexes; fifth ventral segment transversely depressed in the middle at apex in ♂.

Var.? The elytral fasciae wanting.

Hab. PHILIPPINE IS., Luzon [type], Pulo Batu (*Semper, in Mus. Brit.*).

Amongst the ten examples of this species in the Museum (eight of which were obtained by Semper), there are three males, also a pair from Luzon; the immaculate specimen (♀), also from Luzon, has slightly longer elytra, the head more rounded behind, and the occipital groove a little deeper than in the rest. *M. bicincta* is a rather large, robust form, with interruptedly albo- or flavo-bifasciate, closely punctate, feebly striate elytra; a somewhat oval head, with a short, shallow occipital groove behind; large eyes; slender antennae, with joints 9–11 thickened and 11 greatly elongated in ♂; a long, roughly sculptured prothorax; stout legs, and a broad basal joint to the anterior tarsi. The males are narrower than the females and have the pygidium subtruncate at the tip; the femora and tibiae vary in colour, as in several of the allied species. *M. pubescens*, Pic, from Balabac Island, near Borneo, would appear to have a still longer terminal joint to the antennae in ♂.

8. *Macratrìa leucozona*, n. sp. (Plate LXIV, fig. 16, ♂.)

Moderately elongate, narrow, shining (when denuded); closely, finely pubescent, the vestiture in great part fuscous, except along the basal margin of the prothorax, on a common, broad, dense post-basal fascia on the elytra, and on the greater part of the under surface, where it is white or cinereous; black, the antennae, mouth-parts, palpi, tarsi (joint 1 of the posterior pair excepted), and anterior tibiae (except at the base), testaceous. Head rather small, convex, obconic, very minutely, diffusely punctate, the occipital groove short, deep, the eyes comparatively small, distant from the base; maxillary palpi long, stout, the terminal joint large, cultriform; antennae slender, joints 9–11 thickened, 9 and 10 each a little longer than 8, 11 in ♂ about as long as the two preceding united. Prothorax convex, narrow, elongate-oval, attenuate in front, densely, roughly punctate, the basal groove hidden by the fringe of white hairs. Elytra moderately long, much wider than the head, gradually narrowing from the base, closely, somewhat roughly punctate, and also feebly punctato-striate on the anterior half of the disc, the seriate punctures scarcely coarser than the others, the interstices

almost flat. Femora moderately clavate. Basal joint of anterior tarsi thickened, that of the posterior pair curved.

Length $3\frac{1}{2}$ –4 mm. (♂ ♀.)

Hab. BORNEO, Mt. Matang, alt. 1000 feet, W. Sarawak (*G. E. Bryant*, xii. '13).

Seven specimens. An elegant little insect, shining black, with testaceous antennae, palpi, and tarsi, the elytra with a common, broad, post-basal, whitish fascia, the head rather small, obconic, the eyes small, the antennae slender, etc. The elytral sculpture is similar to that of *M. nankinea*, Pic. *M. griscosellata*, Fairm., from Hué, *M. biguttata*, Pic, from Sumatra, *M. testaceicornis*, Pic, from Celebes, and *M. birmanica*, Pic, from Bhamo, appear to be somewhat similarly maculate forms.

9. *Macratria albofasciata*, n. sp.

Moderately elongate, narrow, rather dull (till abraded), thickly clothed with fine, brown, adpressed pubescence, the prothorax with intermixed cinereous hairs at the base, the elytra with a transverse cinereous fascia (not reaching the suture) at about the basal third; black, the maxillary palpi (the infusate apical joint excepted), mouth-parts, joints 1–8 of the antennae, and the apices of the tarsi testaceous, the tip of the antennae rufescent. Head about as long as broad, scarcely wider than the prothorax, subtruncate and deeply excised at the base, densely, minutely punctate; eyes moderately large, distant; antennae rather long, slender, joints 9–11 much longer and stouter than those preceding, 9 and 10 equal, subtriangular, 11 nearly as long as the two preceding united. Prothorax oblong-oval, obliquely compressed on the flanks posteriorly, densely scabroso-punctulate, the basal groove deep. Elytra moderately long, considerably wider than the head, subparallel in their basal half, the transverse post-basal depression deep; densely, finely punctate, and also with rows of fine punctures to beyond the middle. Basal joint of anterior tarsi thickened, that of the posterior pair curved.

Length $3\frac{1}{2}$ mm. (♀?)

Hab. ASSAM, Patkai Mts. (*Doherty*).

One specimen, in very fresh condition. Separable from the insects here referred to *M. gestroi*, Pic, by the densely punctulate, duller, closely pubescent surface, the shorter antennae, the subtruncate, deeply notched base of the head, the scabrous prothorax, the subparallel, finely

striato-punctate, rectifasciate elytra, and the stouter basal joint of the anterior tarsi, the tarsi themselves darker. The seriatly-arranged punctures on the elytra are very little coarser than those of the interstices.

10. *Macratria linita*, n. sp.

Moderately elongate, narrow, rather depressed, shining, somewhat sparsely clothed with adpressed greyish hairs; piceous or obscure ferruginous, the head, the anterior portion of the prothorax, and an elongate patch extending down the disc of each elytron from a little below the base, more or less rufescent, the palpi, mouth-parts, antennae, and legs (the posterior femora and tibiae in part excepted) testaceous. Head rather broad, well-developed behind the moderately large eyes, rounded at the sides posteriorly, and subtruncate at the base, very minutely punctate, the occipital groove short; antennae moderately long, slender, joints 9-11 elongated and thickened, 11 nearly (♀) or quite (♂) as long as 9 and 10 united. Prothorax oval, as wide as the head, rather convex, obliquely compressed on the flanks posteriorly; densely scabroso-punctate, the basal groove deep. Elytra moderately long, much wider than the prothorax, subparallel; closely, finely punctulate and also with rows of coarser punctures on the disc, the interstices scarcely raised. Pygidium rounded at tip. Legs long; basal joint of anterior tarsi much thickened, that of the posterior pair curved.

Length $3\frac{1}{2}$ mm.

Hab. CEYLON (*Thwaites*: type, ♀); ? JAVA (*ex Bowring*: ♂).

Two specimens, received in 1867 and 1863 respectively, the "Javan" habitat requiring confirmation. Near *M. nankinea*, Pic, differing from it in having an elongate rufescent patch on the disc of each elytron, the terminal three joints of the antennae longer, and the vestiture uniform. *M. limbata*, Pic, from Sumatra, may be an allied form?

11. *Macratria nankinea*.

Macratria nankinea, Pic, L'Échange, xxv, p. 109 (1909).

Hab. CHINA, Nankin (*Pic*: type), Haining (*J. J. Walker*), Shan-hai-kwan (*F. M. Thomson*), Shanghai (*Mus. Brit.*).

Found in numbers by Commander Walker at Haining. A small Anthiciform insect, obscure ferruginous in colour, the elytra nigro-piceous, with a transverse, rufous, post-basal fascia; the posterior femora and tibiae (but not the

tarsi) in part black; the vestiture brownish, fine, and close, that on the metasternum and elytral fascia cinereous or white; the apical three joints of the antennae rather stout, 9 and 10 a little longer than broad; the elytra shining, transversely depressed below the base, somewhat roughly punctulate, and also finely punctato-striate down the anterior half of the disc. Length 3-4 mm. The type was probably somewhat abraded. *M. japonica*, Harold, from Japan, is an allied non-fasciate form.

12. *Macratrìa fumosa*.

? *Macratrìa fumosa*, Pasc., Journ. Ent. i, p. 56 (1860).

Macratrìa rubroapicata, Pic, L'Échange, xix, p. 120 (1933).

Hab. INDIA, Dacca.

The insect from Dacca in the Pascoe collection, supposed to be the type of *M. fumosa*,* is very like *M. nankinea*, Pic, from which it differs in having the elytra rufescent at the apex, and much more distinctly punctato-striate, the prothorax more dilated anteriorly, and the occipital groove deeper. Pascoe, however, says nothing about the broad black elytral fascia, but his description agrees in other respects. The length given is $2\frac{1}{4}$ lin.

13. *Macratrìa dichroa*, n. sp.

Elongate, narrow, shining, clothed with rather long, decumbent, whitish hairs, which are uniseriately arranged down each of the elytral interstices; rufous, the head in the middle above, the eyes, a very broad post-median fascia on the elytra (extending forwards along the suture and outer margin to the base), the posterior femora and tibiae (the knees excepted), and the abdomen in part, black or piceous, the mouth-parts, palpi, antennae (the infuseate joints 9-11 excepted), anterior and intermediate legs, and posterior tarsi testaceous. Head transverse, well developed behind the moderately large eyes, subtruncate at the base, minutely punctate, the occipital groove short; antennae rather short, slender, joints 9-11 thickened, 9 and 10 about as broad as long. Prothorax convex, longer than broad, oval, a little wider than the head, slightly dilated on each side at the base behind the transverse groove; scabroso-punctate. Elytra moderately long, rather narrow, wider than the prothorax, subparallel in their basal half; conspicuously striato-punctate, the interstices faintly costate externally

* It bears the MS. name *adamsi* in his handwriting.

and closely punctulate. Legs rather short, stout, the femora strongly clavate.

Length $3\frac{1}{2}$ mm. (δ ?)

Hab. BENGAL, Sarda (*F. W. Champion*).

One specimen, in very fresh condition, recently received from one of my sons resident in India. Very like the insect assumed to be the type of *M. fumosa* (= *rubro-apicata*, Pic), and similarly coloured; but much smaller, less robust, and more shining, the head, antennae, and prothorax shorter, the prothorax more rounded (less compressed) at the sides anteriorly, the elytra without a dense patch of white hairs on the disc below the base (conspicuous in the *Dacca* insect, but not mentioned by Pascoe), the tibial spurs smaller. Compared with *M. linita*, from Ceylon, the present species has much shorter antennae, a more transverse, darker head, a wholly red prothorax, and differently coloured elytra.

14. *Macratria pallipes*. (Plate LXIV, figs. 17, δ , prothorax in profile; 17a, anterior leg, δ .)

? *Macrarthrius pallipes*, Motsch., Bull. Mosc. xxxvi, 1, p. 489 (1863) (*nec* Fairm., Ann. Soc. Ent. Fr. 1888, pp. 364, 365).

δ . Very elongate, shining, clothed above with rather coarse, decumbent, pale brownish hairs, with scattered, fine, erect hairs intermixed, the under surface densely cinereo-pubescent; nigro-piceous, the head obscurely rufescent, the palpi, mouth-parts, antennae, and legs (a broad black patch towards the apex of the posterior femora, and the infuseate basal joint of the posterior tarsi, excepted) testaceous. Head rather small, as long as broad, considerably developed behind the large eyes, rounded at the sides posteriorly, sparsely, minutely punctate, the occipital groove deep; antennae slender, joints 9-11 thickened, 9 and 10 not much longer than those preceding, 11 about one-half longer than 10. Prothorax a little wider than the head, long, oval, strongly attenuate anteriorly, obliquely compressed on the flanks posteriorly (the setose hind angles thus appearing prominent), densely scabroso-punctate, the basal groove complete. Elytra much wider than the head, long, subparallel; sparsely punctulate, and also somewhat coarsely punctato-striate to near the apex, the interstices a little raised. Legs very long, the femora strongly clavate.

δ . Prothorax narrower, less rounded at the sides, rapidly narrowed

from the middle forward, and with a very deep, long, oblique, smooth furrow on each side of the disc anteriorly, the two grooves extending upward and there separated by a narrow cariniform backward prolongation of the apical portion of the pronotum; anterior tibiae compressed and somewhat broadly widened, concave beneath, sinuous within, and obliquely truncated at the tip; basal joint of anterior tarsi much thickened.

Length (with head extended) $5\frac{1}{2}$ –6, breadth $1\frac{1}{5}$ – $1\frac{1}{2}$ mm. (σ ♀.)

Hab. CEYLON, Nuwara Elia [Nura Ellia] (type), Bogawantalawa, alt. 4900–5200 ft. (*G. Lewis*).

The above description is taken from two pairs captured by Lewis. Motschulsky's diagnosis would apply to the ♀, except that he gives the length as 2 lines only; but as his type was from a not very distant locality, it may belong to the same species? The structure of the ♂-prothorax is remarkable, the very deep, oblique, smooth furrow on each of the antero-lateral portions of the disc appearing at first sight to be due to some injury. Fairmaire's *M. pallipes*, Motsch. (1888), (*M. tonkinea*, Fairm. in litt.) from Tonkin, cannot be the same species.

15. *Macratia punctigera*, n. sp.

Moderately elongate, shining, sparsely clothed with rather long, decumbent, brownish-cinereous hairs; black, the antennae, mouth-parts, palpi, and tarsi (joint 1 of the posterior pair excepted) testaceous or obscure testaceous, the knees reddish. Head large, broad, rounded at the sides posteriorly, truncate and emarginate at the base, sparsely, minutely punctate; eyes very large, rounded, somewhat prominent; antennae slender, joints 9–11 elongated and thickened, 11 nearly as long as 9 and 10 united; maxillary palpi with a moderately long, cultriform apical joint. Prothorax very little longer than broad, convex, oval, narrower than the head, obliquely compressed on the flanks posteriorly, rather sparsely punctate, the basal groove deep. Elytra much wider than the head, moderately long, very gradually narrowing from the base; rather coarsely punctato-striate to near the apex, the apical portion closely punctate, the interstices narrow, somewhat convex, and very sparsely punctulate, the interstitial puncturing becoming coarser and regularly uniseriate at the sides. Pygidium rounded at tip. Femora moderately clavate. Basal joint of anterior tarsi not very stout, that of the posterior pair about half the length of the tibia.

Length $4\frac{3}{4}$ mm. (σ ?)

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Hab. BORNEO, Retuh, Sarawak (*G. E. Bryant* : 17. v. '14).

One specimen. An isolated form, with a shining black, sparsely pubescent body, slender, testaceous antennae, a large, broad head, large, rounded, prominent eyes, a comparatively short, ample prothorax, and rather coarsely, conspicuously punctato-striate elytra, the outer interstices of which are regularly uniseriate-punctate.

16. *Macratrìa flavipalpis*, n. sp.

Elongate, narrow, shining, sparsely clothed with fine, adpressed, cinereous hairs; black, the palpi, mouth-parts, antennae, tarsi, and anterior tibiae in part, testaceous, the rest of the legs infusate, the reddish knees excepted. Head about as long as broad, much developed behind the comparatively small eyes, gradually arcuately narrowed posteriorly, closely, finely punctate, subtruncate and feebly emarginate at the base; antennae moderately long, slender, joints 9-11 elongated and stouter than those preceding, 11 a little longer than 10; joints 2 and 3 of the maxillary palpi very broad, 4 elongate, stout, cultriform. Prothorax narrow, elongate-oval, attenuate in front, feebly, obliquely compressed on the flanks posteriorly, the basal groove sharply defined; closely, rather coarsely punctate. Elytra much wider than the prothorax, moderately long, subparallel in their basal half; closely, finely punctate, and also with rows of coarser punctures to near the apex, the interstices finely subcostate externally. Legs rather stout, the femora strongly clavate, the basal joint of the anterior tarsi thickened.

Length $4\frac{2}{3}$ mm. (σ ♀ ?)

Hab. PHILIPPINE IS., Mindanao, Isabela (*Semper*).

Two specimens. Separable from *M. bicincta* and *M. semperi*, apart from colour differences, by the smaller, less elongate eyes, the relatively broader basal portion of the head, the shorter apical joint of the antennae, etc. Compared with the more nearly allied *M. flavicornis*, from Assam, the present species is less robust, and has a more coarsely punctate, less attenuate head, a longer and stouter apical joint to the maxillary palpi, a narrower, less densely punctate prothorax, and narrower, more finely punctured elytra.

17. *Macratrìa flavicornis*, n. sp.

Elongate, moderately robust, shining, sparsely clothed with fine, adpressed, brownish-cinereous hairs, the vestiture of the under surface cinereous; black, the mouth-parts, antennae, anterior tarsi,

the tips of the other tarsi, and the anterior tibiae at the apex, flavo-testaceous, the knees rufescent. Head rather small, as long as broad, convex, rapidly narrowed behind the moderately large eyes, sparsely, minutely punctate, with a short, deep occipital groove; terminal joint of the maxillary palpi comparatively short, securiform; antennae very slender, rather short, joints 9-11 thickened, 11 about as long as 9 and 10 united, the latter elongate-triangular. Prothorax oblong-oval, convex, attenuate in front, slightly wider than the head, feebly, obliquely compressed on the flanks posteriorly, densely, roughly punctate, the basal groove deep. Elytra moderately long, much wider than the prothorax, very gradually narrowed from the base, closely, finely punctate, conspicuously striato-punctate to near the apex, the interstices subcostate externally. Legs rather stout; basal joint of anterior tarsi much thickened, that of the posterior pair arcuate.

Length 5 mm. (♀?)

Hab. ASSAM, Patkai Mts. (*Doherty*).

One specimen. Very like *M. nigerrima*, differing from it in the much smoother, shorter head, the larger eyes, the flavo-testaceous, shorter, very slender antennae, with the last three joints thickened, the shorter, pallid maxillary palpi, the conspicuously striate elytra, the pallid anterior tarsi, etc.

18. *Macratris major*.

? *Macratris major*, Pic, Le Naturaliste, 1897, p. 182.

♂. Very elongate, robust, rather narrow, subopaque (till denuded), the head shining, thickly clothed with adpressed yellowish hairs, the head and antennae with scattered, erect or projecting, bristly hairs, the hind angles of the prothorax with a single long seta; brown or reddish brown, the head and the apex of the elytra rufescent, the antennae, palpi, mouth-parts, and legs (the posterior pair in part excepted) testaceous. Head long, obconic, at the base very little wider than the neck, deeply sulcate down the middle posteriorly, with a few minute widely scattered punctures (appearing almost smooth when denuded); eyes very large, separated by about half their own width; antennae very slender, long, joints 9-11 slightly thickened, 11 nearly as long as 9 and 10 united, the latter scarcely longer than 8. Prothorax very long, oval, about as wide as the head, flattened on the disc, attenuate anteriorly, obliquely compressed on the flanks posteriorly (appearing dilated at the base), densely granulato-punctate, the basal groove deep. Elytra moderately elongate, wider than the prothorax, very slightly narrowed

towards the apex; densely, minutely punctate, and also finely punctato-striate to near the apex, the interstices faintly raised externally. Pygidium emarginate at tip. Legs long, stout; basal joint of anterior tarsi nearly as broad as the tibiae.

Length $6\frac{1}{2}$ mm.

Hab. BORNEO (Wallace).

Three males found by Wallace are possibly referable to *M. major*, Pic, from N. Borneo; but there are various discrepancies in the description ("stries presque nulles," etc.), and the length is given as 5-7 mm. The species is recognisable by the long, obconic, sharply sulcate basal portion of the head, the very slender antennae (the outer joints included), the very long, oval, rough prothorax, the finely punctato-striate elytra, etc. It is of about the same size as *M. robusta*, *cirrata*, and *dilaticollis*. The structure of the head is remarkable. In the Museum there is also a specimen from Java (now without a head) that may belong to the same species?

19. *Macratría dilaticollis*, n. sp. (Plate LXIV, fig. 18, ♂.)

Elongate, robust, rather broad, dull (till denuded), the head shining, thickly clothed with long, adpressed, greyish hairs, the head and antennae with scattered, erect or projecting, bristly hairs; reddish-brown or brown, the metasternum darker, the head rufous, the antennae, mouth-parts, palpi, and legs testaceous, the posterior pair in great part, and the extreme bases of the tibiae of the other pairs, more or less infuscate. Head rather large, rounded at the sides posteriorly, subtruncate at the base, sparsely, minutely punctate, the occipital groove deep, short, the eyes very large; antennae long, slender, joints 9-11 elongated and thickened, 11 one-half longer and much stouter than 10, strongly acuminate. Prothorax broader than the head, somewhat flattened on the disc, oval, much narrowed in front and behind, densely, roughly granulato-punctate, the basal groove complete. Elytra very little wider than the prothorax, long, perceptibly narrowing from the base, closely scabroso-punctate, and also finely punctato-striate to near the apex, the interstices obsoletely costate externally. Pygidium emarginate at tip in ♂. Legs long, stout, the femora strongly clavate; basal joint of anterior tarsi much thickened.

Length 6- $6\frac{1}{2}$ mm. (♂ ♀.)

Hab. PERAK (*Doherty*: ♂, type); PENANG (*G. E. Bryant*, 6. xi. '13: ♂ ♀).

Three males and one female. A long, robustly-built, brown insect, with a red head and testaceous limbs (the posterior legs excepted), the prothorax greatly developed, much rounded at the sides, roughly sculptured, and flattened on the disc (so as to appear obsoletely margined laterally), the apical joint of the antennae unusually stout, the eyes very large, the elytra long, finely punctato-striate. This insect is as large as *M. robusta*, Motsch., from Ceylon; but it is more elongate, the elytra are more finely punctate and more distinctly striate, etc. *M. amphithorax*, Pic, from Banguey, may be an allied smaller form.

20. *Macratia cirrata*, n. sp. (Plate LXIV, fig. 19, ♂, head, in profile.)

♂. Elongate, robust, rather narrow, moderately shining (when denuded), thickly clothed with long, adpressed, brownish hairs, the basal portion of the head with long, fine, projecting setae and a matted tuft of curled fulvous hairs in the centre; reddish-brown, the metasternum darker, the head rufescent, the palpi, mouth-parts, antennae, and legs (a blackish patch on the posterior femora, and the infuscate posterior tibiae and first tarsal joint, excepted) testaceous. Head long, rather narrow, considerably developed behind the eyes, rounded at the sides posteriorly, very sparsely punctate; occipital groove deep, abruptly limited anteriorly, and interrupted by a transverse, lamelliform prominence, which is partly hidden by the tuft of matted fulvous hairs; eyes extremely large, oval, separated by less than half their own width; antennae somewhat closely set with elongate, projecting, bristly hairs, very slender, moderately long, joint 9 not longer, and very little stouter, than 8 [10 and 11 missing]. Prothorax elongate-oval, slightly broader than the head, flattened and subsulcate on the disc, obliquely compressed on the flanks posteriorly, closely, roughly punctate, the basal groove deep. Elytra elongate, parallel, a little wider than the prothorax; densely scabroso-punctate, and also finely punctato-striate to near the apex, the interstices slightly raised externally. Pygidium feebly emarginate at tip. Legs long, stout; basal joint of anterior tarsi much thickened.

Length $6\frac{1}{4}$ mm.

Hab. PERAK (*Doherty*).

One male. Narrower than *M. dilaticollis*; the prothorax oblong, shallowly sulcate to near the apex, and with the sides feebly rounded; the head much longer, and

with the occipital groove interrupted in ♂ by a transverse prominence, which is almost hidden by a tuft of fulvous hairs; the antennae more hirsute and very slender, the terminal joints (apparently) scarcely stouter; the eyes longer and more approximate; the elytra parallel.

21. *Macratia rubiginosa*, n. sp.

Very elongate, robust, shining, sparsely clothed with long, adpressed, fulvous hairs, the head and prothorax with a few intermixed, erect, bristly hairs; uniformly ferruginous or obscure ferruginous, the tarsi paler. Head rather long, obconic, at the base much wider than the neck, deeply sulcate down the middle posteriorly, very sparsely, finely, the inter-ocular space more closely, punctate; eyes very large, separated by about their own width; antennae long, rather stout, joints 9-11 thickened and elongated, 11 in ♂ fully as long as 9 and 10 united, in ♀ slightly shorter. Prothorax a little wider than the head, ovate, flattened and obsoletely canaliculate on the disc, obliquely compressed on the flanks posteriorly (appearing dilated at the base), densely granulato-punctate, the basal groove deep. Elytra long, rather broad, subparallel (♀) or very gradually narrowing from the base (♂); sparsely punctulate, and also finely punctato-striate to near the apex, the interstices feebly raised externally. Legs long, stout; basal joint of anterior tarsi much thickened.

Length $5\frac{3}{4}$ - $6\frac{1}{5}$ mm. (♂ ♀.)

Hab. PERAK (*Doherty*).

Four specimens. A large, robust, shining, sparsely pubescent, ferruginous insect, with an obconic, basally sulcate head, rather stout antennae, an ovate, roughly punctate, obsoletely canaliculate prothorax, and sparsely punctulate, punctato-striate elytra. Compared with the species here identified as *M. major*, Pic, the head and prothorax are shorter, the head is less narrowed posteriorly, the antennae are stouter, the elytral interstices are much smoother, and the vestiture is not nearly so abundant.

22. *Macratia rufescens*, n. sp.

Elongate, rather narrow, shining, sparsely clothed with long, adpressed, fulvous hairs, the head and prothorax with a few intermixed, erect, bristly hairs; obscure ferruginous or brown, the legs and antennae ferruginous. Head rather long, rounded at the sides posteriorly, sparsely, finely punctate, the occipital groove broad, deep, the eyes very large, distant; antennae long, moderately

slender, joints 9-11 elongated and thickened, 11 nearly as long as 9 and 10 united. Prothorax oval, about as wide as the head, obliquely compressed on the flanks posteriorly, the basal groove deep; densely, roughly punctate, obsolete canaliculate towards the base. Elytra long, wider than the prothorax, subparallel; finely punctulate, and also rather coarsely punctato-striate to near the apex, the narrow interstices subcostate. Legs long; basal joint of anterior tarsi much thickened.

Length $4\frac{3}{4}$ -6 mm.

Hab. BURMA, Ruby Mines (*Doherty*).

Three specimens, probably including the two sexes. Narrower than *M. rubiginosa*, from Perak; the head rounded at the sides posteriorly, wider at the base, and with a much broader occipital groove; the elytra more coarsely punctato-striate, with narrower and more raised interstices.

23. *Macratria nilgirica*, n. sp.

Very elongate, narrow, somewhat depressed, shining, thickly clothed with fine, adpressed, brownish or cinereous pubescence; obscure ferruginous or reddish-brown, the head rufescent, the prothorax and metasternum sometimes infuscate, the palpi, antennae, and legs testaceous, the femora and tibiae sometimes reddish, the posterior tibiae and first tarsal joint more or less infuscate, the posterior femora often nigro-maculate on their inner face. Head oblong, considerably developed behind the moderately large eyes, rounded at the sides posteriorly, closely, minutely punctate, the occipital groove short, deep; antennae long, slender, joints 9-11 thickened, 9 and 10 moderately elongated, together in ♀ about as long as 11, the latter in ♂ three times as long as 10. Prothorax elongate-oval, attenuate in front, feebly, obliquely compressed on the flanks posteriorly, densely scabroso-punctate, the basal groove complete. Elytra long, much wider than the prothorax, subparallel in their basal half; closely, minutely punctate, and also finely punctato-striate to near the apex, the interstices obsolete costate externally. Legs long; basal joint of anterior tarsi much thickened in both sexes.

Length $4\frac{1}{5}$ - $5\frac{1}{2}$ mm. (♂ ♀.)

Hab. INDIA, Nilgiri Hills (*H. L. Andrewes*).

Nine specimens, all females but two, three with the posterior femora nigro-maculate. A very elongate, narrow, somewhat depressed, finely pubescent, reddish-brown or ferruginous insect, with the head oblong and considerably developed behind the eyes, the elytra subparallel and finely

sculptured, the antennae entirely testaceous, with the apical joint much longer in ♂ than in ♀. The eyes are smaller and the elytra longer than in the somewhat similar *M. dentipes* from Macassar, etc. Two of Mr. Andrewes' Indian *Macratrīae* were described by Fairmaire in 1896, both from Belgaum, and both unique, but they cannot be very nearly related to *M. nilgirica*.

24. *Macratrīa neoguineensis*.

? *Macratrīa rubriceps*, var. ? *neoguineensis*, Pic, Ann. Mus. Genova, xl, p. 601 (1900).

Elongate, robust, dull, the head shining, densely clothed with fine, adpressed, brownish-cinereous pubescence, that on the elytra partly concealing the sculpture; piceous, the head, the prothorax indeterminately in front, and the metasternum in part, rufescent, the labrum, palpi, antennae (the three or four infusate outer joints excepted), and legs (the slightly infusate tibiae and basal joint of the posterior pair excepted), testaceous or flavo-testaceous. Head large, broad, rounded at the sides behind, subtruncate and very feebly notched in the centre at the base, densely, minutely punctate; eyes very large, distant; antennae long, slender, joints 9-11 thickened and greatly elongated, 9 and 10 equal, 11 much longer than 10. Prothorax oblong-oval, about as wide as the head, obliquely compressed on the flanks posteriorly, the basal groove almost obsolete in the middle; very densely scabroso-punctate. Elytra moderately long, much wider than the prothorax, gradually narrowing from the base; very densely, minutely punctate, and also finely punctato-striate to near the apex, the interstices subcostate externally. Pygidium entire. Legs stout; basal joint of anterior tarsi much thickened.

Length 5 mm. (♂ ♀?)

Hab. NEW GUINEA, Salwatty (Wallace), Ramoi (*L. M. d'Albertis*: type).

Two specimens from Salwatty, acquired by the British Museum in 1862, are perhaps referable to the form named as above by Pic, and doubtfully included by him under *M. rubriceps*. They agree with *M. fulvipes*, Pasc., from Macassar, in having very densely punctate, distinctly striate, closely pubescent elytra, a rough prothorax, etc.; the head, however, in the present insect is larger, more rounded at the sides posteriorly, broadly truncate behind, and rufous in colour, and the elytra are less narrowed posteriorly. *M. rubriceps* is said to have the elytra

"modice punctatis," whatever that may mean? The occipital groove is short and shallow in the Salwatty examples.

25. *Macratia semperi*, n. sp.

Moderately elongate, robust, rather narrow, the ♀ broader, shining (when denuded), somewhat thickly clothed with brownish pubescence; nigro-piceous or piceous, the head rufescent, the palpi, antennae, mouth-parts, and tarsi (the basal joint of the posterior pair excepted) testaceous, the femora and tibiae more or less infuscate in ♂, those of the anterior and intermediate legs testaceous in ♀. Head large, about as wide as the prothorax, narrowly extended behind the greatly developed oval eyes, arcuately narrowed posteriorly, closely punctate, the occipital groove short and shallow; maxillary palpi broad, joint 4 very stout; antennae long, slender, joints 9-11 stouter and elongated, 11 nearly equalling 9 and 10 united. Prothorax ample, oblong-oval, feebly, obliquely compressed on the flanks posteriorly, the basal groove conspicuous; densely, somewhat roughly punctate. Elytra much wider than the prothorax, comparatively short, subparallel in their basal half; closely, finely punctate, and also closely punctato-striate to near the apex, the interstices subcostate externally. Pygidium slightly emarginate at tip in ♂. Legs stout, the basal joint of the anterior and intermediate tarsi much thickened, that of the anterior pair nearly as broad as the tibia in ♂.

Length 4-4½ mm. (♂ ♀.)

Hab. PHILIPPINE IS., Bohol and Samar (*Semper*).

Three specimens. This is one of several species of *Macratia* found by Semper in the Philippines; it differs from the immaculate variety of *M. bicincta*, Mars., in having the head rufous and much less developed behind the eyes, the prothorax less attenuate in front, and the apical joint of the antennae not greatly elongated in ♂. The subparallel, more sparsely punctate elytra, the broader maxillary palpi, the red head, and the more slender antennae separate *M. semperi* from *M. fulvipes*, Pasc.

26. *Macratia pallidicornis*.

Macratia pallidicornis, Pasc., Journ. Ent. i, p. 55 (1860).

Macratia pallidicornis, var. *distinctipes*, Pic, Ann. Mus. Genova, xl, p. 792 (1901).

Hab. BORNEO (*Mus. Brit.*: type), Mt. Matang and Kuching in Sarawak (*Bryant*, xi. and xii. '13), Peugaron

(*Doherty*); MENTAWEI (*Modigliani*: var.); SUMATRA, Padang (*Modigliani*: var.), Merang (*Doherty*); PERAK (*Doherty*); JAVA, Soekaboemi (*Bryant*, 4. iv. '09); ASSAM, Patkai Mts. (*Doherty*).

A variable and widely distributed insect. It is recognisable by the rather coarse, somewhat abundant vestiture, with scattered intermixed erect hairs, at least on the head and prothorax, those at the hind angles of the latter clustered into a conspicuous projecting tuft in fresh specimens, the elytra, too, with slightly longer hairs along the striae, giving a lineate appearance to the surface, this being especially noticeable in most of the examples from Assam. The body varies in colour from reddish-brown to nigropiceous, the head being usually rufescent. The head is large and broad, truncate and feebly emarginate at the base, very sparsely punctulate; the eyes are oval, and very large in ♂; the antennae are testaceous, slender, joints 9-11 elongated and slightly thickened, 11 nearly as long as 9 and 10 united; the prothorax is convex, narrow, not wider than the head, roughly sculptured; the elytra are moderately long, gradually narrowed posteriorly, closely, finely punctate, and with rows of rather large punctures separated by narrow distinctly raised interstices; the legs are testaceous, the posterior femora and tibiae often more or less annulate or maculate with black, all the femora strongly clavate, the basal joint of the anterior tarsi much thickened. The Assam specimens have slightly smaller eyes than the rest, but they cannot be separated from them. It is not impossible that Pic may have incorrectly identified *M. pallidicornis*, Pasc., his *M. crassipes*, from Borneo, and its var. *brunnescens* from Sumatra, coming suspiciously near, to judge from the descriptions.

27. *Macratria dentipes*, n. sp. (Plate LXIV, fig. 20, ♂, anterior tibia.)

Elongate, narrow, shining, thickly clothed with fine, adpressed, brownish-einereous pubescence; ferruginous, the palpi and antennae, and the femora and tarsi in part, testaceous. Head as long as broad, well-developed behind the very large, oval eyes, rounded at the base, closely, minutely punctate, the occipital groove short, deep; antennae very slender, joints 9-11 elongated and moderately thickened, 11 much longer than 10. Prothorax elongate-oval, barely as wide as the head, attenuate in front, feebly, obliquely

compressed on the flanks posteriorly, densely, finely, punctate, the basal groove complete. Elytra moderately long, subparallel, wider than the prothorax, closely, minutely punctate, and also finely punctato-striate to near the apex, the interstices almost flat. Pygidium subtruncate at the tip. Femora strongly clavate. Anterior tibiae of ♂ armed with a sharp triangular tooth towards the middle, and also very feebly, subangularly dilated midway between the tooth and the apex. Basal joint of anterior tarsi subcylindrical.

Length 4-4½ mm. (♂ ♀.)

Hab. MACASSAR (*ex coll. Pascoe*, ♂); CELEBES (*ex coll. Bowring*, ♀).

Described from two specimens, the Macassar ♂ being taken as the type; a female, with a more rounded head and slightly rougher elytra, from Mindanao, may also belong to the same species? The sharply dentate anterior tibiae of the male are characteristic. *M. dentipes* cannot be identified with *M. obscuripes* (1912)* or *M. testaceicornis* (1901), Pic, from Celebes, nor is it referable to *M. fulvipes*, Pasc., from Macassar. Compared with *M. pallidicornis*, Pasc., the present insect is narrower and less robust, the head is much smaller, the prothorax and elytra are more finely punctate, the prothorax wants the long, projecting, bristly hairs on each side of the base, the elytra are subparallel, and the vestiture is finer and more uniform.

28. *Macratia celebensis*, n. sp.

♂. Elongate, narrow, shining, clothed with fine, adpressed, pale brownish hairs; obscure ferruginous, the antennae, palpi, and legs (the tibiae and first tarsal joint of the posterior pair excepted) testaceous. Head very large, broad, truncate and emarginate at the base, sparsely, minutely punctate; eyes large, oval; antennae long, slender, joints 9-11 elongated and thickened, 11 nearly as long as 9 and 10 united. Prothorax long, oval, narrow, strongly attenuate anteriorly, densely scabroso-punctate, obsolete canaliculate, the basal groove deep. Elytra moderately long, subparallel in their basal half, finely punctulate, and also finely punctato-striate on the disc to about the middle, the interstices almost flat. Pygidium subtruncate at tip. Legs long, stout, the femora strongly clavate; anterior tibiae much thickened, the basal joint of anterior tarsi also widened.

Length 4½ mm.

* Nec *M. obscuripes*, Pic, from New Guinea (1900).

Hab. CELEBES (*ex Bowering*).

One male, somewhat abraded, found amongst the insects received from Bowering in 1858, mounted on the same card with a female here referred to *M. dentipes*, which (even in ♂) has a very much smaller and narrower head, a less elongate prothorax, etc. A female (?) from the same island (*ex Bowering*, 1863), with the prothorax and elytra broader, and in great part piceous, the head not quite so wide, and the prothorax less attenuate anteriorly, may belong to the same species? This second example seems to come near *M. obscuripes*, Pic (1912), from Toli Toli, Celebes, but the latter is said to have a long head, a definition inapplicable to the insect before me.

29. *Macratria vicina*.

Macratria vicina, Pic, Le Naturaliste, 1896, p. 159.

Hab. PERAK [type]; PENANG (*G. E. Bryant*).

M. vicina cannot be identified amongst the numerous *Macratriae* before me from Perak,* but an example captured by Mr. Bryant at Penang in Nov. 1913, may belong to it, at least one other member of the genus (*M. dilaticollis*) being common to the two places. The Penang insect is very like *M. pallidicornis*, Pasc.; but it is more elongate, the pubescence is finer, the eyes are smaller, rather prominent, and more rounded, the prothorax is less convex and densely scabroso-punctate, and the elytra are longer, subparallel, and more finely punctato-striate, the interstices costulate externally, the striae thus appearing sharply defined.

30. *Macratria robusta*.

Macrathrius robustus, Motsch., Études Ent. vii, p. 67 (1858); Bull. Mosc. xxxvi, 1, p. 489 (1863).

Hab. CEYLON, Colombo.

The type of this species was from Colombo, whence I have seen two examples found by Mr. Bryant on May 19th, 1908, and there is a very large ♀ of it in the Museum (*ex coll. Murray*) labelled "Ceylon." A large, robust form, dark reddish-brown in colour, with the palpi, antennae, and legs (the tibia and first-tarsal joint of the posterior pair

* One of Doherty's captures at this locality, *M. instriata*, Pic (1915), a small shining black form, with testaceo-fasciate, non-striate, elytra, is not represented in the material before me.

excepted) ferruginous; the pubescence long, with scattered erect setae intermixed; the head broad, closely punctate, truncate at the base, with a shallow occipital groove extending forward as far as the posterior margin of the eyes, the latter rounded and moderately large; the antennae rather slender, with joints 9-11 thickened and much elongated, 11 a good deal longer than 10; the prothorax ample, oval, roughly sculptured, faintly canaliculate; the elytra shining, subparallel, moderately elongate, roughly punctate, and also substriate on the basal half of the disc; the legs long, stout. Length 5-6½, breadth 1½-1¾ mm.

31. *Macratria marginata*, n. sp.

Moderately elongate, somewhat depressed, shining, sparsely clothed with yellowish adpressed hairs; obscure ferruginous, the head rufescent, the antennae, legs, elytra, and abdomen testaceous, the elytra with the suture and sides indeterminately infuscate. Head long, narrow, well-developed behind the very large eyes, rounded at the sides posteriorly, sparsely, minutely punctate, the occipital groove short, deep; antennae slender [joints 9-11 missing]. Prothorax oblong-oval, narrow, about as wide as the head, obliquely compressed on the flanks posteriorly, densely scabroso-punctate, the basal groove complete. Elytra long, relatively broad, subparallel; sparsely, minutely punctate, and also shallowly punctato-striate to beyond the middle, the interstices narrow, subcostate on the disc. Pygidium feebly emarginate at tip. Legs stout, the femora strongly clavate.

Length 5 mm. (♂?)

Hab. PERAK (*Doherty*).

One specimen, somewhat imperfect. Recognisable by the long, narrow, rufescent head and prothorax; the slender, pallid antennae; the relatively broad, subparallel, shining, punctato-striate, testaceous elytra, with the suture and sides darker; and the stout, pallid legs. *M. limbata*, Pic, from Sumatra, must be somewhat similarly coloured, except that the reddish longitudinal elytral stripe appears to be narrower and better defined.

32. *Macratria setigera*, n. sp.

Elongate, robust, shining, clothed with fine, adpressed, greyish pubescence, the elytral striae each with a row of longer hairs, the upper surface also set with scattered, long, erect, fine, pallid setae;

piceous, the prothorax in part and the head entirely reddish, the palpi, mouth-parts, antennae, and legs testaceous, the posterior femora and tibiae infuscate. Head about as wide as the prothorax, well developed behind the moderately large eyes, rounded at the sides posteriorly, sparsely, minutely punctate, the occipital groove broad, deep; antennae moderately long, slender, joints 9-11 stouter and elongated, 11 nearly as long as 9 and 10 united. Prothorax convex, narrow, elongate-oval, obliquely compressed on the flanks posteriorly, the basal groove complete; densely scabroso-punctate. Elytra moderately elongate, rather broad, subparallel in their anterior half; densely, minutely punctate, and also punctato-striate to near the apex, the interstices flat and set with an irregular row of scattered setigerous punctures similar to those of the striae. Legs stout; basal joint of anterior and intermediate tarsi much thickened, that of the posterior pair curved.

Length 5 mm. (♀?)

Hab. INDIA, Darjeeling (*G. Rogers*).

One specimen, received by the Museum in 1906. Distinguishable by the scattered, intermixed, erect setae on the upper surface, those on the elytra arising from conspicuous punctures on the flattened interstices, suggestive of those of many Lagriids (*Statira*, etc.). The general coloration resembles that of *M. nigripennis*, Pic, from Kandy, Ceylon. The only Himalayan *Macratris* recorded is *M. harmandi*, Pic, from Sikkim, which must be a very different insect.

33. *Macratris longipennis*, n. sp.

Very elongate, shining, rather sparsely clothed with long, fine, decumbent, brownish hairs; black, the mouth-parts, palpi, joints 1-6 of the antennae in part, and legs rufo-testaceous or ferruginous. Head as long as broad, much developed behind the comparatively small eyes, and arcuately narrowed posteriorly, sparsely, finely punctate, the occipital groove short, shallow; antennae long, rather stout, joints 9-11 thickened and elongated, 11 much longer than 10. Prothorax convex, narrow, elongate-oval, attenuate in front, obliquely compressed on the flanks posteriorly, the basal groove deep, closely granulato-punctate. Elytra much wider than the prothorax, very long, subparallel, transversely depressed below the base; somewhat coarsely, rather sparsely, confusedly punctate, without definite impressed lines on the disc (the sutural and submarginal striae excepted), the interspaces smooth and shining. Legs long,

the femora strongly clavate; basal joint of anterior tarsi rather narrow, subcylindrical.

Length 6 mm. (♀?)

Hab. BURMA, Ruby Mines (*Doherty*).

One specimen. A very elongate, shining, black form, with red legs, a sparsely punctured, oblong head, comparatively small eyes, rather stout, long antennae, a long, narrow, roughly punctured prothorax, and elongate, confusedly punctate, sparsely pubescent, subparallel elytra. *M. instriata*, Pic, from Perak (*Doherty*), may be an allied smaller form, with testaceo-fasciate elytra.

34. *Macratia nigerrima*, n. sp.

Elongate, robust, shining, clothed with fine, adpressed, fuscous pubescence, with scattered, intermixed, erect, brown hairs, the vestiture of the under surface cinereous; black, the mandibles, tarsi, and antennae obscure rufo-testaceous, the antennae becoming darker towards the tip, the palpi nigro-piceous. Head rather long, obliquely narrowed behind the comparatively small eyes, closely, finely punctate, with a short, deep, occipital groove; antennae moderately long, gradually thickened outwards, joints 9 and 10 a little longer and stouter than 8, subequal, 11 about the length of 9 and 10 united in ♀, slightly longer in ♂. Prothorax oblong-oval, convex, attenuate in front, not or very little wider than the prothorax, obliquely compressed on the flanks posteriorly, densely granulato-punctate, the basal groove deep. Elytra moderately long, subparallel (♀) or very gradually narrowed from the base (♂), much wider than the prothorax, transversely depressed below the base, densely granulato-punctate throughout, with indication of faint irregular striae on the anterior half. Pygidium rounded at apex. Legs stout; basal joint of anterior tarsi much thickened, that of the posterior pair curved.

Length $5\frac{1}{4}$ – $6\frac{1}{2}$ mm. (♂ ♀.)

Hab. BURMA, Ruby Mines (*Doherty*).

Three specimens. An elongate, robust, fusco-pubescent, black insect (the antennae and tarsi excepted), with roughly sculptured prothorax and elytra, a much smoother, finely punctate, posteriorly narrowed head, rather small eyes, a deep occipital sulcus, and the antennal joints 9 and 10 together about the length of 11. The subconical head, dark legs, rougher sculpture, etc., separate *M. nigerrima* from *M. longipennis*.

35. *Macratia atricolor*, n. sp.

Elongate, narrow, shining, sparsely clothed with adpressed brown and cinereous hairs; black, the mouth-parts, the antennae in part (joints 9-11 excepted), and tarsi (joints 1 and 2 of the posterior pair excepted) testaceous, the palpi more or less infusate, the knees reddish. Head as long as broad, convex, much developed behind the rather small eyes, rounded posteriorly, sparsely, minutely punctate, the occipital groove short, deep; antennae long, slender, joints 9-11 elongated and thickened, 11 much longer than 10, slightly shorter in ♀ than in ♂. Prothorax about as wide as the head, convex, oblong-oval, obliquely compressed on the flanks posteriorly, roughly granulato-punctate, the basal groove deep. Elytra long, much wider than the prothorax, very gradually narrowed from the base, subparallel in ♀; somewhat coarsely, confusedly punctate, without definite impressed lines on the disc (the sutural and submarginal striae excepted), the interspaces smooth and shining. Legs long, the femora strongly clavate; basal joint of anterior tarsi moderately thickened.

Length 4-5 mm. (♂ ♀.)

Hab. BURMA, Ruby Mines (*Doherty*).

Six specimens. This is one of three closely allied forms found by Doherty in the same district. Compared with *M. longipennis*, it is smaller and less elongate, the elytra are more closely and a little more coarsely punctate, the antennae are much more slender, and the femora and tibiae are infusate or black. Less robust, smaller, and narrower than *M. nigerrima*, the elytra not so densely punctate (with smooth, flattened interspaces between the punctures), the antennae more slender, the head smoother, the tarsi in great part testaceous.

36. *Macratia pumilio*, n. sp.

Moderately elongate, somewhat flattened above, subacuminate posteriorly, feebly shining (when denuded); thickly clothed with very fine, adpressed, brownish and cinereous pubescence, the entire upper surface very densely punctulate; nigro-piceous, the palpi, mouth-parts, antennae (the infusate terminal three joints excepted), and tarsi (joint 1 of the posterior pair excepted) testaceous or obscure testaceous. Head short, broad, rounded at the base, without occipital groove above; eyes large, distant, depressed; antennae short, slender, joints 9-11 thickened, 9 about as long as broad, 10 transverse, 11 ovate. Prothorax oval, about as long as broad, as

wide as the head, widest before the middle, the basal groove shallow, incomplete. Elytra a little wider than the head, comparatively short, rapidly narrowed from the middle, conjointly rounded at the apex, transversely depressed below the base, the usual impressed lines (the sutural and submarginal striae excepted) barely indicated. Legs short; femora strongly clavate; basal joint of anterior tarsi moderately thickened.

Length $2\frac{1}{10}$ – $2\frac{1}{4}$ mm.

Hab. BORNEO, Pengaron (*Doherty*).

Two specimens, possibly sexes, one being broader than the other. A minute form, with the general facies of an *Anthicus*. It appears to be nearest allied to *M. anthicoides*, Fairm., from Madagascar, and *M. pygmaea*, Pic, from Balabac Isl., near Borneo. The very dense punctuation of the upper surface, the close, fine pubescence, the broad head, the abruptly widened, comparatively short terminal three joints of the antennae, the non-striate dorsum of the elytra, etc., separate *M. pumilio* from all the other species of the genus here enumerated, the following excepted.

37. *Macratria parvula*, n. sp.

Moderately elongate, rather dull (till denuded), the head shining, thickly clothed with fine, adpressed, brownish and cinereous pubescence; nigro-piceous, the mouth-parts, palpi, antennae, and legs (the partly infuscate posterior pair excepted) testaceous or rufotestaceous. Head nearly or quite as broad as the prothorax, transverse, rounded at the base, densely, minutely punctate, the occipital groove just indicated in the middle behind, the eyes large, distant; antennae rather short, slender, joints 9–11 abruptly thickened, 9 about as broad as long, 10 a little shorter, 11 acuminate-ovate. Prothorax oblong-oval, densely scabroso-punctate, the basal groove shallow, incomplete. Elytra moderately long, much wider than the head, gradually narrowed from the base, conjointly rounded at the tip; densely scabroso-punctate, and shallowly, but distinctly striate. Legs short, stout; femora strongly clavate; basal joint of anterior tarsi moderately stout.

Length $2\frac{1}{2}$ – $2\frac{3}{8}$ mm.

Hab. PHILIPPINE IS., Luzon and Alabat (*Doherty*).

Three specimens. This is the Philippine representative of the Bornean *M. pumilio*, from which it differs in the rather robust build and more elongate general shape, the longer antennae, with more acuminate apical joint, the

shining head, and the shallowly, but distinctly striate elytra, the elytra themselves narrowed from the base.

Australian Species.

38. *Macratia erythrocephala*, n. sp.

Moderately elongate, narrow, shining, thickly clothed with rather coarse, adpressed, cinereous pubescence; nigro-piceous, the head, the basal and apical margins of the prothorax, and the base, humeri, and suture of the elytra, ferruginous or rufo-testaceous, the mouth-parts, antennae, and legs testaceous, the terminal antennal joint slightly infuscate. Head broad, transverse, polished, very sparsely, minutely punctulate, the eyes moderately large, the occipital groove wanting; antennae short, slender, joints 9-11 thickened, 9 and 10 subtriangular, very little longer than broad, 11 acuminate-ovate. Prothorax as wide as the head, slightly longer than broad, margined at the base, the hind angles extending a little outwards; densely, rugulose punctate. Elytra comparatively short, narrowing from a little below the humeri, wider than the prothorax, transversely depressed below the base; roughly, confusedly punctate, obsolete striate on the basal portion of the disc, the fine sutural and submarginal striae present. Legs short, stout, the femora strongly clavate.

Length $2\frac{1}{3}$ mm. (σ ?)

Hab. AUSTRALIA, Kew on the Yarra River, Victoria (*H. J. Carter*).

One specimen. This minute form approaches the Bornean *M. pumilio* and the Philippine *M. parvula*, differing from them in the rufo-testaceous, polished head, the rougher puncturing of the prothorax and elytra, the rufous base and suture of the latter, and the entirely pale legs. *M. banghaasi*, Pic, from N.S. Wales, seems to be an allied form. The example described was sent me by Mr. Carter as *M. australis*, King (the type of which was from Gawler, S. Australia), an insect said to resemble a *Dircaea*, and to have indistinct olivaceous spots on the prothorax and elytra, the legs and antennae castaneous, etc.

39. *Macratia macrophthalma*, n. sp.

σ . Elongate, narrow, shining, thickly clothed with long, decumbent, brownish hairs, with a few erect hairs intermixed; fuscous, the palpi, mouth-parts, antennae, and legs (the slightly infuscate tibiae

and first tarsal joint of the posterior pair excepted) testaceous. Head large, feebly developed behind the eyes, rounded at the sides posteriorly, truncate at the base, closely, minutely punctate, with a short, deep occipital groove; eyes extremely large, oval, coarsely faceted, somewhat narrowly separated anteriorly; antennae slender, long, joints 9-11 elongated and moderately thickened, 11 nearly as long as 9 and 10 united. Prothorax as wide as the head, long, oval, obsoletely canaliculate, densely granulato-punctate, the basal groove shallow. Elytra moderately long, very gradually narrowing from the base; closely punctulate, and also punctato-striate on the disc, the interstices subcostate externally. Ventral segment 5 broadly sulcate down the middle. Legs long, the femora strongly clavate; basal joint of anterior tarsi about as broad as the tibia, that of the posterior pair elongate and feebly curved.

Length 5 mm.

Hab. N. QUEENSLAND, Kuranda (*G. E. Bryant*, 18. xi. '09).

One male. Amongst the seven described Australian members of this genus (one only of which is known to me, *M. victoriensis*, Blackb.) the present species seems to be nearest allied to *M. intermedia*, Lea, from Cairns, which is a smaller insect (length $3\frac{1}{2}$ mm.), and has the head longer than wide, etc. The extremely large, oval, coarsely faceted eyes, the large head, and the narrowly subcostate, punctato-striate elytra are the chief characters of *M. macrophthalmia*.

40. *Macratia carteri*, n. sp.

Elongate, shining, thickly clothed with rather coarse brownish pubescence; piecous, the head and elytra dark brown, the fifth ventral segment ferruginous, the antennae and mouth-parts, and the anterior and intermediate legs, testaceous, the posterior pair with the femora nigro-piecous and the tibiae and tarsi more or less infusate. Head as long as broad, well-developed behind the very large eyes, closely, minutely punctate, the occipital groove short and deep; antennae long, not very slender, joints 9-11 thickened, 9 and 10 elongate, equal, 11 nearly as long as 9 and 10 united. Prothorax longer than broad, slightly wider than the head, oval, sharply marginal and dilated at the base; densely scabroso-punctate, unimpressed. Elytra long, subparallel, much wider than the prothorax; conspicuously punctato-striate, the interstices subcostate externally and closely punctate. Legs long, rather stout, the femora strongly clavate, the basal joint of the anterior tarsi much widened.

Length $5-5\frac{1}{2}$ mm.

Hab. NEW SOUTH WALES, National Park, Sydney (H. J. Carter).

Three specimens, one (apparently ♂) now without a head, sent me by Mr. Carter as *M. (Anthicus) aberrans*, MacL. (the type of which was from Gayndah), an insect described as opaque, with the elytra scarcely wider than the prothorax, the legs pale red, etc. Compared with the nearly allied *M. macrophthalma*, from N. Queensland, the eyes are not so large (the head thus appearing more developed behind them), the antennae are stouter, the posterior femora in great part black, etc. *M. pallidiceps*, Pic, from N.S. Wales, *M. intermedia*, Lea, from Cairns, and *M. analis*, Lea, from Tamworth, must all be different from the present insect.

41. *Macratria duboulayi*, n. sp.

Moderately elongate, feebly shining (till denuded), thickly clothed with fine, adpressed, fulvo-cinereous pubescence; reddish-brown, the head rufescent, the palpi, mouth-parts, antennae, and legs testaceous, the tibiae a little darker than the femora and tarsi. Head transverse, rounded at the sides posteriorly, truncate at the base, closely, minutely punctate, the occipital groove short and very shallow, the eyes moderately large and somewhat prominent; antennae slender, joints 9-11 elongated and thickened, 11 as long as 9 and 10 united. Prothorax a little broader than the head, oval, strongly rounded at the sides and much narrowed behind, obsoletely canaliculate on the disc, obliquely compressed on the flanks posteriorly, densely, finely scabroso-punctate, the basal groove shallow. Elytra moderately long, very gradually narrowing from the base, densely punctulate, and also shallowly, minutely punctato-striate on the disc, the interstices obsoletely costate externally. Legs stout, the femora strongly clavate; basal joint of anterior tarsi nearly as broad as the tibia.

Length 4 mm. (♂?)

Hab. W. AUSTRALIA, Champion Bay (*Duboulay, ex coll. F. Bates*).

One specimen, in perfect condition, found many years ago by Duboulay. This species, to judge from the brief description, seems to be related to *M. (Anthicus) aberrans*, MacL., from Gayndah, Queensland. It may be known from the described Australian forms by its reddish-brown colour, the very densely punctulate, feebly shining, closely pubescent surface, the transverse head, the strongly rounded

sides of the prothorax, the very finely and shallowly punctato-striate elytra, and the stout legs.

South African Species.

42. *Macratría permagna*, n. sp.

♀. Elongate, comparatively broad, robust, feebly shining (when denuded), thickly clothed with fine, adpressed, pale brownish hairs, some of which are uniseriately arranged on the almost obsolete elytral striae; reddish-brown, the eyes black, the legs ferruginous, with the tibiae, first tarsal joint, and the posterior knees infuscate, the palpi and antennae (the infuscate joints 9-11 excepted) rufo-testaceous. Head rather long, oval, densely, finely punctate, the occipital groove moderately deep and extending forward as far as the posterior margin of the eyes, the latter very large; antennae slender, not very long, joints 9-11 thickened, 9 and 10 triangular, longer than broad, 11 much longer than 10. Prothorax longer than broad, wider than the head, oblong-oval, slightly dilated at the sides behind the basal groove; densely, roughly punctate, and obsoletey canaliculate. Elytra long, subparallel, much wider than the prothorax; densely, finely, rugulose punctate, and with rows of intermixed slightly coarser punctures extending from the base to near the apex, these latter bordered internally down the anterior half by an irregular line of minute asperities or granules. Fifth ventral segment angularly produced in the middle at the tip. Legs stout, the posterior tarsi comparatively short, the penultimate joint of each tarsus strongly lobed.

Length $8\frac{1}{2}$, breadth $2\frac{1}{2}$ mm.

Hab. NATAL, Durban (*H. W. Bell Marley*).

One specimen, received by the Museum in 1903. Larger and more robust than *M. canaliculata* (= *maxima*), Pic, from Brazil, *M. grandis*, Pic, from New Guinea, and *M. robusta*, Motsch., from Ceylon. Compared with *M. rugulipennis*, from Salisbury, apart from the very much larger size, it may be separated by the less dilated post-ocular portion of the head, the broader, less ovate prothorax, and the finer granulation of the elytra, the seriate punctures on which are scarcely distinguishable till the insect is viewed in profile.

43. *Macratría rugulipennis*, n. sp.

Elongate, robust, shining, rather sparsely clothed with long, adpressed greyish hairs, with a few erect hairs intermixed; reddish-

brown, the head rufescent, the palpi, mouth-parts, antennae (the infusate terminal three joints excepted), femora (the tip of the posterior pair excepted), and tarsi in great part, testaceous, the tibiae all more or less marked with black. Head oblong, well developed behind the large, rounded eyes, arcuate at the sides posteriorly, closely, minutely punctate, the occipital groove extending some distance forward; antennae long, slender, joints 9-11 elongated and thickened, 9 not much longer than those preceding, 11 nearly twice as long as 10. Prothorax long, ovate, a little wider than the head, much narrowed behind, obliquely compressed on the flanks posteriorly, densely, roughly scabroso-punctate, the basal groove complete. Elytra moderately long, much wider than the prothorax, subparallel in their basal half; roughly punctate, and also with rows of rather coarse punctures on the disc, the interstices narrow, somewhat raised, asperate. Pygidium emarginate at tip. Legs long, very stout, the posterior pair rather shorter in proportion than usual, the femora strongly clavate; penultimate joint of each tarsus produced into a long, broad membranous lobe, the basal joint of the anterior pair thickened.

Length $5\frac{1}{2}$ mm. (σ ?)

Hab. MASHONALAND, Salisbury (*G. A. K. Marshall*, xii. '97).

One specimen, somewhat injured by an *Anthrenus*, but in sufficiently good preservation for description. A reddish-brown, robust insect, with a long head, slender antennae (the terminal three joints excepted), a basally narrowed, ovate, subgranulate prothorax, moderately long, roughly asperato-punctate elytra, and very stout legs, with all the tibiae in part black, and the penultimate tarsal joint strongly lobed. This is one of three species found in S. Africa by Dr. Marshall, all very different from the single recorded representative from that region, *M. mustela*, Pasc., from Natal.

44. *Macratrria cordata*, n. sp.

Elongate, rather narrow, dull (till denuded), the head shining, thickly clothed with fine, adpressed, brownish pubescence, the elytra with slightly longer hairs down the striae; reddish-brown, the head red, the antennae, palpi, and legs (a blackish patch on the posterior femora, and the slightly infusate posterior tibiae and first tarsal joint, excepted) rufo-testaceous. Head rather small, narrower than the prothorax, oblong, well-developed behind the rounded eyes, arcuate at the sides posteriorly, sparsely, minutely punctate, with

a short, deep occipital groove; antennae moderately slender, joints 9-11 elongated and thickened, 11 nearly as long as 9 and 10 united. Prothorax long, ovate, obliquely compressed on the flanks posteriorly (the deflexed basal portion appearing prominent laterally), obsolete canaliculate towards the base, densely scabroso-punctate, the basal groove complete. Elytra much wider than the prothorax, subparallel in their basal half; very densely punctulate, and also finely punctato-striate on the disc, the interstices almost flat, sparsely granulate towards the suture. Legs long, the femora strongly clavate; basal joint of anterior tarsi subcylindrical.

Length $4\frac{1}{5}$ -5 mm.

Hab. NATAL, Malvern (*G. A. K. Marshall*, ix. '97).

Two specimens, probably sexes, one being broader than the other. Less robust than *M. rugulipennis*, the head smaller, with shorter occipital groove, the sculpture of the elytra fine and dense, the laterally depressed basal portion of the prothorax rather prominent. The relatively narrow head and the rough subcordate prothorax distinguish *M. cordata* from numerous very similar forms from other regions.

45. *Macratia mustela*.

Macratia mustela, Pasc., Journ. Ent. i, p. 55, pl. 2, fig. 7 (1860).

Hab. NATAL.

Of this species there are five specimens in the Museum (two of them labelled Port Natal), including the type. *M. mustela* may be known by its very elongate, narrow shape, dark coloration (the elytra paler than the prothorax); the dense, fine puncturing of the whole upper surface; the fine, adpressed pubescence; the long head, with conspicuous occipital groove; the rather small, rounded eyes; the somewhat parallel-sided basal portion of the prothorax; and the asperate sculpture of the elytra, on the disc of which rows of slightly coarser punctures are traceable. The apical joint of the antennae is as long as 9 and 10 united in both sexes. The outer joints of each tarsus, and the basal half or more of the antennae, are testaceous.

46. *Macratia ruficollis*, n. sp.

Elongate, narrow, depressed, shining, finely cinereo-pubescent; black, the head nigro-piceous, the prothorax rufous, the palpi,

mouth-parts, antennae (the infusate terminal three joints excepted), the anterior and intermediate legs, and probably the posterior tarsi [which are now wanting] in part, testaceous. Head small, rounded, closely, minutely punctate, without occipital groove; eyes rounded, rather small; antennae short, slender, joints 9-11 abruptly widened, forming a definite club, 9 as long as broad, 10 a little shorter, 11 ovate. Prothorax oblong-oval, as wide as the head, densely, finely scabroso-punctate, the sides becoming sub-parallel towards the base, the basal groove sharply defined. Elytra moderately long, nearly twice as wide as the head, parallel in their basal half; closely, finely, punctate, with an indication of faint impressed lines on the disc, the vestiture appearing uniseriately arranged. Legs short, the femora moderately thickened; basal joint of anterior tarsi about as broad as the tibia.

Length $3\frac{1}{10}$ mm.

Hab. NATAL, Umkomaas R. (*G. A. K. Marshall*).

One specimen, presented to the Museum in 1901. Recognisable by its small size, Anthiciform facies, oblong, rufous prothorax, infusate, rather stout antennal club, small, dark head, and parallel-sided, depressed, obsoletely striate, black elytra. An isolated form.

South American Species.

47. *Macratría complanata*, n. sp.

Moderately elongate, somewhat depressed, feebly shining (till denuded), thickly clothed with fine, adpressed, greyish pubescence; obscure ferruginous, the head red, the antennae, palpi, mouth-parts, and legs (the slightly infusate bases of the femora and the first posterior tarsal joint excepted) testaceous or rufo-testaceous; the entire upper surface densely, very finely punctate. Head rather large, rounded, subtruncate at the base, the occipital groove short, shallow (only visible from behind), the eyes moderately large, rounded; antennae slender, joints 9-11 elongated and thickened, 11 considerably longer than 10. Prothorax elongate-oval, barely as wide as the head, scabrous, the basal groove deep. Elytra comparatively broad, moderately long, gradually narrowed from the base; the very dense, fine sculpture appearing somewhat granulate in places, the disc also with irregular rows of minute punctures, the interstices almost flat, the sutural and submarginal striae sharply defined. Pygidium trifid at the apex. Legs stout, the femora strongly clavate; posterior tibiae compressed, feebly curved; basal joint of the anterior tarsi

moderately thickened, that of the posterior pair curved, not very elongate.

Length 4-4½ mm. (♀?)

Hab. COLOMBIA.

Two specimens, acquired by the Museum in 1844. This species, to judge from the description, must be very closely related to *M. filiformis*, Laf., from Cumana, Venezuela, which is said to have glabrous, shining lines along the elytral striae, the latter without distinct punctures. *M. sericea*, Laf., based upon a single (♂?) example from Nueva Valencia, Colombia, seems to have a longer head, the basal groove of the prothorax almost obsolete, the elytra parallel, etc. The pygidium of the insect described is shaped as in the female of *M. incana*, Champ. (*cf.* B. C.-Am., Coleopt. iv, 2, pl. 9, fig. 9a), but the curved posterior tibiae are suggestive of the male sex.

48. *Macratria canaliculata*.

Macratria canaliculata, Pic, Le Naturaliste, 1896, p. 20.

Macratria maxima, Pic, op. cit. 1902, p. 21.

Hab. BRAZIL [types], San Antonio, Bahia (*Fry*).

Two specimens (♂♀) in the Fry collection, labelled *M. canaliculata*, H. Deyr., doubtless belong to this species, which is one of the largest known members of the genus. They are brown or blackish-brown in colour, with the palpi and antennae, and the legs in part, ferruginous; the vestiture close, long, and adpressed, with scattered long, erect, bristly hairs intermixed; the head broad, subtruncate and deeply cleft at the base; the prothorax broad, arcuately dilated at the sides anteriorly, and much narrowed behind (the laterally depressed basal portion thus appearing prominent), the faint median channel mainly due to the arrangement of the pubescence; the elytra long, subparallel in their basal half, densely, confusedly punctate, not striate; the pygidium feebly emarginate in ♂; the basal joint of the anterior tarsi moderately stout. *M. maxima* is said by Pic to be a dark form of *M. canaliculata* with the median depression of the prothorax obsolete, *e. g.* as in the ♀ from Bahia, the ♂ from the same locality belonging to *M. canaliculata*. The present species is more elongate than *M. robusta*, Motsch., and has a broader, deeply cleft head, an ovate prothorax, more finely punctate elytra, etc. Length 7-8 mm.

49. *Macratria scabrida*, n. sp. (Plate LXIV, figs. 21, ♂, genital armature; 21a, ditto, in profile.)

♂. Elongate, robust, subopaque, thickly clothed with fine, adpressed, brownish-cinereous pubescence, with numerous pallid erect hairs intermixed; nigro-piceous, brownish on the disc of each elytron, anteriorly, the palpi, mouth-parts, antennae, and legs (a patch on the femora, and the tibiae in part, of the posterior pair excepted) ferruginous or rufo-testaceous; the entire upper surface very densely, finely punctate. Head short, transversely subquadrate, broadly truncate at the base, the occipital impression broad, shallow; eyes moderately large, rounded, prominent; antennae rather slender, joints 9-11 thickened and elongated, 9 nearly twice as long as 8, 11 much longer than 10. Prothorax long, subcordate, broader than the head, widest before the middle, obliquely compressed on the flanks posteriorly, the basal portion rather prominent laterally, the basal groove shallow. Elytra much wider than the prothorax, long, narrowed from the base, without definite impressed lines (the sutural stria excepted) on the disc, the minute punctures confluent, the surface appearing uniformly scabrous. Legs stout; basal joint of the anterior tarsi broad, that of the posterior pair not very elongate. Penis-sheath with the dilated outer portion oblong, broad, spoon-shaped, and furnished with a slender, hook-like process at the tip; the lateral lobes of the aedeagus long, hook-like, angularly dilated basally.

Length 5 mm.

Hab. BRAZIL, Rio de Janeiro (*Fry*).

One male, with the remarkable genital armature exposed. Recognisable by the very dense, fine sculpture, the fine pubescence intermixed with long, erect hairs, the reddish limbs, the transversely subquadrate head, the rather prominent eyes, the long, simple, subcordate prothorax, and the posteriorly narrowed, non-striate elytra, the usual submarginal stria being almost obsolete. Compared with the somewhat similar *M. canescens*, Champ., from Mexico, the present species may be separated by the smaller, shorter, more truncate head, with broader occipital impression, the non-seriate-punctate elytra, and the shallower basal groove of the prothorax.

50. *Macratria fissiceps*, n. sp. (Plate LXIV, figs. 22, genital armature; 22a, ditto, in profile.)

♂. Elongate, robust, shining (when denuded), thickly clothed with long, coarse, decumbent, pale brownish hairs, with a few scattered

long, erect, bristly hairs intermixed, the vestiture of the under surface dense and whitish; reddish-brown, the head rufescent, the antennae, palpi, and legs (except the anterior knees, the intermediate and posterior tibiae, a patch on the posterior femora, and the first posterior tarsal joint, which are infusate) testaceous. Head short, broad, densely punctulate, rounded at the base, the occipital groove broad, extending forward to nearly as far as the middle of the eyes, the latter very large; antennae rather short, not very slender, joints 9-11 elongated and thickened, 11 slightly longer than 10; maxillary palpi moderately stout, joint 4 cultriform. Prothorax long, convex, broader than the head, arcuately dilated anteriorly and narrow at the base (thus appearing cordate), densely scabroso-punctate, the basal groove shallow and very near the margin. Elytra shining, long, somewhat convex, subparallel in their basal half; closely punctulate, without definite striae (the sutural and submarginal lines excepted), but with rows of minute punctures down the disc to beyond the middle, the interstices broad, and with a line of minute granules along their outer edge. Legs long, stout; basal joint of anterior tarsi as broad as the tibia. Penis-sheath very long, slender, compressed, blunt at the tip; the lateral lobes of the aedeagus long, slender, acuminate, a long, curved, slender, spiniform process arising from near the base of each of them.

Length 6 mm.

Hab. COLOMBIA, ?Bogota (ex coll. F. Bates).

One male. This insect seems to be nearly related to *M. goudoti* and *funcki*, Laf., from Colombia and Venezuela respectively, but it cannot be identified with either of them. Compared with the Central-American *M. princeps*, Champ., the present species is narrower and more convex, and it has the elytra less densely punctate, the prothorax more dilated anteriorly, the head rounded (instead of truncate) behind, and the occipital groove longer. *M. fissiceps* is recognisable from its American allies by the long, convex, cordate prothorax; the short, deeply cleft, basally rounded head; the large eyes; the seriato-granulate, non-striate, shining elytra; and the elongate, robust body. The genital armature is wholly different from that of *M. scabrida* and *incana*, the only American members of the genus as yet dissected by me.

51. *Macratia egaensis*, n. sp.

Elongate, robust, moderately shining, thickly clothed with fine, adpressed, yellowish pubescence; reddish-brown, the head rufescent,

the antennae, palpi, anterior legs (the knees excepted), and the femora and tarsi of the other legs, testaceous or rufo-testaceous; the entire upper surface densely, minutely punctate. Head large, transverse, broadly truncate behind, the occipital groove very deep; eyes rounded, moderately large, distant; antennae rather short, not very slender, joints 9-11 thickened and elongated, 11 nearly as long as 9 and 10 united, 10 a little longer than 9. Prothorax long, almost as wide as the head, oval, much narrowed posteriorly, the lower basal portion but little dilated laterally, the basal groove fine and placed close to the margin, the surface finely scabrous. Elytra rather broad, long, subparallel in their basal half, confusedly punctulate, substriate on the basal half of the disc, without definite series of punctures, the interstices flat. Legs moderately long, the femora strongly clavate; basal joint of anterior tarsi nearly as stout as the tibia.

Length 5 mm. (♂?)

Hab. AMAZONS, Ega (*H. W. Bates*).

One specimen, injured by pinning. Smaller, less robust, and more finely pubescent than *M. fissiceps*; the head truncate behind, and with a shorter and deeper occipital sulcus; the eyes smaller; the prothorax less convex, and less dilated anteriorly; the elytra not so shining and much more densely punctate; the antennae with a longer apical joint. The reddish-brown body, larger head, deeper occipital groove, less rounded sides of the prothorax, and the subparallel, less densely punctate, more shining elytra separate *M. egaensis* from *M. scabrida*.

52. *Macratia truncata*, n. sp.

Elongate, robust, shining, sparsely clothed with rather long, decumbent, cinereous hairs; black, the palpi, mouth-parts, and legs (the bases of the femora, the knees, and the posterior tibiae and first tarsal joint excepted) testaceous, the two basal joints of the antennae fusco-testaceous. Head large, subquadrate, broadly truncate at the base, closely, minutely punctate, the occipital impression almost obsolete, the eyes large; antennae slender, moderately long, joints 9-11 elongated and thickened, 11 one-half longer than 10. Prothorax long, broader than the head, oval, widest anteriorly, obliquely compressed on the flanks posteriorly, the basal portion dilated laterally, the basal groove shallow; densely scabroso-punctate. Elytra wider than the prothorax, long, rather convex, subparallel in their basal half, densely, confluent punctate, without trace of striae (the sutural stria excepted) on the disc. Legs stout,

the femora strongly clavate; basal joint of the anterior tarsi large, fully as broad as the tibia, that of the posterior pair curved and not very long.

Length $5\frac{1}{2}$ mm. (σ ?)

Hab. BRAZIL, Parana (*Fry*).

One specimen. A robust, black, shining, sparsely cinereo-pilose form, with a transversely subquadrate head, dark antennae, a large, subcordate prothorax, and confusedly punctate, non-striate elytra, the legs stout and in great part testaceous. The basal joint of the anterior tarsus is so much thickened as to appear, at first sight, a continuation of the tibia. *M. truncata* is allied to *M. obsoleta*, Champ., from Costa Rica, from which it differs in the broader, black head, the shorter antennae, the anteriorly dilated prothorax, and the more densely punctured elytra; the posterior femora, too, are infuscate at the base and apex only, not at the middle as in *M. obsoleta*.

53. *Macratia crassimanus*, n. sp. (Plate LXIV, fig. 23,
♂, anterior leg.)

Elongate, shining (when denuded), the prothorax subopaque, thickly clothed with fine, adpressed, fulvous or greyish pubescence, with a few erect hairs intermixed; brown or reddish-brown, the head usually rufescent, the prothorax and metasternum sometimes piecous, the palpi, mouth-parts, antennae, and legs (a large blackish patch on the posterior femora, and the slightly infuscate posterior tibiae and first tarsal joint, excepted) testaceous. Head transverse, broadly truncate and feebly emarginate at the base, densely, finely punctate; eyes very large, oval, coarsely faceted; antennae slender, long, joints 9-11 thickened and elongated, 11 one-half longer than 10; maxillary palpi moderately stout, joint 4 cultriform. Prothorax about as wide as the head, oblong-oval, rounded at the sides anteriorly, obliquely compressed on the flanks posteriorly, densely scabroso-punctate, the basal groove shallow. Elytra moderately long, rather broad, subparallel in their basal half; finely, densely, confusedly punctate, with faintly impressed lines on the disc, the usual rows of punctures altogether wanting, the submarginal stria incomplete and only just traceable. Pygidium simple. Legs long, the femora strongly clavate; basal joint of anterior tarsi very stout, wider than the tibia in both sexes.

Length $3\frac{1}{2}$ - $4\frac{3}{4}$ mm. (σ ♀.)

Hab. BRAZIL. Petropolis (*Gray*), Rio de Janeiro, Macahi (*Fry*), Alto da Serra in Sao Paulo (*G. E. Bryant*).

Apparently not uncommon in the neighbourhood of Rio de Janeiro. The numerous specimens before me vary greatly in size, and in the colour of the body, and also to some extent in the intensity of the elytral sculpture, two small males from Macahi having the punctures more scattered and the interspaces smoother. In this species there is no trace of a seriate arrangement of punctures on the disc of the elytra, the basal joint of the anterior tarsi is greatly thickened, the head is broadly truncate at the base, the eyes are large, oval, and coarsely faceted, and the posterior femora are constantly fusco-maculate.

54. *Macratia frontalis*, n. sp.

♂. Moderately elongate, narrow, shining, the prothorax subopaque, the surface sparsely cinereo-pubescent; piceous, paler beneath, the anterior half of the head, the palpi, antennae, and legs testaceous, the rest of the head rufescent. Head transverse, as wide as the prothorax, broadly truncate and unimpressed at the base, closely, minutely punctate; eyes moderately large, not prominent; antennae very slender, moderately long, joints 9-11 elongated and thickened, 11 nearly twice as long as 10. Prothorax elongate-oval, compressed on the flanks posteriorly, densely scabroso-punctate, the basal groove incomplete. Elytra comparatively short, narrowing from the base, closely, finely, confusedly punctate, without impressed lines on the disc, the sutural and submarginal striae excepted. Legs long, the femora clavate; basal joint of the anterior tarsi very stout, wider than the tibia, that of the posterior pair curved; intermediate tibiae feebly sinuate within.

Length 3 mm.

Hab. AMAZONS, Rio Jurua [lower] (*Trail*).

One example, labelled 12-14. xi. '74, received by the Museum in 1897. A small, narrow form, piceous in colour, with the anterior half of the head and the limbs testaceous; the head transverse, and broadly truncate behind; the elytra comparatively short, narrowed from the base, and not striate; the basal joint of the anterior tarsi (♂) greatly widened. The eyes are smaller and less coarsely faceted than in the much larger *M. crassimanus*, the elytra, too, are shorter and not subparallel as in that insect.

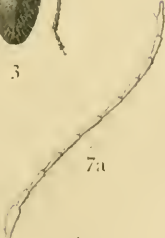
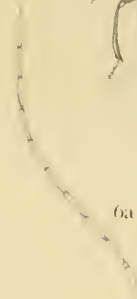
EXPLANATION OF PLATES LXIII, LXIV.

[See *Explanations facing the PLATES.*]

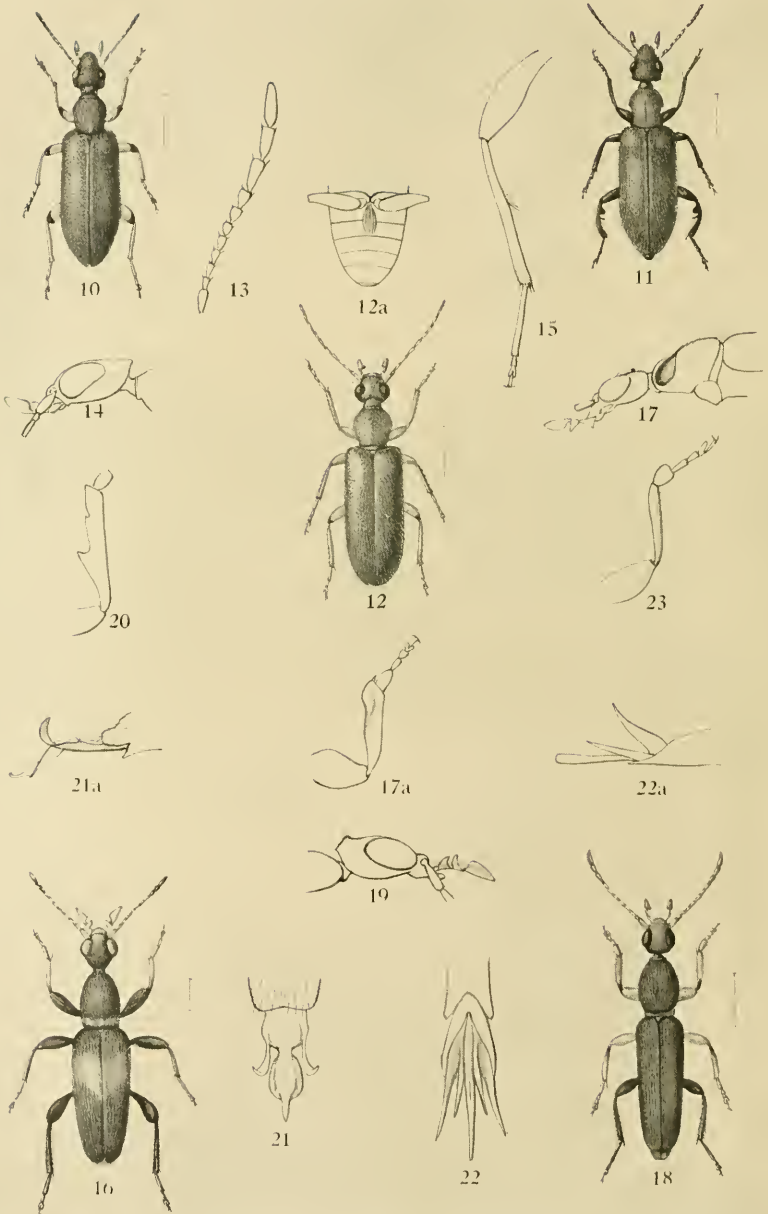


EXPLANATION OF PLATE LXIII.

- FIG. 1. ♂. *Egestriomina* (n. gen.) *albilincata*, Carter [Australia];
1a, genital armature, in profile.
- 2 ♂. *Ictistygna adusta*, Pasc., var. *rugosa*, Pic [N.S. Wales].
- 3 ♂, 4 ♀. *Ictistygna biformis*, n. sp. [N.S. Wales].
- 5 ♂. *Ictistygna tenuis*, n. sp. [W. Australia].
- 6 ♂. *Ictistygna* (n. gen.) *filicornis*, n. sp. [Brazil]; 6a, antenna.
- 7 ♂. *Diacallina* (n. gen.) *multiforis*, n. sp. [W. Africa]; 7a,
antenna.
- 8 ♂. *Diacalla comata*, Pasc. [Australia]; 8a, antenna.
- 9 ♂. *Egestria suturalis*, Pasc. [Australia].







EXPLANATION OF PLATE LXIV.

- FIG. 10 ♂. *Egestrina* (n. gen.) *sulcicollis*, Blackb. [Australia].
- 11 ♂. *Macratriomima* (n. gen.) *lobigera*, n. sp. [New Guinea].
- 12 ♂. *Eurygenius scoparius*, n. sp. [Nilgiri Hills]; 12*a*, abdomen.
- 13 ♂. *Macratrìa wallacei*, n. sp. [Waigiou], antenna.
- 14 ♂. „ *gestroi*, Pic [New Guinea], head, in profile.
- 15 ♂. „ *giloloana*, n. sp. [Gilolo], posterior leg.
- 16 ♂. „ *leucozona*, n. sp. [Borneo].
- 17 ♂. „ *pallipes*, Motsch. [Ceylon], prothorax, in profile; 17*a*, anterior leg.
- 18 ♂. „ *dilatocollis*, n. sp. [Perak].
- 19 ♂. „ *cirrata*, n. sp. [Perak], head, in profile.
- 20 ♂. „ *dentipes*, n. sp. [Macassar], anterior tibia.
- 21 ♂. „ *scabrida*, n. sp. [Rio de Janeiro], genital armature; 21*a*, ditto, in profile.
- 22 ♂. „ *fissiceps*, n. sp. [Colombia], genital armature; 22*a*, ditto, in profile.
- 23 ♂. „ *crassimanus*, n. sp. [Rio de Janeiro], anterior leg.

VIII. Gynandromorphous *Agriades coridon*, *Poda*; *A. coridon* *ab. roystonensis*, *Pickett*. By E. A. COCKAYNE, D.M., F.R.C.P., F.E.S.

[Read March 1st, 1916.]

PLATES LXV-LXXIII.

THREE forms of *Agriades coridon* occur, in which the blue scaling differs in amount on the corresponding wings on the two sides. In females, which have a good deal of blue on the hind-wings, it is not very unusual to find the blue spots larger on one side than on the other, or to find one or more diffuse patches or well-defined spots on one hind-wing unrepresented on the other. In the second of these forms one finds one or even more than one streak of brilliant blue scales. Such streaks are generally confined to one wing, and are seen more often on the fore-wing than on the hind-wing. The specimen figured is exceptional in having the fore-wing and the hind-wing on opposite sides affected in this way. Both these forms are referable to *ab. inaequalis*. Tutt, but they are probably due to different causes and for this reason deserve distinctive names. I propose to restrict the name *ab. inaequalis* to the second, or streaked form (Pl. LXXII, figs. 1 and 2), and to name the first or unequally spotted form *ab. impar* (nov. ab.), (Pl. LXXIII, figs. 1 and 2). The majority of specimens described as gynandromorphous in the lists of Oscar Schultz are examples of *ab. inaequalis* in this restricted sense, but it is doubtful if there is really a male element in them or in *ab. impar*. Though I have examined a number of well-marked specimens of both forms I have never seen androconia in either, except in a specimen which shows gynandromorphism on the right side and a blue spot without androconia on the left. This specimen affords strong evidence of the different nature of the asymmetry of blue scaling in *ab. impar* and *ab. roystonensis*.

In the third form, with very few exceptions there is inequality in the size of the wings, and the blue scales are accompanied by androconia and coarse hair scales. In my article on these specimens with asymmetry of size and

blue scaling, published in the "Entomologists' Record," 1914, I stated that they also fell under Tutt's ab. *inaequalis*. Mr. Pickett has written recently at some length to prove that this is not so, and has named the form ab. *roystonensis*, extending it to include specimens with inequality in the size of the corresponding wings, but without asymmetry of blue scaling. He says that Tutt had never seen a specimen of ab. *roystonensis*, but a reference to "British Butterflies," vol. iv, shows that this is not strictly accurate. On p. 6 of this work Tutt describes a specimen taken by Dr. Hodgson in 1888 near Brighton as a teratological example ($\theta\theta$), and refers both to the extra blue scales and to the smaller size of the blue-scaled wings. On p. 30, where he describes ab. *inaequalis*, he specially refers to it as an example of the aberration. Fortunately I have examined it microscopically, and have seen androconia and coarse hair scales on the smaller right fore-wing and androconia on the smaller hind-wing. Like the Royston specimens it is undoubtedly gynandromorphous.

In the "Entomologists' Record," 1914, I gave descriptions of six complete dissections of Royston gynandromorphs, and in the Journal of Genetics, 1915, I described a seventh. On this rather meagre material I ventured to make some generalisations, for which I hoped to obtain further support at a later date. This I have been enabled to do by fresh material obtained in 1915 by my own efforts and through the kindness of my friends.

In this paper I propose to discuss these peculiar gynandromorphs, including all specimens coming under Pickett's ab. *roystonensis*, with a complete account of my new dissections, dealing with them under the following headings.

1. *Geographical range.*
2. *Family and hereditary character.*
3. *Anatomy of internal and external genitalia.*
4. *Psychology.*
5. *External appearance.*
6. *Theoretical discussion.*

GEOGRAPHICAL RANGE.

The vast majority have been taken at Royston on the borders of Hertfordshire and Cambridgeshire, where they

occur year after year. They are very scarce, and, since they cannot be distinguished in flight from normal females, they may be overlooked very easily. I estimated roughly that one was present in every 2000 females, and Pickett says he took 66 amongst 60,000 females, or approximately one in 900.

Mr. P. M. Bright has a specimen taken at Tring in 1899. Mr. A. E. Gibbs made a preliminary investigation of the Tring and Dunstable chalk hills in 1915, and, although the weather was very unfavourable, two specimens were captured near Dunstable. I examined the Tring and Dunstable specimens, and found that they agreed with Royston examples in having the wings on one side smaller than those on the other and dusted with blue scales, coarse hair scales and androconia.

These specimens from such outlying localities in Hertfordshire and Bedfordshire suggest that wherever *coridon* occurs in these counties gynandromorphs of this kind will be found. The only specimen, of which I have certain knowledge, taken outside these counties is the one already mentioned in the Hodgson Collection at Cambridge, set on a gilt pin and labelled "Bevingdean, 7. 9. 1888." According to Tutt this is Bevendean near Brighton. The gynandromorphous specimen captured by Briggs on the Sheep Leas, Horsley, Surrey (*Entom.*, xx, p. 266), is stated by Tutt to be female on the left side and male on the right side, with the *wings slightly smaller on the male side*. This reduction in size of the wings on the male side makes it probable that this is an instance of the same phenomenon.

The great excess of females over males at Royston has led to the suggestion that there may be a connection between it and the prevalence of the preponderantly female gynandromorphs. Some evidence of this may be obtained by noting whether it occurs at Tring and Dunstable and elsewhere in Hertfordshire, and in the Brighton district.

FAMILY AND HEREDITARY CHARACTER.

We know that gynandromorphism of various kinds may be familial or hereditary. Though direct proof that it is familial is lacking in the case of the Royston gynandromorphs, there is circumstantial evidence in favour of its being so. They are so rare that one may search for a

whole day or more examining thousands of females and not find a single gynandromorph, and then one may find two or three close together in a very short time.

This fact has been noticed by Mr. Newman and Mr. Pickett, both of whom have collected very extensively at Royston, and by other Entomologists. My own experience strongly supports the view that several may occur in one family.

In 1914, one evening when *coridon* was beginning to settle down for the night, I found two on neighbouring plants of knapweed, and two others only a few yards away. All four were very perfect and probably had emerged quite recently.

Last year I had a still more striking experience. I went to the locality too early in the season and found that *coridon* was scarce and that few females had emerged. Mr. Newman told me that in three days he had not captured a single gynandromorph. Yet on July 25th, in one small, rather isolated piece of ground, where not more than fifty females were flying, I took five gynandromorphs, and a sixth specimen with the wings smaller on one side but without any blue sealing. All these had emerged quite recently, and none had ova descending the oviducts. Two other gynandromorphs were taken elsewhere on the downs. On July 28th I took a specimen with one side small and with two blue scales and a coarse hair scale on the small side on the same bit of ground, and on August 1st took four more gynandromorphs and another female with the wings unequal, but with only two blue scales on the small side, all on exactly the same spot. Prolonged search elsewhere only yielded two more. All the ones taken close together were very freshly emerged, and were probably members of a single family.

In describing the internal and external organs in this species I have continued to use the names adopted in my earliest papers. Dr. Chapman, however, has very kindly written to me and told me that he considers the organ I have named the *caput bursae* to be the entire *bursa copulatrix*, and that what I call the *bursa copulatrix* is nothing more than a specialised chitinous arrangement for extruding the long tubular prop or hypostema with its chitinous genital opening. He names this the rein or henia. His views are probably correct. But the subject is a difficult one, as it is uncertain what structures in

the Plebeid Blues are homologous with those found and named by Pierce and Burrows in the *Noctuidae* and *Geometridae*, and, indeed, whether the prop and rein have any homologues in these classes. Under these circumstances I must be content to leave my diagrams to show my meaning without in any way insisting on the correctness of my nomenclature.

ANATOMY OF INTERNAL AND EXTERNAL GENITALIA.

The following are descriptions of eighteen gynandromorphs, fourteen examined in a fresh condition, four after preservation in spirit, all taken at Royston in 1915. For the four specimens in spirit I am indebted to Mr. H. B. Williams. There are also descriptions of four specimens with inequality of size, but without androconia on the small side. Three had one or two blue scales on the small side, the fourth had none and is, I believe, unique. The specimen described by Pickett as having no blue scales has at least one.

No. 1. Fore-wings, right 16 mm. in expanse, left 15 mm. Discal spots ringed with white on both sides, ab. *albicincta*, Tutt. Many blue scales on right fore- and hind-wings, numerous androconia and coarse hair scales. Ovaries and cement glands equal and normal. Spermatheca present. *Caput bursae* (*bursa copulatrix*, Chapman) and *ductus seminis absent*. Rein and prop present. External genitalia symmetrical and like those of normal female.

No. 2. Fore-wings, right 13.75 mm., left 14 mm. Blue scales with numerous androconia and coarse hair scales on left fore-wing. Underside ab. *parisiensis*, Gerh., on both sides. Ovaries and cement glands equal in size and normal. *Bursa copulatrix*, *caput bursae*, *ductus seminis* and *spermatheca* normal. *Caput* contained much dark-coloured material. External genitalia symmetrical and like those of normal female.

No. 3. Fore-wings, right 16.25 mm., left 15.75 mm. Underside almost symmetrical. Discal spots on upperside ringed with white, pale blue wedges internal to lunules on both hind-wings. Many blue scales and androconia on left fore- and hind-wings, coarse hair scales on left fore-wing. Ovaries symmetrical. *Caput bursae* of abnormal shape (Fig. 4). *Ductus seminis* represented by a blind remnant leading from common oviduct. *Cement gland on left side small, on right side almost entirely aborted* (Fig. 5). *Spermatheca* normal. *Caput bursae* empty. External genitalia symmetrical and like those of normal female.

No. 4. Fore-wings, right 15 mm., left 16 mm. Underside colour and spotting symmetrical. Blue scales with numerous androconia and coarse hair scales near apex and along posterior margin of right fore-wing. Blunting of apex. Only two or three blue scales on right hind-wing. Ovaries and cement glands symmetrical. Other organs present and normal. Caput bursae contained much dark material. External genitalia symmetrical and like those of normal female.

No. 5. Fore-wings, right 14.5 mm., left 16 mm. Blue scaling diffuse but slight on both wings on right side. Androconia numerous. Underside alike on both sides. Ovaries and cement glands symmetrical. Other organs normal. Caput contained a little granular material. External genitalia symmetrical and like those of normal female.

No. 6. Fore-wings, right 17 mm., left 15.5 mm. Underside colour and spotting symmetrical. Blue scales, coarse hair scales and androconia numerous along posterior border of left fore-wing, diffuse blue scaling on left hind-wing. Ovaries normal and symmetrical. *Cement glands* symmetrical but *small*. Bursa, caput and ductus seminis normal, *spermatheca nodular* (Fig. 6).

No. 7. Fore-wings, right and left 13 mm., hind-wings, right 11 mm., left 10 mm. No blue scales on fore-wings, dense patch of blue scales with androconia near anal angle of left hind-wing, and reduction of lunules. Slight asymmetry of spotting on underside. Ovaries small but symmetrical; cement glands normal and symmetrical. Bursa, caput, ductus seminis and spermatheca normal. Caput empty. External genitalia symmetrical and like those of normal female (Pl. LXVII, fig. 2).

No. 8. Fore-wings, right 16.5 mm., left 15 mm. H.B.W. Diffuse but thin blue scaling over wings on left side. Numerous coarse hair scales and androconia. Lunules small on left hind-wing. Upperside colour and underside colour and spotting alike on both sides. Ovaries and cement glands normal and symmetrical. Other organs present and normal. *Caput bursae* empty and *abnormal in shape* (Fig. 2). External genitalia symmetrical and like those of normal female.

No. 9. Fore-wings, right 16 mm., left 17 mm. H.B.W. Extensive diffuse blue scaling with numerous androconia on both wings on right, coarse hair scales numerous on right fore-wing. General facies the same on both sides. Ovaries and cement glands normal and equal. *Caput bursae and ductus seminis absent*. Rein and prop present. Other organs present and normal. External genitalia symmetrical and those of normal female.

No. 10. H B W. Wings smaller on right but too little difference

to measure accurately. Small patch of blue scales with many androconia near apex of right fore-wing, numerous blue scales and androconia on right hind-wing with smaller lunules. General faecies alike on the two sides. Ovaries and cement glands normal and symmetrical. Bursa, caput and ductus seminis normal. Caput empty. *Spermatheca branched* (Fig. 7). External genitalia symmetrical and like those of normal female.

No. 11. Fore-wings, right 16 mm., left 17 mm. H.B.W. General faecies alike on both sides. Blue scales most numerous near posterior margins of fore- and hind-wings on right. Androconia numerous. Lunules on right hind-wing reduced. Ovaries and cement glands normal and symmetrical. Other organs present and normal. Caput empty. External genitalia symmetrical and like those of normal female.

No. 12. Fore-wings, right 15.5 mm., left 16 mm. Costa o right fore-wing curved. General faecies alike on both sides, discal spots ringed with white, ab. *albicincta*, Tutt. Diffuse blue sealing of both wings on right. Lunules reduced. Androconia and coarse hair scales few in number. Ovaries and cement glands large and symmetrical. Other organs present and normal. Caput empty. External genitalia symmetrical and like those of normal female.

No. 13. Fore-wings, right 15 mm., left 16 mm. General faecies alike on both sides. Blue scales diffuse but not numerous on both wings on right. Androconia numerous even amongst purely brown scales. Ovaries and cement glands normal and symmetrical. Other organs present and normal. Caput bursae full of dark material. External genitalia symmetrical and like those of normal female.

No. 14. Fore-wings, right 16 mm., left 15 mm. Blue scales, coarse hair scales, and androconia numerous on the left fore-wing, local patch of blue scales without androconia on the left hind-wing. No reduction in size of lunules. General faecies alike on both sides, underside near ab. *parisiensis* on both sides. Ovaries and cement glands normal and symmetrical. Other organs present and normal. Caput empty. External genitalia symmetrical and like those of normal female.

No. 15. Fore-wings, right 13 mm., left 13.5 mm. Right fore-wing: numerous blue scales, coarse hair scales and androconia diffused over surface. Right hind-wing has only about 33 blue scales with one androconial scale. General faecies the same on both sides. Ovaries and cement glands symmetrical and normal. Other organs present and normal. Caput empty. External genitalia symmetrical and like those of normal female.

No. 16. Fore-wings, right 16.4 mm., left 15.5 mm. Stripe of

densely packed blue scales, coarse hair scales and androconia on left fore-wing. No blue scales on left hind-wing. Ovaries and cement glands symmetrical and normal. Other organs present and normal. Caput empty. External genitalia symmetrical and like those of normal female (Pl. LXV, fig. 1).

No. 17. Fore-wings, right 16.5 mm., left 17.5 mm. Facies alike on both sides, very dark colour. Very small patch of blue scales, coarse hair scales and androconia along posterior border of right fore-wing. The patch is only just visible to the naked eye. No blue scales on right hind-wing, but obvious reduction in total area and in size of lunules. Ovaries and cement glands symmetrical and normal. Other organs present and normal. Caput contains granular material. External genitalia symmetrical and like those of normal female (Pl. LXVIII, fig. 2).

No. 18. Fore-wings, right 16.25 mm., left 14 mm. Left hind-wing smaller than right. Upperside facies the same on both sides. Underside, right typical, left ab. *parisiensis*. Left antenna shorter than right. Left fore-wing has one blue scale near apex and a blue scale and coarse blue hair scale near posterior border. No androconia seen. Ovaries and cement glands symmetrical and normal. Other organs present and normal. Caput empty. External genitalia symmetrical and normal (Pl. LXXI, fig. 2).

No. 19. Both wings smaller on the left side, right fore-wing 17 mm., left 16 mm. General facies alike on both sides. One blue scale external to discal spot on small fore-wing. Lunules slightly reduced on small hind-wing. Internal and external genitalia like those of normal female.

No. 20. Both wings smaller on the right. Internal and external genitalia like those of normal female.

No. 21. Fore-wings, right 17.25 mm., left 16.5 mm. Very dark specimen. Marked reduction of size of lunules on the small left hind-wing. Careful microscopic search revealed no blue scales and no androconia. Ovaries and cement glands equal in size and large. Other organs present and normal. Caput contained granular material. External genitalia symmetrical and like those of normal female (Pl. LXIX, fig. 2).

In addition to above complete dissections partial examinations were made of sixteen gynandromorphs, taken in August and September 1915 at Royston by Mr. L. W. Newman, and set and dried by him in the usual way. They were treated with potash, and though minor abnormalities may have been overlooked an almost perfect dissection was carried out on some of them. In seven,



FIG. 1.—Normal bursa copulatrix (bursa with prop and rein of Chapman).

FIG. 2.—Bursa with abnormally shaped caput (dissection No. 8).

FIG. 3.—Bursa with abnormal caput and ductus seminis aborted (dissection No. 3).

FIG. 4.—Bursa with caput and ductus seminis absent (dissection No. 1).

FIG. 5.—Rudimentary cement glands and blind ductus bursae (dissection No. 3).

FIG. 6.—Small but symmetrical cement glands and nodular spermatheca (dissection No. 6).

FIG. 7.—Branched spermatheca (dissection No. 10).

FIG. 8.—Normal 9th and 10th abdominal segments.

FIG. 9.—Tenth abdominal segment showing each half of the ovipositor widely spread instead of parallel.

a. Caput bursae (bursa copulatrix: Chapman).

b. Prop or hypostema (Chapman).

c. Bursa copulatrix (rein or henia: Chapman).

d. ductus seminis (ductus bursae).

e. Cement gland.

f. Spermatheca or receptaculum seminis.

g. Ovipositor with rods (10th abdominal segment).

h. 9th abdominal segment with rods.

all the internal organs were recognised and appeared to be like those of normal females. In many others the cement glands were recognised and the ovaries, though the ova were swollen up and destroyed. In all sixteen the *bursa copulatrix* with its *caput bursae* was present. In twelve the caput was noticed to be empty, but in two some dark-coloured material was present. The external genitalia were examined in all sixteen. In none was any asymmetry discovered, and in none was any male structure present. In one specimen the two halves of the ovipositor were widely spread instead of lying parallel to one another. This defect was noticed when the insect was captured, and must have been due to an injury occurring shortly after emergence, while the chitin was still soft, or to an error of development (Fig. 9).

I have dissected completely twenty-five undoubted gynandromorphs, for in specimen No. 2 ("Ent. Rec.," xxvi. p. 221) I found androconia in a later search, and can summarise the results as follows. The ovaries were normal and symmetrical in twenty-four, in one they were symmetrical but each ovary had only three follicles instead of four. Departures from the normal number of four follicles in each testis and ovary are rare, except in primary somatic or genetic hermaphrodites. Doncaster has observed six in each ovary in an otherwise normal female *Abrazas grossulariata*. Reduction in the size of the cement glands was noticed twice, and partial abortion of one of the glands in two other cases. Maldevelopment of the spermatheca was also met with. The most noteworthy errors of development occurred in connection with the *bursa copulatrix*, its caput and the *ductus seminis*. It was possible to examine these structures in forty-one gynandromorphs.

Normally the *ductus seminis* arises from the bursa at the same point as the *caput bursae*, or, according to Chapman's nomenclature, at the very commencement of the tubular bursa. In two specimens the *caput bursae* (or, according to Chapman, the entire bursa) and the *ductus seminis* were absent; in a third, the caput (or entire bursa) was absent and the ductus represented by a blind rudiment entering the common oviduct; and in a fourth, though the caput was present the *ductus seminis* was entirely absent. In all these the prop and rein of Chapman were present and normal in appearance. Probably the

abnormalities found in the other specimens would not have interfered with the production of fertile ova, but in these four they must have led to complete sterility. In three specimens, though the caput was present it was abnormal in formation (see figures).

In the thirty-nine specimens, where the point was noted, a variable amount of granular material was seen in the *caput bursae* in twelve, and in some it had become very dark coloured and conspicuous. In twenty-seven the caput was entirely transparent and empty. Of the specimens described in the "Ent. Record," xxvi, p. 221, granular material was present in numbers 4 and 6 and absent in 1, 2 and 3, and it was also absent in the one described in the Journal of Genetics, 1915. In twenty normal females taken as controls, including three *ab. semisyngnatha*, this granular material was noticed in eighteen, it was absent in two. Unfortunately the material was not examined in a fresh condition. Prolonged boiling in potash did not make it transparent. After boiling, the caput in several instances was opened and the dark débris was tested but failed to give either Millon's or the biuret reaction for proteids, a failure which is not surprising in view of the treatment to which it had been subjected. The material is probably altered semen, and could only be present in females after fertilisation. If this view is correct, its presence in so few gynandromorphs shows that a much smaller proportion of these had been fertilised than of normal females.

PSYCHOLOGY.

Of the psychology of these gynandromorphs I have little information to offer. Their rarity and the enormous numerical preponderance of females over males at Royston makes it very difficult to take any observations.

I have never seen a gynandromorph being courted by a male, nor found one paired. Mr. Newman, with a wider experience, has never seen one courted or paired. Mr. Pickett says he has paid special attention to this point, and in no year has he seen one paired or being courted by a male. There seems to be no physical reason why this should not take place, and only in a very small proportion does there appear to be any anatomical obstruction to fertilisation or oviposition. If my suggestion

about the condition of the bursa be a correct one fertilisation does occur in some of these gynandromorphs, though less often than in the case of normal females.

Since I wrote this I have asked Mr. Bethune-Baker and Dr. Chapman for their opinions. The latter wrote: "As to the dark contents of the bursa I am ignorant, but have supposed it to represent some change (decomposition?) in contents *after* pairing." Mr. Bethune-Baker has noticed its presence, and thinks it is found only after fertilisation.*

EXTERNAL APPEARANCE.

The vast majority of the Royston gynandromorphs show the reduction in wing area accompanied by the presence of blue scales, coarse blue hair scales and androconia on one side only; I have seen more than two hundred of these myself. In most specimens the fore-wing appears to be more affected than the hind-wing, but the reverse may be the case. Occasionally only the fore-wing or only the hind-wing may have the abnormal scales, and the other wing on the same side may show a reduction in size or may appear to be exactly like the one on the opposite side (Pl. LXVII, fig. 2). In some, coarse hair scales are rare and in others androconia. In some the lunules show no reduction in size.

The situation of the blue scales is variable, but they are usually most dense on the part furthest from the thorax and distal to the central spot, or along the posterior border in the fore-wing, and in the hind-wing also they are most abundant in situations distal to the central spot. These are just the situations where blue scaling is not found in the blue females, or where it becomes least abundant.

* In order to throw light on the nature of the brown material in the bursa copulatrix, I dissected in August 1916 three females of *A. coridon* taken in cop., three virgin females and two gynandromorphs in very fresh condition. Two of fertilised females had the bursa quite full of brown material, which under the microscope appeared amorphous and granular and was mixed with large numbers of living spermatozoa, the third had very little brown material but spermatozoa were abundant. In the virgin females and gynandromorphs there was no granular brown material and no spermatozoa were present. This makes it almost certain that the brown material is only present after fertilisation, and it is probably the secretion of the glandulae accessoriae of the male. The bursal contents of *Ornithoptera hclena* gave marked Millon and biuret reactions. The two gynandromorphs, ab. *roystonensis*, showed normal and symmetrical internal and external genital organs.

Blue scaling may be extremely marked as in my specimens (Journal of Genetics, Pl. xxi, fig. 6, and Pl. xxii, fig. 7), or very scanty as in a specimen in Mr. T. W. Hall's collection, which has about fifty blue scales with a few androconia near the apex of the small fore-wing. I have another specimen showing reduction in size of the wings on the right side, especially of the hind-wing. It has only four blue scales and no androconia on the fore-wing, but there are a few additional blue scales on the hind-wing with one or two coarse hair scales and some androconia (Pl. LXVIII, fig. 1).

Another with only a small patch of blue scales, coarse hair scales and androconia is No. 17, and here there is reduction in size of the hind-wing with no abnormal scales (Pl. LXVIII, fig. 2). From these the transition is only a slight one to specimens such as Pickett's (Journal of Genetics, Pl. xxii, figs. 11 and 12) and to the specimens No. 18 and 19. These have the reduced size, but no androconia. Only one or two blue scales are present, but they lie in those areas where blue scaling is commonest in gynandromorphs and only present in the bluest normal females. They are, however, rather dark specimens with but few basal blue scales. In No. 18, too, there is a single blue hair scale. Mr. Pickett possesses a specimen of ab. *semi-syngrapha* with no androconia and no coarse hair scales, but with marked difference in size on the two sides. No. 21 is quite remarkable; it shows no sign of faulty expansion, and yet there is marked difference in the size of the wings on the two sides, and with it a marked reduction in the size of the lunules (Pl. LXIX, fig. 2).

I think that these very unusual specimens are really of the same nature as the others, but the evidence of their gynandromorphism is masked. The reduction in size is a remarkable feature. In *A. coridon* the male is considerably larger than the female, and in the six or seven halved or nearly halved gynandromorphs recorded, the male side has been larger than the female. Yet in the predominantly female gynandromorphs of Royston the side showing male characters is smaller and, as a rule, the more marked the male characters are the greater is the reduction. Local areas which show many blue scales show parallel reduction in size, and so lead to deformity of wing, such as blunting of the apex, curving of the costa or indentation of the margin of the wing.

In addition to the specimens showing male characters and reduced size on one side only, there are a few examples known which show them on both sides. Some are figured here, others in the *Journal of Genetics*. All the forms known so far can be classified in the following way:—

I. *Unilateral or halved Gynandromorphism.*

(a) Both wings reduced, blue scales, coarse blue hair scales and androconia present. It is not very unusual to find no hair scales and no androconia on the hind-wing.

(b) Fore-wing or hind-wing alone showing the abnormal scales; the other wing usually reduced, but sometimes normal in size.

(c) Both wings reduced, androconia absent. Only one or two blue scales present, and either none or one or two coarse hair scales.

(d) Wings reduced; no abnormal scales present.

II. *Bilateral Gynandromorphism.*

(a) All four wings affected, but generally unequally (*Journal of Genetics*, Pl. xxii, figs. 8 and 9). Another specimen similar to fig. 8 is in Mr. P. M. Bright's collection.

(b) Three wings affected (Pl. LXVI, fig. 1). This is in Mr. Pickett's collection taken at Royston 1915, and in addition to blue scales it has coarse blue hair scales on both fore-wings. Androconia are numerous on the left hind-wing, uncommon on the right fore-wing and very scanty on the right hind-wing.

(c) Two wings affected (Pl. LXVI, fig. 2). Taken by Mr. Leeds at Royston, 1915. Blue scales not very numerous. Only one or two coarse hair scales, and only one androconial scale seen on each fore-wing. No inequality in size.

(d) Reduction of size on one side; blue scales, coarse hair scales and androconia on the other (*Journal of Genetics*, Pl. xxii, fig. 10).

III. *Crossed Gynandromorphism.*

Specimen taken by Mr. Pickett at Royston, 1915. Reduction in size with presence of a number of blue scales, coarse hair scales and androconia of left fore-wing. Reduction of size with presence of numerous blue scales and androconia of right hind-wing (Pl. LXVII, fig. 1).

A very important point to consider is the condition of the general somatic characters on the two sides of the body in these blues. Examination of a great number of specimens has convinced me that they are almost invariably the same.

Females of *coridon* vary in colour on the upperside from pale brown to almost black. Some have the spot ringed with white ab. *albicincta*, Tutt, others have whitish spots internal to the lunules, and the amount of blue at the base of the wings is very variable. However marked any of these characters may be in a gynandromorph they are present on both sides alike. The ground-colour of the underside also is variable, but as in normal specimens so in gynandromorphs it is the same on both sides. I have one a peculiar silvery white on both sides, and another of a most unusual chocolate brown colour on both the gynandromorphous and the normal sides.

Spotting often shows slight asymmetry in normal females, and slight asymmetry is still commoner in gynandromorphs, owing to the difference in size and shape of the wings on the two sides; but here again the pattern is approximately symmetrical.

I have three specimens ab. *parisiensis*, Gerh., on both sides, one with basal spots obsolete, ground-colour pale grey and a strong brown line near the margin on both sides, and another is a well-marked example of ab. *crassipuncta*, Court., on both sides. Two specimens figured show great asymmetry, but the difference in size is so marked that it can probably be put down to this cause and not to a real difference of somatic constitution on the two sides. The only specimen I have seen in which the difference is such as to make me suspect a true segregation of somatic characters, heterochroism, is figured in the Journal of Genetics (Pl. xxii, fig. 12). There is great difference in size, which makes one suspect that it is a gynandromorph, though I know one instance of simple heterochroism where the asymmetry of size is equally great. The presence of a blue scale on the small side still further suggests a segregation of secondary sexual characters.

The most striking proof of the identity of somatic constitution on the two sides is afforded by the specimens of ab. *semisygrapha*, Tutt, which show gynandromorphism. My own specimen is figured (Journal of Genetics,

Pl. xxii, fig. 14*a*). A second was captured by Mr. H. B. Williams at Royston, in 1915, and has androconia on both wings on the right side (Pl. LXX, fig. 2), and a third, taken by Mr. F. W. J. Jackson at the same time and place, also has androconia on the small misshapen side (Pl. LXX, fig. 1).

THEORETICAL DISCUSSION.

A good deal of evidence has accumulated to prove that sex and secondary sexual characters are Mendelian unit characters, and that although closely linked they are probably separable. There is even some evidence to show that the secondary sexual characters themselves may be separable into more than one unit character. It is thought that the character for sex is carried by a special chromosome sometimes recognisable microscopically, and that secondary sexual characters are probably carried by the same chromosome. It is probable that ordinary gynandromorphs are produced by unequal chromosome divisions at the first cleavage of the normally fertilised ovum, and that in this unequal division both the units for sex and for secondary sexual characters participate. Hence such individuals are likely to be true genetic hermaphrodites, having the gonad, external genitalia and secondary sexual characters peculiar to one sex on the one side, and those peculiar to the other on the other side.

In the Royston gynandromorphs the condition found is quite different from this. In the considerable number examined the gonads, internal and external genitalia have always proved to be female. The dissimilarity on the two sides is confined to certain secondary sexual characters, male scent scales or androconia, coarse blue hair scales and blue scales of ordinary shape, all of which together may perhaps be a single Mendelian character. The irregular division, which I suppose to be the cause of this, must be confined to that part of the chromosome bearing this character. The factor for sex in the chromosome must be unaffected because both gonads are female and are invariably equal in size on the two sides. There is some evidence that the unit for the accessory internal genitalia and for the external genitalia is independent of that for the gonads and it must also be unaffected; for, although the internal organs are occasionally imperfectly

formed, they are always wholly female and almost always symmetrical. In the two specimens in which one cement gland was smaller than the other, in one it was smaller on the gynandromorphous and in the other and more marked example it was smaller on the normal purely female side.

It is difficult to explain why reduction in size takes place on the side showing male characters in an insect in which the male is considerably larger than the female. Large size may be a unit character independent of that responsible for the peculiar scales of the male; but, even if this be so, it remains obscure why the parts which show a mixture of secondary sexual characters should show an actual deficiency of growth. All the other parts on the gynandromorphous side, such as the antennae, legs, abdominal rings and external genitalia, show a normal growth. It is evident, however, that defective growth of the wings is almost a constant feature of the Royston gynandromorphs, and on the whole is most marked where the male element is most manifest. The most notable exception is the specimen (Pl. LXXIII, fig. 5) in the possession of Mr. P. M. Bright. In this the male element, judged by the abundance of blue scales, is stronger than in any other specimen of this kind which I have seen. There are, however, very few androconia; large areas being entirely destitute of them. The wings are equal on the two sides and so it does not fall under *ab. roystonensis*, though obviously it ought to do so. It is interesting to compare this specimen with the next bluest specimen I have seen, in which androconia and coarse hair scales are very abundant on the fore-wing, which is correspondingly small (Pl. LXXIII, fig. 4).

Halved or nearly halved gynandromorphs of *A. coridon* (genetic and primary somatic hermaphrodites) are extremely rare, and only about half a dozen have been recorded. One from Dover, perfectly halved, is figured in Barrett's "British Lepidoptera," vol. i, Pl. xii, fig. 1e. Another was taken by Mr. Quarrington in the Reigate district on July 31st, 1911, and has not been recorded previously (Pl. LXXIII, fig. 3). The external genitalia are partly male and partly female. In a specimen taken at Purley by Mr. Kirkman, the abdomen and three wings are apparently male, and one fore-wing and half the thorax are female (Ent., xxv, p. 2, Pl. i, fig. 3). In these and similar

specimens the male wings are considerably larger than the female, contrasting strongly in this respect with the secondary somatic hermaphrodites, which form the subject of this paper.

The fact that the somatic characters are almost invariably the same on both sides in these gynandromorphs from Royston is important, because it disproves the view that either fertilisation of an ovum by two spermatozoa or fertilisation of one half of a prematurely divided ovum gives rise to the condition of gynandromorphism; though both suggestions have been advanced at one time or another to explain ordinary halved gynandromorphism. An irregular division of chromosomes at the first cleavage of the fertilised ovum may account for the halved examples of gynandromorphous *coridon*, but will not account for bilateral or crossed forms. In these far rarer specimens an irregular division probably took place earlier, perhaps at the second maturation division before the fertilisation of the ovum. In all cases there is probably some antecedent abnormality of the chromosome.

In the majority of lepidopterous insects the female is a heterozygous dominant for sex, the male a homozygous recessive, and *A. coridon* is probably no exception. The occurrence of aberrations peculiar to the female, such as abs. *tithonus*, Meig. (*syngrapha*, Kef.), and *semisyngrapha*, Tutt, supports this hypothesis. In the simpler cases of this kind the spermatozoa always have sex chromosomes of one kind, but the ova are of two kinds: one with a large sex chromosome, which on fertilisation produces a female, the other with a small sex chromosome, which produces a male. If we suppose that some part of the large sex chromosome is lost either before or after fertilisation, femaleness may be incompletely dominant. A somewhat similar condition may exist in the case of the chromosomes bearing the secondary sexual characters, and loss of part of the dominant chromosome (that for female secondary sexual characters) may cause an imperfect dominance of female over male secondary sexual characters. If the dominance becomes much reduced, the male element may become visible in the form of numerous blue scales and androconia. If the margin is narrow, it may only be visible in the form of a few blue scales and androconia; or, where there is almost a perfect balance between the male and female elements, only one or two

blue scales may show the mixed characters, or only the curious deficiency of growth which the mixing seems almost uniformly to produce. And since the deficiency of growth is greatest where the female element predominates least strongly, it is possible that when the balance is very even the chromosomal abnormality may be present without any external evidence whatever. Such an individual might appear to be a normal female *coridon*.

That a gynandromorphous constitution may be masked in this way is suggested by some of the families of *Lymantria dispar* \times *L. dispar* var. *japonica* bred by Goldschmidt. In several of these families the percentages of males, females and gynandromorphs was such that he was driven to the view that some of the specimens which appeared externally to be males were really gynandromorphs.

We are thus met by the paradox, that in *Lymantria* and *Agriades* gynandromorphs exist with the external marks of their gynandromorphism entirely masked.

I venture to hope that by putting forward these very speculative suggestions I shall stimulate some more competent than myself to undertake the work necessary in order to prove or disprove them. Field observations may fill in some of the gaps in our knowledge, but breeding experiments and cytological investigations are needed to solve the fascinating problem presented by the Royston gynandromorphs.

In conclusion, I offer my thanks to many Entomologists for helping me, and to Messrs. Jackson, Leeds, Pickett and H. B. Williams for permission to photograph and figure their specimens.

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EXPLANATION OF PLATES LXV-LXXIII.

PLATE LXV.

- FIG. 1. Gynandromorph resembling ab. *inaequalis*. Wings on left side reduced in size. Numerous androconia and coarse hair scales on blue striped areas of left fore-wing.
- FIG. 2. Gynandromorph showing reduction in size of wings on right side, numerous blue scales, coarse hair scales and androconia, and curving of costa of fore-wing.

PLATE LXVI.

- FIG. 1. Bilateral gynandromorphism. Blue scales and androconia on right fore-wing, right hind-wing and left hind-wing (Pickett coll.).
- FIG. 2. Bilateral gynandromorphism. Blue scales and an androconial scale on each fore-wing (Leeds coll.).

PLATE LXVII.

- FIG. 1. Crossed gynandromorphism. Blue scales and androconia with reduction in size in left fore-wing and right hind-wing (Pickett coll.).
- FIG. 2. Fore-wings equal and normal. Left hind-wing with reduction in size, blue scales and androconia (Dissection No. 7).

PLATE LXVIII.

- FIG. 1. Gynandromorph with reduction in size of both wings on right side. Four additional blue scales and no androconia on right fore-wing, and a few additional blue scales, two coarse hair scales and a few androconia present on right hind-wing.
- FIG. 2. Gynandromorph with reduction in size of both wings on right side. A few blue scales, coarse hair scales and androconia near posterior border of right fore-wing, but none present on hind-wing (Dissection No. 17).

PLATE LXIX.

- FIG. 1. *A. coridon* ab. *semisyngrapha*. Wings on right side reduced in size. Costa of right fore-wing curved. A few additional blue scales but no androconia and no coarse hair scales on right side.
- FIG. 2. Wings on left side reduced in size and with smaller lunules. No blue scales and no androconia present (Dissection No. 21).



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GYNANDROMORPHISM IN AGRIADES CORIDON.



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GYNANDROMORPHISM IN *AGRIADES CORIDON*.



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AGRIADES CORIDON, ABERRATIONS.



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PLATE LXX.

GYNANDROMORPHS ILLUSTRATING IDENTITY OF SOMATIC CHARACTERS ON THE TWO SIDES.

- FIG. 1. *A. coridon* ab. *semisyngrapha* with reduction in size of wings, curving of costa, additional blue scales, coarse hair scales and androconia on left side (F. W. J. Jackson).
- FIG. 2. *A. coridon* ab. *semisyngrapha* with reduction in size of wings, additional blue scales and androconia on right side (H. B. Williams).

PLATE LXXI.

- FIG. 1. Wings on right side reduced in size. A few additional blue scales but no androconia on upper side, asymmetry in pattern on underside.
- FIG. 2. Wings on left side reduced in size. Two blue scales, one coarse hair scale, no androconia on upper side, asymmetry in pattern on underside (Dissection No. 18).

PLATE LXXII.

- FIG. 1. *A. coridon* showing combination of abs. *semisyngrapha* and *inaequalis*, Tutt. No reduction in size of wings, no coarse hair scales and no androconia present (F. W. J. Jackson).
- FIG. 2. *A. coridon* ab. *inaequalis*, Tutt. Right fore-wing and left hind-wing streaked with blue scales but without androconia, coarse hair scales or reduction in size.

PLATE LXXIII.

- FIGS. 1 and 2. *A. coridon* ab. *impar*.
- FIG. 3. *A. coridon*, gynandromorph. Wings on right side almost completely male and larger than those on left. External genitalia on right side showing male characters.
- FIG. 4. *A. coridon*, gynandromorph (ab. *roystonensis*, Pickett). Reduced size of wings on right side. Numerous blue scales, androconia and coarse hair scales on right fore-wing with curving of costa. A few blue scales on right hind-wing.
- FIG. 5. *A. coridon*, gynandromorph. Wings equal in size on the two sides. A few androconia on right side, no coarse hair scales (P. M. Bright). From a drawing.

IX. *New Chrysidids from Egypt and Algeria.* By the Rev.
F. D. MORICE, M.A., F.E.S.

[Read May 3rd, 1916.]

***Parnopes nilotica*, n. sp.**

Parva (long. circ. 5-6 mm.); capite et thorace viridibus et sparsim subauratis, postscutelli appendice brevissima thoracisque angulis postico-lateralibus concoloribus, tegulis alarum albidis; abdomine metallescenti-roseo vel carneo, segmentis—vel omnibus (♂! an semper?) vel solum tertio—apicem versus plus minusve virescentibus: segmenti 3tii parte apicali pallidior (flavida), lateribus transversim ita impressis ut in medio quasi carinam relinquunt, quae tamen carina in disco segmenti non continuatur; margine ipso scarioso et acutissime inaequaliter multispinuloso: antennis, mandibulis (apicibus harum nigris exceptis), ore, pedibus, et ventre flavido-testaceis, genibus vero et parte tibiaram albidis.

Cavitas facialis albo-pilosa, longitudine sua latior, lateribus (i.e. oculorum orbitis interioribus) fere parallelis. Clypei apex in medio excisus. Pronoti anguli antici in formam spinularum obliquarum excurrentes. Tegulae alarum (ut in hoc genere fieri solet) maximae, punctatae. Postscutelli apex vix mucronatus, sed tuberculo concolore parum conspicuo munitus. Caput thorax que crasse rugoso-vel reticulato-punctata; abdomen inaequaliter subtilius punctatum. Segmenti tertii partes impressae breviter albo-pubescentes: mesopleurae vero glabrae.

1 ♂, 2 ♀♀, taken by Dr. Longstaff at Khartum, 8-10. ii. 1909, and presented by him to the Hope Coll. in Oxford.

I treat this species as new on the authority of M. Robert du Buysson, who has kindly examined it for me and called my attention to several characters distinguishing it from *vareillesi*, Buyss., an Algerian form which superficially much resembles it.

In *vareillesi* the eyes are much larger, occupying more of the head, so that the face between them is narrower. They are also much wider above than beneath, while in *nilotica* they are regularly oval. Partly, no doubt, for this reason, the tempora in *nilotica* appear dilated behind the

centre of the eyes (in the lateral view). The postscutellar appendage is evidently much longer in *vareillesi*, and is also *white* (as are likewise the posterior toothlike angles of the thorax), this difference of colour from the metallic areas round it rendering it exceedingly conspicuous. In *nilotica* both the angles of the thorax and the merely tuberculate apex of the scutellum are concolorous with the parts adjacent to them (green). It is also slightly smaller than *vareillesi*; the mesopleuræ are not pubescent as in that species; and the dorsulum is more largely and uniformly punctured.

It cannot be confounded with *P. schmiedeknechti*, Mocs. (from Egypt and Palestine), that species having *inter alia* the thorax above, including the tegulæ, concolorous with the abdomen, and very abnormal characters in the mouth parts, which do not exist in *nilotica*.

I am, however, not altogether certain that it may not prove to be a form of *P. elegans*, Klug, described (on a single ♀) from Ambukohl, Nubia, and apparently not since rediscovered. The figure in *Symb. Phys.* suspiciously resembles it. But the last segment in *elegans* is described as "*laete viridi-aureo*," which could hardly be said of any of Dr. Longstaff's specimens. And it should perhaps be noted that *elegans* was taken in July, but *nilotica* early in February.

Chrysis modestior, n. sp.

Statura minima (long. 3-4½ mm.); segmenti abdominalis 3tii serie anteapicali foveolarum circ-12 rotundarum mediocriter distincta, apice ipso integro, edentato, subtruncato angulis lateralibus rotundatis; postscutello convexo; oculis haud magnis, breviter ac late ovalibus; genis longis, convergentibus; cavitate faciali transversa, superne haud distincte marginata (sc. carina frontali nulla), in ♂ argenteo-pilosa, in ♀ glabra, basi sulco brevi lineari longitudinaliter impressa, in medio subtiliter oblique striolata, lateribus dense rugoso-punctulatis.

Corpus superne rosco-violascenti-metallicum, punctis haud profundis sed latis reticulato-scabrum, propterea que parum nitens; infra cyaneum. Cyanea sunt etiam cavitatis facialis pars media, tegulæ alarum, propodei apex atque latera (area vero huius basali subvirescenti-igneæ). Genæ virides. Mesopleuræ subauratæ, sterna vero omnia cyanea. Segmenti abd. 3tii limbus apicalis cyaneus. Venter obscure cyanescentis, maculis 2 basalibus segmenti 2di violascentibus. Pedes viridi-cyanei vel cyanei, tarsi vero brunnei.

Pronoti anguli haud spiniformes, fere recti. Antennarum articulus 3tius duobus sequentibus simul sumptis fere aequalis. Alae hyalinae nervis fuscis, cellulae radialis apice clauso.

2 ♂♂, 2 ♀♀, Hamman-bou-hadjar, Algeria (Province of Oran): 21. iv. 1910.

An exceedingly small and (to the naked eye) rather duskily coloured species. I found it settling on stones at the foot of a sort of cliff where the pretty little Masarid wasp *Quartinia major*, Kohl, was abundant, and suspect that it may be parasitical on that species.

Chrysis sefrensis, Buys. ♂.

This species was described by Vicomte R. du Buysson in the *Revue d'Entomologie*, August 1900, from a single ♀ taken by M. Abeille de Perrin at Ain-Sefra in Algeria (Province of Oran). I believe that it has not been since recorded, and that the ♂ is still unknown.

I was so fortunate as to meet with both sexes at a much more northern locality in the same province, viz. at Hamman-bou-hadjar, in April 1910. M. du Buysson has kindly compared the ♀ with his original type and satisfied himself of their identity, and it is at his request that I here record the hitherto unpublished ♂.

It is exceedingly like the ♀, so that a complete description of it would be superfluous. But the genae are slightly less developed, evidently shorter than the scape of the antennae, their exterior outlines (frontal view) not quite so parallel, though the convergence is exceedingly slight, and their inferior angles not so sharply prominent. In colour its only difference from the ♀, so far as I can see, is a slightly greater prevalence of the red (or coppery) tints over the green with which they are blended, especially in the head. Thus the vertex, almost the whole face, and the second joint of the antennae, are thoroughly cupreous in the ♂, while in the ♀ all these parts are more or less virescent. The third antennal joint appears to me to be altogether non-metallic, while in the ♀ it is green above like the second. As usual in the Genus, the ♂ 3rd abdominal segment is shorter and more truncate at the apex than in the ♀, and, perhaps for this reason, the four "teeth" appear shorter in proportion to their breadth; especially the exterior pair are evidently far more obtuse than in the ♀, and lie

wholly on the apical margin of the segment (not, as in the ♀, forming a portion of its lateral margin also!).

The ♂ was taken on April 27, the ♀ on April 24; both, probably, in a waste and stony patch of ground abounding in *Ferula*, but of this I am not absolutely certain, nor can I say whether they occurred on the plants or on the stones. (Most of my captures in that place, however, were on the latter, for the *Ferula* had mostly gone to seed, and ceased to be attractive to *Hymenoptera*.)

Chrysis scintillula, n. sp. ♂.

Parva (long. in ♂ circ. 5 mm.); lacte viridis; tegulis alarum, suturis juxta latera propodei, pedum anteriorum tibiis, abdominisque limbo apicali quadridentato aureo-rutilantibus; etiam vertice, mesonoto cum scutello, abdominisque regionibus quibusdam dorsalibus, plus minusve (secundum lucis incidentias varias) inter viride et rutilum versicoloribus; tarsis pedum omnium antennarumque albo-pruinosa flagellis brunnescentibus, scapis harum cum articulo tertio (quarto dimidio longiore) viridi-metallescentibus, articulo vero secundo (brevis) aureo-rutilo.

Oculi prominuli, latitudine sua paullo longiores. Genae longae, scapis antennarum subaequales, valde convergentes. Facies superne lata, carina tenui sed distincta (quae tamen ad oculos non attingit) ab ocellis separata; in medio sulco nitido longitudinali divisa; lateribus dense subtiliter punctatis; argenteo-pilosa.

Pronotum transversum, antice in medio impressum haud profunde; angulis lateralibus subacutis (non autem spiniformibus). Postscutellum simplex, fere planum.

Segmenti abdominalis tertii latera (desuper visa) fortiter a basi usque ad apicem fere recte convergentia; series anteapicalis foveolarum (in exemplari hoc octo) satis profunde impressa; dentes apicales quattuor, forma triangulari, magnitudine inter se non multum differentes, exteriores vero plus minusve introrsum deflexi proptereaque dentibus interioribus porrectis etiamque suberectis aliquanto minus conspicui.

Corporis dorsum punctis magnis crassisque—in vertice et pronoto quasi reticulatis, alibi magis inaequaliter sed fere ubique dense congregatis—, scabrum: exceptis limbo bene definito postico scutelli singulariter (an semper?) prorsus laevigato, et segmenti abdominalis 3tii apice (post foveolas) punctis magnis nullis sed tantum minutissime vix visibiliter punctulato.

(Alas, in exemplari unico casu aliquo laceratas et pertusas, describere non tento!)

1 ♂ taken by myself on *Ammi visnaga*, just outside the village of Sidi Okba, near Biskra, in Algeria (Province of Constantine): 16. vi. 1911.

The size and general appearance of this insect give it a superficial likeness to *Chrysogona assimilis*, Dhlb. (? *pumila* Klug). But the long genae at once separate it from that species; and though in my specimen the upper wings are sadly torn, and one is wanting altogether, enough remains of the other to show that its neuration is not that of a *Chrysogona* but of a *Chrysis*.

X. *Butterflies of Southern Kordofan, collected by Captain R. S. Wilson, Lancashire Regiment.* By G. B. LONGSTAFF, M.A., M.D., F.L.S.

[Read May 3rd, 1916.]

WITH MAP.

A VALUABLE addition has been made recently to the Hope Collection at Oxford in the shape of a number of butterflies from the Nuba Hills in Southern Kordofan, presented by Mr. C. A. Willis, late an Inspector in the Civil Service of the Anglo-Egyptian Sûdân, but now Assistant Director of Intelligence at Khartûm.

The butterflies were collected by Captain R. S. Wilson, of the Lancashire Regiment, more than ten years ago, in November and December 1904, but owing to various circumstances they were not examined until recently.

The collection comprises 223 specimens belonging to 62 species of butterflies, and one moth, all from the hilly country lying between El Obeid on the north and Lake Nô on the south, and between Darfur on the west and the White Nile on the east, and is especially interesting since little or nothing has been published concerning the butterfly fauna of that remote part of the world.

To speak more precisely, the area to be dealt with lies between Lat. $12^{\circ} 40'$ N. and Lat. $10^{\circ} 40'$ N.—a distance of about 120 miles, and between Long. $29^{\circ} 40'$ E. and $30^{\circ} 31'$ E.—about 90 miles.

Although none of Captain Wilson's collecting ground is nearer to the White Nile than 90 miles, it all lies within the basin of that river, and it was for that reason that I was asked by some of my Oxford friends to write a memoir setting forth the geographical relationship between the insects in Captain White's collection and those previously dealt with by me in a paper entitled "The Butterflies of the White Nile: A study in Geographical Distribution." *

Naturally, my first desire was to get into communication with the collector, but war conditions made this impos-

* Trans. Ent. Soc. Lond., 1913, pp. 11-56.

sible. However, Mr. Willis has been most kind in giving me all the information at his disposal, and I have pleasure in quoting at some length from his quite admirable letters in reply to my numerous queries.

“The season would be after the rains, when the country is still green and water lying out in places.” Among Mr. Willis’s kind acts was putting me in possession of the official guide-book, entitled “Kordofan and the Region to the West of the White Nile; Compiled in the Intelligence Department, Sûdân Government, Khartûm,” Dec. 1912.

From this book, which is not to be obtained through the usual channels, I learned that : The end of the rainy season, when the crops are ripened but still uncut, is in October or November; in the south the first rain-storms may be expected as early as the beginning of March (p. 14). This confirms Mr. Willis’ statement, but seasons, even in the tropics, vary, and in considering statements as to “dry-season” or “wet-season forms,” it must not be forgotten that “wet” individuals may, and often do, survive some way into the dry season.

Again, we have this statement : “The places mentioned are probably about 400 ft. higher than the White Nile, but there is very little to go on.” Khartûm is said to be 1200 ft. above the sea; Kâkâ is 404 miles higher up the river than Khartûm, and is in about the same latitude as Talodi, the headquarters of the Nuba Mountains Province. Now the guide-book (p. 69) states that Talodi is 2000 ft. above sea-level; from this we may deduce that the White Nile falls 400 ft. between Kâkâ and Khartûm. That is all that I have been able to find out; the two statements seem fairly concordant.

“Kadugli and Dilling are villages situated in the plain in the vicinity of hills, with a ‘khor’ or rain-fed stream, only running as a rule for a few hours at a time, close by.

“Sungikai is on a biggish khor, lying somewhat north of the hills, running through what we call ‘forest’ here, which means a rolling country covered with trees about the size of an apple-tree, grass, etc., which dries up in winter, and turns green again as soon as the rainfall about the end of May.

“Tira Mandi and Tatcho are both hills—rough granite blocks with practically no vegetation on them except where the black Nubawi terraces the land, which he does

fairly extensively, and gets a considerable crop of red millet. He also grows a little tobacco. . . . These khors sometimes fill with water and remain full for a long time, and even if they do not, water can generally be obtained by digging in the bed of them.

“The country is alternate ‘cotton-soil’ (black stuff which cotton does not grow in, but in appearance like the cotton-soil of Egypt) and a reddish soil which is probably the same black soil mixed with sand, etc.”

The official guide-book cited above states that the cotton-soil plains contain too high a percentage of clay to be easily worked and are usually covered with forest, but that the slopes of the Dar Nuba hills, the banks of the khors, etc., are eminently suitable for cultivation, with a rich soil capable of bearing good crops of *dura* and vegetables (p. 25).

Again, to quote Mr. Willis’ letter: “The hills stand straight up out of the plain, rising abruptly; sometimes there is a considerable extent of plateau high up where soil can be cultivated, but the appearance of the hills is extraordinarily rocky, though trees grow upon them.”

This description of the hills vividly recalls to my mind what I saw at Gebel Ên, and more particularly at Rejâf. The mountains there suggest Nasmyth’s description of the mountains of the moon, which he compared to pellets of clay thrown by boys so as to stick upon a wall or fence. The official guide shows that these abrupt hills may be anything from 500 ft. to, in exceptional cases, nearly 2000 ft. above the plain, *i. e.* 4000 ft. above the sea.

Mr. Willis goes on to make the sound suggestion: “It is most probable that the butterflies were captured close to water. It is extraordinary to see them collect on any little damp patch of ground which lies in the shade, and there are always quantities by the watering-places, when the ground is clear of grass and the water has been spilled into troughs or the like for watering animals.”

I have myself taken butterflies under like circumstances by the watering-places of baggage mules at Malakand (N.W. frontier of India), but I suspect that the staling of the animals has something to do with it.

“Each side of a khor is heavily wooded and covered with thick vegetation, the depth, of course, varying, and it is in that little belt that all the beasts or butterflies lie at some period of the day.”

It should be noted that the specimens bear particulars as to the localities and exact dates of capture; but at present I have no information as to the circumstances under which they were taken, or the plants with which they were associated.

The first thing that struck me on looking at the collection was that it bore internal evidence of being a fair sample of the fauna,* inasmuch as, among others, such a comparatively obscure insect as *Pinacopteryx venata* was represented by a series of nine specimens, as compared with four *Danaïda chrysippus*, one *Teracolus protomedia* and one *Terias brigitta*. On the other hand, that the collector had not confined his attentions to the more sluggish insects was proved by the presence of six *Eronia leda*.

The collection had been previously critically examined by my friends, Dr. F. A. Dixey—*Pierinae*, Dr. H. Eltringham—*Nymphalidae*, and Mr. G. T. Bethune-Baker—*Lycaenidae* and *Hesperidae*, who all very kindly placed their notes at my disposal.

In order to make the comparison of the two papers as easy as possible, I have dealt with the insects in the same order as in the paper referred to. Each species has a serial number, the same in the two papers; where a species occurs in this paper not dealt with in the first, letters are added to the last numeral, *7a*, *7b*, etc., the interpolated species being put in what seemed to be suitable places.

The very numerous quotations from these three authorities, as well as those from Mr. Willis's letters are within inverted commas. The old plate of the map in the earlier paper has been used again with a few additions.

Family NYMPHALIDAE.

Sub-family DANAINAE.

1. *Danaida chrysippus*, Linn.

a. Curiously enough, the typical form is not represented in the collection.

β. Form *alcippus*, Cram.

One ♂ from Jebel Tira Mandi, Nov. 25, 1904.

“The hind-wing upperside nearly all white, with the

* At least so far as the butterflies to be met with in November and December 1904.

usual exception of the black border inwardly tinged with yellow" (Eltringham).

γ. Form *dorippus*, Klug.

One ♂ and one ♀ from J. Tira Mandi, Nov. 25, 1904.

δ. Form *albinus*, Lanz.

One ♂, Kadugli, Dec. 13, 1904.

"The white covers a large area of the hind-wings. There is the usual trace of the ancestral white bar in the subapical region of the fore-wings" (Eltringham).

2. *Tirumala petiverana*, Dbl. and Hew.

One ♀, Khor Nucila [Lat. 11° 21' N.], May 26, 1906.

The locality is at least 2° further north than that given in the White Nile list.

Sub-family SATYRINAE.

3a. *Mycalesis milyas*, Hew.

Two ♀♀ of the dry-season form, Tira Mandi, Nov. 23, 1904.

Not in the White Nile list. Dr. Eltringham notes that the British Museum specimens are from Atbara (Abyssinia). Aurivillius [Seitz, "Gross-Schmetterlinge der Erde"] gives White Nile, and says it spreads to the Congo and Togo.

Sub-family NYMPHALINAE.

[4. It is remarkable that *Pyrameis cardui*, Linn. is not included in the collection.]

5. *Precis oenone cebrene*, Trimen.

One ♂, two ♀♀, Kadugli [Lat. 11° 0' N.], Dec. 13, 1904.

6. *Precis clelia*, Cram.

One ♂, Tira Mandi [Lat. 10° 52' N.], Nov. 25, 1904.

This is more than 1° further north than in the White Nile list.

"This species has recently suffered from the attention of the German entomologist Strand, who has given nine new names to trifling aberrations" (Eltringham).

7. *Precis orithyia madagascariensis*, Guen.

Three ♂♂ and two ♀♀, Dilling, Nov. 16, 1904; three ♂♂, Tira Mandi, Nov. 23, 25, 26, 1904; one ♂, Kadugli, Dec. 13, 1904.

Of this species Dr. Eltringham says: "The typical *orithyia* was first described from China, the sub-species *madagascariensis* (= *boopis*, Trimen) being the form inhabiting the African continent and Madagascar. The sub-species *here*, Lang, is found in Arabia, and is smaller, and without the red marks in fore-wing cell."

Dilling is nearly $2\frac{1}{2}^{\circ}$ north of the Bahr al-Zarâfa, the previous White Nile record.

7a. *Precis octavia*, f. *sesamus*, Trimen.

One ♀, Jebel Shwai, Nov. 21, 1904; one ♂, Kadugli, Dec. 13, 1904, and one ♀ from the same locality, Jan. 18, 1905.

"The dry-season form of *P. octavia*; one ♀ may be regarded as tending slightly to an intermediate in that it shows rather more red, especially in the fore-wing cell" (Eltringham). Prof. Poulton tells me that this specimen much resembles the Abyssinian form, which is nearer to the western sub-species than to the southern form, which is found in British East Africa.

Although occurring in Abyssinia and Somaliland and widely distributed throughout South Africa, it is not in the White Nile list.

7b. *Catacroptera cloanthe cloanthe*, Cram.

One ♂, Khororak, Nov. 29, 1904; one ♂, one ♀, Kadugli, Dec. 13, 1904.

"One ♂ specimen tends towards the dry-season form named *obscurior* by Staudinger, in which the underside is darker" (Eltringham).

This species is not in the White Nile list, but has been found in Abyssinia and is widely distributed in Africa south of the Equator.

9. *Hamanumida daedalus*, Fabr.

One ♂ and one ♀, Dilling [Lat. $12^{\circ} 3' N.$], Nov. 16, 1904; one ♀, Jebel Shwai [Lat. $10^{\circ} 11' N.$], Nov. 21, 1904.

“The ♂ tends towards the form *meleagris*, Cram., being somewhat paler underneath” (Eltringham).

At least $2\frac{1}{2}^{\circ}$ north of previous records.

10. *Neptis agatha*, Cram.

Five ♂♂ at Khororak [Lat. $10^{\circ} 48' N.$], Nov. 29, 1904.

In my White Nile list, after mentioning that a *neptis* had been seen by me at Kirô [Lat. $5^{\circ} 22' N.$], I remark: “This species has been taken at Shoa, in Abyssinia [circa Lat. $10^{\circ} N.$].—perhaps the northern limit of the genus in East Africa.”

11. *Byblia ilithyia ilithyia*, Drury.

One ♂, “of the wet-season form” (Eltringham), Kadugli, Dec. 23, 1904.

12. *Byblia acheloia acheloia*, Wall. (= *goetzius*, Herbst.).

One ♂, “of the dry-season form” (Eltringham), J. Tatcho [Lat. $10^{\circ} 48' N.$], Nov. 28, 1904, *i. e.* at least 1° further north than in my White Nile list.

Sub-family ACRAEINAE.

14. *Acraea acerata acerata*, Hew.

“One ♂, more or less intermediate to the form *vinidia*, Hew.” (Eltringham).

Tira Mandi, Nov. 25, 1904.

15. *Acraea terpsichore*, Linn.

Four ♂♂ and one ♀, all taken at Tira Mandi, Nov. 25, 1904. This is $5^{\circ} 40'$ north of the locality in the White Nile list.

“One ♂ is of the form *rougeti*, Guér., and the ♀ example resembles the ♂♂ more closely than is usual in this species” (Eltringham).

17. *Acraea encedon*, Linn.

“Ten ♂ examples, no two of which are exactly alike. Two nearest the typical form have the ground colour dull and somewhat darkly suffused. One resembles these, but has the fore-wing subapical white dusted with tawny.

The next two are intermediate between this and the *daira* form. The sixth is a nearly typical *daira*, Godm. and Salv., the seventh is of the form *lycia*, Wall., with some tawny suffusion, and the remainder are *lycia* of varying degrees of whiteness" (Eltringham).

All taken at Tira Mandi, Nov. 23, 25, 1904.

This series shows how much the species may vary in the same place and at the same time.

17a. *Acraea neobule*, Doubl.

One ♀, "unusually small" (Eltringham).

Taken at Kadugli, Dec. 29, 1904.

Not in the White Nile list. It occurs in Somaliland, Abyssinia and Socotra, and has a wide African distribution.

17b. *Acraea caecilia caecilia*, Fabr.

Two ♂♂ and two ♀♀, Kadugli, Dec. 17, 21, 23, 29, 1904.

All the specimens "have the characteristics of the western rather than the eastern form. Abyssinian examples may be of the western form or intermediate to *puđera*, Auriv., the eastern sub-species in which the apical black is narrow and sharply defined" (Eltringham).

A widely distributed species recorded from Nubia (Ambukôl), Abyssinia and Somaliland among other places, but not in the White Nile list.

[17c. *Acraea marnois*, Rogen.]

This is regarded by Aurivillius as a variety of *oncaea*, Hopff., but Dr. Eltringham ("African species of *Acraea*," pp. 184, 185) considers it more nearly allied to *caldarena* and *caecilia*. As the type (at Vienna) came from the Bahr el-Zarâfa it should be added to the White Nile list.]

17d. *Acraea doubledayi sykesi*, Sharpe.

A ♂, Kadugli [Lat. 11° 0' N.], Dec. 17, 1904.

Not in the White Nile list. Dr. Eltringham says of it: "A single ♂ example of this rare species in exceptionally fine condition. This is the most northern record for the sub-species." The sub-species *A. doubledayi arabica*, Eltring., occurs in the Azvaki Ravine, S. Arabia.

Family LYCAENIDAE

I have to thank Mr. Bethune-Baker for determining the butterflies in this family.

19. *Polyommatus baeticus*, Linn.

One ♂, Dilling, Nov. 16, 1904.

20. *Lachnocnema bibulus*, Fabr.

One ♂, two ♀♀, Jebel Shwai, Nov. 21, 1904; two ♀♀, Tira Mandi, Nov. 23, 25, 1904.

The latter place is $2\frac{1}{2}^{\circ}$ further south than any locality for the species given in the White Nile list.

21. *Tarucus theophrastus*, Fabr.

Two ♂♂, Jebel Shwai, Nov. 21, 1904; one ♀, Dilling, Nov. 14, 1904; one ♀ Tira Mandi, Nov. 25, 1904.

22. *Tarucus telicanus*, Lang.

One ♀, Khor Nubbaka, Nov. 12, 1904.

24a. *Castalius lactinatus*, Butl.

One, Tira Mandi, Nov. 23, 1904; one, Kadugli, Nov. 29, 1904.

Not in the White Nile list. For *C. cretosus*, Butl., of which Aurivillius considers this to be a variety, he gives Senegal and Abyssinia as localities, as well as the White Nile; for *C. lactinatus* he gives Somaliland only.

26. *Catochrysops malathana*, Boisd.

Four ♂♂, and two ♀♀, Tira Mandi, Nov. 23, 25, 1904; two ♂♂, Kadugli, Dec. 13, 17, 1904.

28. *Chilades trochilus*, Frey.

One, Jebal Shwai, Nov. 21, 1904.

30a. *Lycaenesthes crawshayi*, Butl., var. *minuta*, B.-B.
var. nov.

A ♂, Dilling, Nov. 16, 1904; a ♀, Tira Mandi, Nov. 23, 1904.

Mr. Bethune-Baker has described this as a new variety of Butler's Nyassaland species.* It is but two-thirds of the size of specimens from Sierra Leone and Uganda, though Mr. Bethune-Baker has specimens intermediate in size from the Budonga Forest, in the Congo [$4^{\circ} 30' S.$, $20^{\circ} E.$].

31. *Azanus sigillatus*, Butl. [?= *jesous*, Guér.].

One ♂, Tira Mandi [Lat. $10^{\circ} 52' N.$], Nov. 23, 1904.
This is $5\frac{1}{2}^{\circ}$ further north than in the White Nile list.

31a. *Azanus mirza*, Ploetz.

A ♂, Tira Mandi, Nov. 23, 1904.
Not in the White Nile list. The species has a wide distribution in Central and South Africa.

34. *Virachola antalus*, Hopff.

Two ♂♂, three ♀♀, all from Kadugli, Dec. 16, 17, 19, 1904.

This locality is $2\frac{1}{2}^{\circ}$ further south than that given in the White Nile list.

34a. *Rapala licinia*, Mab.

One ♂, one ♀, Kadugli, Dec. 17, 23, 1904.
Not in the White Nile list. A South African species extending to Madagascar.

35a. *Axiocerces harpax*, Fabr.

Two ♂♂, eight ♀♀, Kadugli, Dec. 14, 16, 17, 29, 1904.
Not in the White Nile list. This is a South African species, recorded by Aurivillius from Waddelai, Lat. $3^{\circ} N.$ Kadugli is in Lat. $11^{\circ} N.$

35b. *Spindasis kaduglii*, B.-B. sp. nov.

A ♂, Kadugli, Dec. 29, 1904.
Described by Mr. Bethune-Baker, who says that it is near to *S. victoriae*, Butl.†

* See Ann. and Mag. Nat. Hist., 1916, p. 379.

† Ann. and Mag. Nat. Hist., 1916, p. 379.

35c. *Argiolaus ismenias*, Klug.

Two, Sungikai, Nov. 13, 1904; two, Kadugli, Dec. 16, 1904.

Not in the White Nile list. A fine but delicate species; the type came from Ambukôl, 6° to the north.

Mr. H. H. Druce has 6 ♂♂ and 1 ♀ from Lagos, of all places; they were captured by Mr. C. A. (later Sir Alfred) Moloney, then governor of the Colony. Mr. Druce writes me that he has since seen others from the same locality (Ann. and Mag. Nat. Hist. 1891, p. 148).

Prof. Poulton says that there are many resemblances between the fauna of Abyssinia and that of the West Coast.

35d. *Stugeta marmoreus*, Butl.

Two at Kadugli, Jan. 18, 1905.

Until lately represented solely by Petherick's type from "the White Nile," in the British Museum, but Mr. Bethune-Baker tells me that he has specimens from the Bahr el-Ghazâl to the south. See White Nile list, p. 55 footnote.

Family PAPILIONIDAE.

Sub-family PIERINAE.

Dr. Dixey has examined the butterflies of his favourite sub-family with the thoroughness characteristic of him, and has kindly placed his MS. notes at my disposal. All the determinations are his and the copious extracts from his notes are given in inverted commas.

"The Pierinae captured by Captain Wilson number twenty-one species. Of these all but two occur in the records brought together by Dr. G. B. Longstaff in his paper 'On the Butterflies of the White Nile.' The two not there recorded are *Glutophrissa epaphia*, Cram., and *Teracolus celimene*, Lucas. [See notes to these species, 39a, 51a.] . . . Of the nineteen species common to the two lists, fifteen were previously known to occur in latitudes corresponding to those explored by Capt. Wilson. . . . Eight of the fifteen occur also in Southern Arabia, and several of them have been recorded from the Nile Valley north of Khartûm. The four species included in Dr. Longstaff's list, but not previously known from localities

so far north as Capt. Wilson's, are *Pinacropteryx venata*, *Teracolus achine*, *Eronia leda* and *Terias brigitta*. [See notes to these species under the serial numbers 40, 55, 63 and 67.] . . . It will be gathered that the predominant forms of Pierines in Capt. Wilson's collection are those characteristic of Arabia and North-east Africa. The chief exceptions to the general 'desert' aspect of the Pierine fauna are afforded by *Eronia leda* and *Glutophrissa epaphia*.

"The dry-season characters are strongly marked throughout the series, the chief exceptions occurring in two species of the genus *Teracolus* (*T. eupompe* and *T. evagore*). Of the former species, one specimen is 'wet' and six are 'dry.' Of the latter, two are 'wet' and four 'dry.'"

36. *Herpaenia eriphia*, Godt.

Two ♂♂, Kadugli, Dec. 14, 23, 1904.

"Both of the 'dry' northern form, = *lacteipennis*, Butl."

37. *Belenois gidica*, Godt.

A ♂, Tira Mandi, Nov. 25, 1904; a ♂, Tatcho, Nov. 28, 1904; three ♂♂, Kadugli, Dec. 13, 21, 1904.

"Dry season."

38. *Belenois severina*, Cram.

Four ♂♂, Kadugli, Dec. 27, 1904; one ♀, Sungikai, Nov. 13, 1904.

The latter locality is 1° 20' north of the furthest range given in the White Nile list.

Dr. Dixey writes: "These are of what is usually considered the wet-season phase. The seasonal colouring resembles that shown by Mr. Marshall's Mashonaland specimens captured in March, and his bred Mashonaland specimens emerging in June after exposure to damp heat as both larvae and pupae. Two of the males are conspicuously marked on the underside with orange-yellow."

39. *Belenois mesentina*, Cram.

A ♂ from Khor Nubbaka, Nov. 12, 1904; two ♂♂, Kadugli, Dec. 23, 27, 1904.

39a. *Glutophrissa epaphia*, Cram.

Two ♀♀, Khororak, Nov. 29, 1904.

Not in the White Nile list. Dr. Dixey says: "This species, so far as I am aware, has not hitherto been met with in East Africa further north than Wadelai (about Lat. 2° N.), though Aurivillius gives 'ganz Afrika' as its habitat."

40. *Pinacopteryx venata*, Butl.

Two ♀♀, Sungikai [Lat. 12° 36' N.], Nov. 13, 1904; one ♂, one ♀, Dilling, Nov. 14, 1904; one ♂, Tira Mandi, Nov. 23, 1904; one ♂, two ♀♀, Tatcho, Nov. 28, 1904; one ♂, Kadugli, Dec. 27, 1904.

Dr. Dixey says: "These differ in some respects from Dr. Longstaff's White Nile series, being generally 'drier.' Two at least of the females are hardly distinguishable (if at all) from dry-season females of *P. simana*, Hopff., and raise doubts as to whether Godart's *doxo*, the locality of which is unknown, may not after all be a female similar to these; in which case *doxo* would have priority as the name of the species."

Dr. Dixey's remarks in "The Butterflies of the White Nile," p. 31, should be compared with this later judgment.

Sungikai is upwards of 3° further north than any locality given for the species in that paper, and its occurrence there was, as Dr. Dixey says, somewhat unexpected.

47. *Teracolus amelia*, Lucas.

A ♂, Tatcho, Nov. 28, 1904; two ♂♂, Tatcho, Dec. 17, 21, 1904.

"Dry: the male taken in November is transitional towards the *catachrysops*, Butl., form of *T. vesta*, Reiche."

48. *Teracolus protomedia*, Klug.

Of this conspicuous species, which I found commonly on the White Nile, a single ♂ was taken at Dilling, Nov. 14, 1904.

49. *Teracolus halimede*, Klug.

Two ♂♂, one ♀, Kadugli, Dec. 14, 23, 1904.

Of these Dr. Dixey says: "Dry; like Dr. Longstaff's and Mr. Loat's from the White Nile."

51. *Teracolus eris*, Klug.

One ♂, Tira Mandi, Nov. 25, 1904; one ♂, two ♀♀, Kadugli, Dec. 14, 17, 21, 1904.

About 2° further south than my specimen captured in 1912. Dr. Dixey says: "Dry. The ♀♀ are 'drier' than any others in the Hope Collection, one of them very remarkably so. This specimen (Dec. 17) is also reduced in size."

51a. *Teracolus celimene*, Lucas.

One ♀, Khor Nubbaka [Lat. 12° 36' N.], Nov. 12, 1904; a ♂, Tira Mandi [Lat. 10° 52' N.], and another ♂, Kadugli [Lat. 11° 0' N.], Dec. 14, 1904.

This conspicuous and distinct species is not in my White Nile list; Dr. Dixey says of it: "Has occurred in Abyssinia, and is found as far south as Swaziland and the Transvaal."

53. *Teracolus phlegyas*, Butl.

A ♂, Tatcho, Nov. 28, 1904; a ♂ and a ♀, Khororak, Nov. 29, 1904; three ♂♂, Kadugli, Dec. 17, 21, 1904.

"Dry-season phase. The ♂♂ resemble one caught by Mr. W. S. L. Loat twelve miles north of Kâkâ, White Nile. (See *Trans. Ent. Soc. London*, 1903, p. 146.)"

54. *Teracolus eupompe*, Klug.

Three ♀♀, Sungikai, Nov. 13, 1904; one ♀, Dilling, Nov. 14, 1904; two ♂♂ and one ♀, Kadugli, Dec. 17, 21, 29, 1904.

"One ♀ is 'wet,' the others and the ♂♂ are 'dry.' All the specimens are small; one ♂ and one ♀ are dwarfs. The wet-season ♀ and the dwarf dry-season ♀ were taken on the same day, Nov. 13. [It may be added that both are alike in poor condition.—G. B. L.] They resemble White Nile specimens captured in February by Dr. Longstaff, but are generally somewhat smaller and 'drier' than Mr. Loat's specimens taken in January and March slightly further south."

55. *Teracolus achine*, Cram.

One ♀, Tira Mandi [Lat. 10° 52' N.], Nov. 23, 1904.

"Dry-season. Resembles Dr. Longstaff's from the

White Nile, but is 'drier' than his series from Port Sûdân (Red Sea)." Tira Mandi is $1^{\circ} 22'$ north of any White Nile locality for this species, but 8° south of Suâkin, $8\frac{1}{2}^{\circ}$ south of Port Sûdân.

57. *Teracolus दौरا*, Klug.

One ♀, Sungikai, Nov. 13, 1904; one ♂, four ♀♀, Kadugli, Dec. 14, 17, 21, 29, 1904.

"'Dry.' Resemble Dr. Longstaff's and Mr. Loat's from the White Nile; also Dr. Longstaff's from Khartûm."

58. *Teracolus evagore*, Klug.

Two ♂♂, Dilling, Nov. 14, 1904; one ♂, one ♀, Tira Mandi, Nov. 23, 25, 1904; two ♀♀, Kadugli, Dec. 29, 1904.

Dr. Dixey writes: "Two of the ♂♂ (Nov. 14) are wet-season; the remaining ♀ (Nov. 23) and the three ♀♀ are of the dry-season phase (*saxeus*, Swinhoe). The dry-season specimens resemble Dr. Longstaff's and Mr. Loat's White Nile series; the wet-season ♂♂ are like examples from further south and from Somaliland."

61. *Teracolus evarne*, Klug.

One ♂, Khororak, Nov. 29, 1904; one ♂, two ♀♀, Kadugli, Dec. 21, 1904.

"All dry-season. They resemble Dr. Longstaff's specimens from the White Nile (February 1912), but are generally smaller and 'drier' than the same collector's specimens from the west shore of the Red Sea (March 1912)."

62. *Eronia cleodora*, Hübn.

One ♀, Dilling, Nov. 14, 1904; five ♂♂, one ♀, Kadugli, Dec. 17, 21, 1904.

"These are of the North-east African form, and resemble Dr. Longstaff's and Mr. Loat's specimens."

63. *Eronia leda*, Boisd.

One ♀, Khor Nubbaka, Nov. 12, 1904; three ♂♂, Sungikai, Nov. 13, 1904; one ♂, Dilling, Nov. 14, 1904; one ♂, Tira Mandi, Nov. 23, 1904.

These places range from $2^{\circ} 40'$ to $4^{\circ} 20'$ north of the White

Nile records. Dr. Dixey notes that the ♀ is unusually pale; he also quotes my conjecture that "It would appear that this conspicuous insect does not get further down the White Nile than the Sadd."

65. *Catopsilia florella*, Fabr.

One ♂, one ♀, Sungikai, Nov. 13, 1904; two ♂♂, one ♀, Kadugli, Dec. 14, 16, 1904.

"Somewhat small. Resemble specimens from Khartûm captured in January and February 1912."

67. *Terias brigitta*, Cram.

One ♀, Sungikai, Nov. 13, 1904 [Lat. 12° 21' N.].

On this species Dr. Dixey's note is: "Dry-season. Dr. Longstaff remarks (in his paper on the Butterflies of the White Nile, p. 48), 'It might appear allowable to conjecture that *brigitta* does not extend far north of Lake Nô, but the fact that specimens of . . . *T. senegalensis* . . . turned up no less than three degrees north of that place makes one cautious.' Capt. Wilson's specimen was caught in the Nuba Hills nearly 3° north of Lake Nô."

Sub-family *PAPILIONINAE*.

70. *Papilio pylades pylades*, Fabr.

Two, Jebel Shwai, Nov. 21, 1904; eight, Tira Mandi, Dec. 23, 25, 26.

"The western form" (Eltringham).

70a. *Papilio antheus nyassae*, Butl.

Three, Serraf Fellata [Lat. 11° 54' N.], May 28, 1906.

"The East African form" (Eltringham).

Not in the White Nile list. The species has a wide Central African distribution.

Family *HESPERIIDAE*.

Mr. Bethune-Baker kindly determined these for me.

71a. *Sarangesa plistonius*, Ploetz.

One, Dilling, Nov. 15, 1906; four, Tira Mandi, Nov. 23, 25, 26, 1904.

Not in the White Nile list.

71b. *Sarangesa pertusa*, Mab.

Three, Kadugli, Dec. 23, 1904.
Not in the White Nile list.

71c. *Caprona adelica*, Karsch, var. *Kordofani*, B.-B.
var. nov.

One, Tira Mandi, Nov. 25, 1904.

Mr. Bethune-Baker says that this is the dry-country form, whereas *C. cassualalla*, B.-B., is the more variegated western form of the same insect found at Angola.*

I have taken *C. adelica* at Sydenham, Natal. It is not in the White Nile list.

72a. *Gegenes obumbrata*, Trimen.

One ♂ of the typical form, Tira Mandi, Nov. 25, 1904.
Not in the White Nile list.

72b. *Hesperia mafa*, Trimen.

One, Sungikai, Nov. 13, 1904; two, Kadugli, Dec. 13, 29, 1904.

Not in the White Nile list. This is a South African species.

How does the butterfly fauna of the Nuba Hills compare with the fauna of the White Nile hitherto known to us?

To begin with, material is sadly deficient for such a comparison, as is so often the case. For example, my White Nile list is founded for the most part on captures made in the month of February, whereas Capt. Wilson's insects were taken in November and December. Again, the time devoted to collecting at each place was a matter of days, more often of hours. These limitations should be kept in mind.

Although much of Northern Kordofan is more or less desert in character, both Mr. Willis and the Government Handbook speak of "forests" in the region of the Nuba Hills; it might therefore be reasonably expected that the fauna of the latter would exhibit a forest rather than a desert aspect.

* See Ann. and Mag. Nat. Hist., 1916, p. 380.

The following lists show (A) the twenty species added to the fauna by Capt. Wilson, and (B) the thirty-five species in my White Nile list which he did not happen upon, or at any rate did not send home.*

A. SPECIES TAKEN BY CAPTAIN WILSON
BUT NOT IN THE WHITE NILE LIST.

- 3a. *Mycalesis milyas*, Hew.
7a. *Precis octavia sesamus*, Trim.
7b. *Catacroptera cloanthæ*, Cram.
17a. *Acraea neobule*, Dbl.
 [f. *neobule arabica*, Rebel] D]
17b. *Acraea caecilia*, Fab. D
17c. *Acraea doubledayi sykesi*, Sharpe
 [f. *doubledayi arabica*, Eltring.] D]

30a. *Lycaenesthes crawshayi*, Butl.
31a. *Azanus mirza*, Ploetz.
34a. *Rapala licinia*, Mab.
35a. *Aziocerces harpar*, Fab.
35b. *Spindaris kaduglii*, B.-B.
35c. *Argiolaus ismentas*, Klug. D
39a. *Glutophrissa epaphia*, Cram.

51a. *Teracolus celimene*, Lucas

70a. *Papilio antheus nyassae*, Butl.
71a. *Sarangesa pisticus*, Ploetz.
71b. *Sarangesa pertusa*, Mab.
71c. *Caprona adelica kordofani*, B.-B.
72a. *Gegenes obumbrata*, Trim.
72b. *Hesperia mafa*, Trim.

B. SPECIES IN THE WHITE NILE LIST
BUT NOT IN CAPTAIN WILSON'S
COLLECTION.

3. *Ypthima asterope*, Klug. D
4. *Pyrameis cardui*, Linn. D
8. *Hypolimnas misippus*, Linn. D?
13. *Atella phalantha*, Drury.

16. *Acraea natalica*, Boisid.
18. *Acraea abdera*, Hew. D
23. *Castalius usemia*, Neave. D
24. *Cupido cretosus*, Butl. D
25. *Catochrysops eleusis*, Dem. D
27. *Zizera lysimon*, Hübn. D
29. *Lycaenesthes anarah*, Guér. D
30. *Lycaenesthes otacilia*, Trim. D
32. *Azanus ubaldus*, Cram. D
33. *Deudorix livia*, Klug. D
35. *Hypolycaena philippus*, Fab. D
41. *Calopieris eulinene*, Klug. D
42. *Teracolus calais*, Klug. D
43. *Teracolus phisadia*, Klug. D
44. *Teracolus castalis*, Stdgr. D
45. *Teracolus chrysonome*, Klug. D
46. *Teracolus vesta*, Reiche D
50. *Teracolus pleione*, Klug. D
52. *Teracolus hetaera*, Gerst. D
56. *Teracolus evippe*, Linn. D
 [f. *epigone*, Feld.] D
59. *Teracolus ephyia*, Klug. D
60. *Teracolus liagore*, Klug. D
64. *Leuceronia duquetii*, Boisid. D
 [f. *arabica*, Hopff.] D
66. *Terias senegalensis*, Boisid. D
68. *Colias hyale marnooana*, Rogers D?
69. *Papilio demodocus*, Esp. D?
71. *Sarangesa eliminata*, Holl. D
72. *Gegenes nostradamus*, Fab. D
73. *Parnara mathias*, Fab. D
74. *Parnara fatuellus*, Hopff. D
75. *Rhopalocampta forestan*, Cram.

These lists may be analysed by dividing A and B into sub-families.

	A	B
Satyrines	1	1
Nymphalines	2	3
Acraeines	3	2
Lycaenids	6	9
Pierines	2	14
Papilionines	1	1
Hesperids	5	5

* It is not improbable that Capt. Wilson was so familiar with the typical form of *D. chrysisippus* and with *P. cardui*, *H. misippus*, and *A. phalantha* that he did not think it worth while keeping specimens of those species.

Obviously the only really notable difference between them from this point of view is the very small number of new Pierines that Capt. Wilson collected. This may be in part explained—but only in part—by the fact that when on the White Nile I paid special attention to that group and sent home long series.

The extreme scarcity of Satyrines in the White Nile basin is very remarkable. To my *single specimen* of *Ypthima asterope* Capt. Wilson adds *two Mycalesis milyas*. In the nature of things positive observations have much more value than negative, and it is quite probable that a collector working throughout the year might find many more. My own observations in Cape Colony suggest that when Satyrines are scarcest Pierines are most abundant and *vice versâ*.

In the lists, I have marked with a D all the butterflies that I consider to be "desert" insects; this, of course, by no means implies that the species so marked are confined to "desert" areas; far from it. The D indicates that butterflies so marked—however extensive their distribution may be—are such as can live where "desert" conditions prevail.

Deserts differ *inter se*; some are much more barren than others, in some the prevailing surface is sand, in others rock, while some are shingly. Their common characteristic is aridity, an absence of rain for sufficiently long periods to stunt vegetation. Much depends upon season; Col. Yerbury says graphically: "Few . . . have any idea of the effect on 'the barren rocks of Aden' of a few heavy showers; how almost immediately, as if by magic, vegetation springs up in every ravine and water-course, accompanied by a tolerably abundant insect fauna."* Under such circumstances the desert literally rejoices and blossoms as the rose.

The sand-dunes on our British coasts are true deserts, small though they be; on them *C. pamphilus*, *P. cardui*, *A. aglaia*, *C. phlaeas*, *L. icarus* and *astrarche* may generally be found among the bents, while now and then a *Colias* may be seen coursing over the sand; such are desert butterflies, though they may all be found inland living under very different conditions.

Looked at in this way, we see that whereas among

* Journal Bombay Nat. Hist. Soc., 1892, p. 208.

Capt. Wilson's twenty added species *four* only bear the D, no fewer than twenty-two of the White Nile species that he did *not* send home bear that mark.

Undoubtedly the fauna of Southern Kordofan has not the very marked desert character of that found nearer the river, but at the same time it can scarcely be deemed to be a forest fauna.

It is curious that of the ten Skippers not one is common to the two lists.

Capt. Wilson may be congratulated on having taken one species and two varieties new to science.





- XI. *On Certain Forms of the Genus Acraea. A reply to M. Ch. Oberthür.* By H. ELTRINGHAM, M.A., D.Sc., F.Z.S.

[Read June 7th, 1916.]

PLATE LXXIV.

IN M. Charles Oberthür's *Études de Lépidoptérologie Comparée*, Fasc. xi, 1916, appears a study of Madagascan Lepidoptera, largely dealing with species of the genus *Acraea*. M. Oberthür states that after reading with great pleasure my monograph of the African species of the genus *Acraea* he has been moved to endeavour to complete some of the details and dispute some of my conclusions.

I would say at the outset that any criticism of my work is welcomed by no one more than by myself. M. Oberthür (p. 133, l.c.) says, "Un même sentiment nous anime, M. le Professeur Houlbert et moi même; la recherche de la vérité." All true scientific workers are animated by this sentiment, and if I feel it necessary to criticise to some extent Professor Houlbert's conclusions, he will, I am sure, consider my remarks in the same friendly spirit in which they are made, and as our countries are allied in the suppression of a barbarous race, so, in a more peaceful sphere, our scientists are allied in the search after truth.

First, then, as to the structure of the male armature in *Acraea*, Professor Houlbert suggests that in this genus occur the most complicated organs to be found in the Lepidoptera. The point is not of great importance, but I would ask him to examine, merely as a relaxation, the armatures of, say, *Hypolimnas monteironis*, some of the *Lycaenidae*, and Plate I in "The Genitalia of the *Noctuidae*" (F. N. Pierce, Liverpool, 1909).

Professor Houlbert next questions my contention that Mabille's effort to classify the genus *Acraea* on the structure of the armature is of little value. I stated at the time that Mabille's view seemed "based on an inadequate study of these structures." I see no reason to modify that statement now, and would only add that had Professor Houlbert

made some five hundred carefully mounted preparations of *Acraea* genitalia, as I had to do for my monograph of the genus, he would, I am sure, agree entirely with my statement.

At this point Professor Houlbert makes a curious error in quoting my words. In referring to Schatz and Röber's efforts to classify the species of *Acraea*, I stated that the "characters given are for the most part inconstant." These words Professor Houlbert makes to be my criticism of Mabille instead of Schatz and Röber. It is true I said almost the same thing of Mabille's characters. The words are: "the impossibility of these groups is evident from the instability of the characters suggested." My meaning here was, however, slightly different. Mabille named one of his groups *Aphanopeltis*, and his characteristic for this group was that the ventral plate of the male armature was a structure of variable form. It did not seem to me that variability, or as I said, instability, could be regarded as a suitable characteristic on which to found a subgenus. Moreover, the features Mabille selected for his classification are not features of a comparable kind, since in some species they do not occur at all. Finally, his attempt suffers from the great objection that it utilises a purely sexual characteristic as a feature on which to base a classification.

Now, whether applying to Mabille or to Schatz and Röber, Professor Houlbert objects to my words "the characters given are for the most part inconstant," and says, "mais, ou trouve-t-on des caractères constants?" Naturally I agree with him that characters are not constant in the absolute sense of the word. Were they so the whole majestic scheme of evolution would be an impossibility. Nevertheless, there are characters which are relatively sufficiently constant to enable us to use them as a basis for classification, and when I spoke of the inconstancy of Schatz and Röber's characters I indicated that they were devoid even of that relative constancy which was necessary if they were to be of any taxonomic value. I have nothing but admiration for the descriptions and excellent drawings of the armatures of *A. igati* and *A. damii*. As a study in the anatomy of these insects they are admirable. In a footnote on p. 145 Professor Houlbert says, "Mr. H. Eltringham, l.c. p. 7, a donné de ces organes, deux petites schémas trop simplifiés (fig. 11 et 12) qui ne peuvent fournir

qu'une idée très imparfaite de l'armature génitale des *Acraea*." I agree entirely that my "two little diagrams" "can only furnish a very imperfect idea of the genital armature in *Acraea*." They were not made with any such comprehensive purpose in view, but merely to illustrate the most essential differences between the two species *igati* and *damii*. My monograph runs to some 375 pages and over 250 illustrations. To have dealt with the detailed structure of the armatures of the 140 species of *Acraea* would have required another volume of similar dimensions, and would scarcely have served an advantageous purpose.

The second part of Professor Houlbert's interesting contribution deals with the sphragis, or seal, found on the female of most species of *Acraea* after pairing. That this structure is of great interest, and its function somewhat obscure, I certainly agree, but I cannot think that Professor Houlbert has thrown much light on the subject by declaring, as he does, that the sphragis is not the result of a secretion deposited by the male on the abdomen of the female. It is true that the process of formation has not, so far as I am aware, been actually observed in the case of an *Acraea*. A homologous formation occurs, however, in at least seven other genera of butterflies, and in the case of *Parnassius* the process of formation has been investigated by Mr. Arthur Thomson, and the subject is dealt with at some length by Mr. H. J. Elwes in his paper on *Parnassius* in Proc. Zool. Soc. Lond., p. 6 *et seq.*, 1886. In my monograph I referred to this article, but did not give extracts from it, thinking that the investigations mentioned were sufficiently well known. I would refer Professor Houlbert, and others who may be interested, to this paper. He will there see that the "pouch" is produced during copulation, and that there is exuded from the abdomen of the male a gelatinous substance which hardens rapidly on exposure to the air, and retains in its hardened condition impressions made upon it whilst in the viscous state. The sphragis in *Acraea* being a formation homologous with that in *Parnassius*, there is every reason to suppose that its origin is of the same nature. On p. 8 of my monograph I pointed out that Marshall had observed no less than three female *Acraeas* in which the sphragis had been duplicated, though both formations were more or less distorted in shape, "indicating that the second pairing must have

taken place immediately after the first, and whilst the first secretion was in a more or less viscous condition." That it is only produced by pairing is certain, since bred females, of which we have hundreds of examples at Oxford, *never* show the structure in question. In face of this fact it is difficult to understand why Professor Houlbert should have written, "Quant à l'origine même du sphragis nous n'avons pas en ce moment, de données assez précises; mais nous ne désespérons pas de l'expliquer le jour où il nous sera permis de suivre l'évolution de quelques *Acraea* vivants. Dans tous les cas, nous ne pouvons pas accepter l'opinion des auteurs qui considèrent le sphragis comme le résultat d'une sécrétion déposée par le mâle sur l'abdomen de la femelle au moment de l'accouplement."

Professor Houlbert expresses the opinion that the sphragis, owing to its perfect adaptation to the shape of the male armature, ensures the precise and unerring action of those complicated organs. It seems not to have occurred to him that the exact correspondence in shape between the sphragis and the male armature is due to the same cause which governs the correspondence between the plaster cast and its mould: the one has taken its shape through intimate contact with the other.

Two further points remain. Professor Houlbert on p. 152 expresses the opinion that the sphragis is an organ of adaptation, and that after pairing it falls off, and the female genital plate being thus uncovered, the eggs can be deposited, without hindrance, on the plants which are to sustain the larvae.

Now, in the first place, the sphragis does not fall off under normal conditions. It is found on the parent *Acraeas* in the Hope collections at Oxford, from which were bred long series of examples. Secondly, there is no necessity for its removal, since the external opening of the oviduct is not the same as the copulatory opening, but occupies a posterior position. The insect would be in no way inconvenienced in the matter if the copulatory orifice were hermetically sealed for the rest of its life after pairing. This fact of butterfly anatomy has doubtless escaped Professor Houlbert's notice. The remaining point with which I must deal is the statement on p. 158 that the uncus of the male is more highly developed in those species whose females are found to bear a sphragis, and is very small in cases where the genital plate is reduced or absent. In very

many of the smaller *Acraeas* the sphragis is not or scarcely at all developed, yet in these the uncus is, in proportion to the claspers, very large and well developed.

In one or two places Professor Houlbert suggests that he has had some difficulty in making out the structure of the genital armatures owing to their desiccated condition. Should he continue his investigations, and I sincerely hope he will do so, he will find that if the terminal segments of the abdomen are boiled in caustic potash (KHO) for a minute or two all extraneous matter is easily removed, and the specimen can be dehydrated, cleared in clove oil, and mounted in Canada balsam in a cell so that it is not compressed. He will then find that the organ can be examined under the most favourable conditions, and its form easily made out with the help of the stereoscopic microscope.

If he will submit a sphragis to the same treatment he will find that it disintegrates and dissolves with great rapidity, conclusive evidence that it is of an entirely different chemical constitution from that of the organs to which he would seek to ally it.

Following on this discussion of the armature and sphragis generally, M. Oberthür contributes interesting details concerning some of the less-known Madagascar *Acraeas*. He points out an error in my account of *Acraea igati*, which I stated to occur only in Madagascar, whereas he has examples from Anjouan and Grand Comoro. I was, of course, unaware of this when my paper was published. *A. damii* and *A. fornax* are dealt with, and finally the author gives a comparative study of *A. strattipocles*, *A. masamba*, and a form to which he gives specific rank, *A. siliana*. M. Oberthür's discussion of these forms is a most useful addition to our knowledge. With characteristic generosity the eminent French naturalist has presented to the Hope Collection at Oxford beautiful series of several Madagascar species of *Acraea*. Amongst these are a number of examples labelled *masamba* and some labelled *silia*. M. Oberthür now finds that the latter do not in reality correspond to Mabille's var. *silia*, but are in fact an undescribed form which he regards as a good species, and for which he proposes the name *siliana*. Furthermore, he declares his inability to distinguish the species of *Acraea* to which Mabille's Pl. 9, fig. 1, 1a (*masamba*) and fig. 3 (var. *silia*) belong. *A. strattipocles* is dealt with in the same section of the paper, but as there is no difficulty in identifying

this as a good species, it remains only to deal with *masamba* and *siliana*.

M. Oberthür expresses his regret at having sent specimens labelled as *silia*, which do not precisely agree with Mabille's *silia*, and which he now refers to his new species *siliana*. Professor Houlbert has examined the male and female genitalia and also some of the wing scales, and the specific rank of *siliana* is claimed on the following points.

	<i>masamba</i>	<i>siliana</i>
H.-w. border upper-side	regular outline	indented at 4th nervure.
F.-w. inner margin	suffused with black	not so.
Papilla on which occurs external orifice of bursa copulatrix	rounded	triangular.
Uncus of male	straight	curved.
Scales from f.-w. apical area	suboval	subtriangular.
Ditto from internal angle	rounded	subangulate.

Now, in dealing with these points I should explain that in discussing the forms in my monograph, the supposed examples of *silia* which I had before me were specimens of what M. Oberthür now calls *siliana*, and furthermore amongst those labelled *masamba* were four examples of the *siliana* form, but of the dark ground-colour similar to that in *masamba*, a variety named by M. Oberthür *A. siliana antakara*. It was on these examples that, in speaking of the indentation of the hind-wing border, I based my remark that "the same feature is observable in varying degrees of development in a series of *masamba*."* Having removed these examples, I must admit that the indentation of the border is peculiar to the *siliana* form. Moreover, the black suffusion of the inner margin of the fore-wing in *masamba*, especially in the male, seems a good character. As to the papilla related to the orifice of the *bursa copulatrix* in the respective females, I regret I have not been able to make out this character, alluded to by Professor Houlbert,

* This remark of mine is curiously misquoted on p. 170, the word "observable" being printed "*inobservable*" and emphasised by small capitals.

though it may well be as he states. Greater differences than this occur in the genital plates of forms of *A. acrita*, but do not enable us to define specific limits to those forms. The alleged difference in the uncus in the two species does not appear to me to be valid. The organ in both species is curved in a vertical plane. If Professor Houlbert alludes, as I think he does, to a curve in the horizontal plane, such an appearance in a dry specimen is of no value whatever, since the organ is frequently distorted through desiccation. In the many dissections I have made, I have never found the uncus in any *Acraea* to be curved laterally when once its flexibility has been restored by the caustic treatment. Such a curved condition would be a form of asymmetry, a phenomenon which, so far as my experience goes, does not occur in any species in the male, though one or two females have an asymmetrically placed copulatory orifice (*neobule*, etc.). In my opinion, the male armatures of *masamba* and *siliana* are not distinguishable when the features of these organs are considered as a whole and in relation to those of other species of the genus. In some genera the male armatures are practically indistinguishable, and so useless for specific distinction, but the genus *Acraea* is remarkable for the constant intra-specific differences in the genitalia.

Now as to the scales. On Plate LXXIV I have illustrated sixteen examples of scales in an endeavour to confirm Professor Houlbert's conclusions. Figs. 1-5 are taken from the fore-wing apical area of *A. masamba*, and figs. 6-10 from the same area in *A. siliana*. No two are exactly alike, nor do any quite resemble Professor Houlbert's figures on p. 169 of the paper referred to. In spite of diligent search I could find no scales which had not the deeply indented "shoulder" at the base, shown in my drawings, but quite absent in those of Professor Houlbert. Figs. 11-13 are from the fore-wing internal angle of *masamba*, and figs. 14-16 from the same area in *siliana*. So far as I can judge, the outlines of the scales are so variable that they do not furnish a character which is useful in this case for specific distinction. Nor is the outline of scales an entirely satisfactory character for the purpose, since my friend Dr. F. A. Dixey has found that even the Pierine scent scales, so characteristic in most cases, show considerable variation in different individuals of *G. napi*.

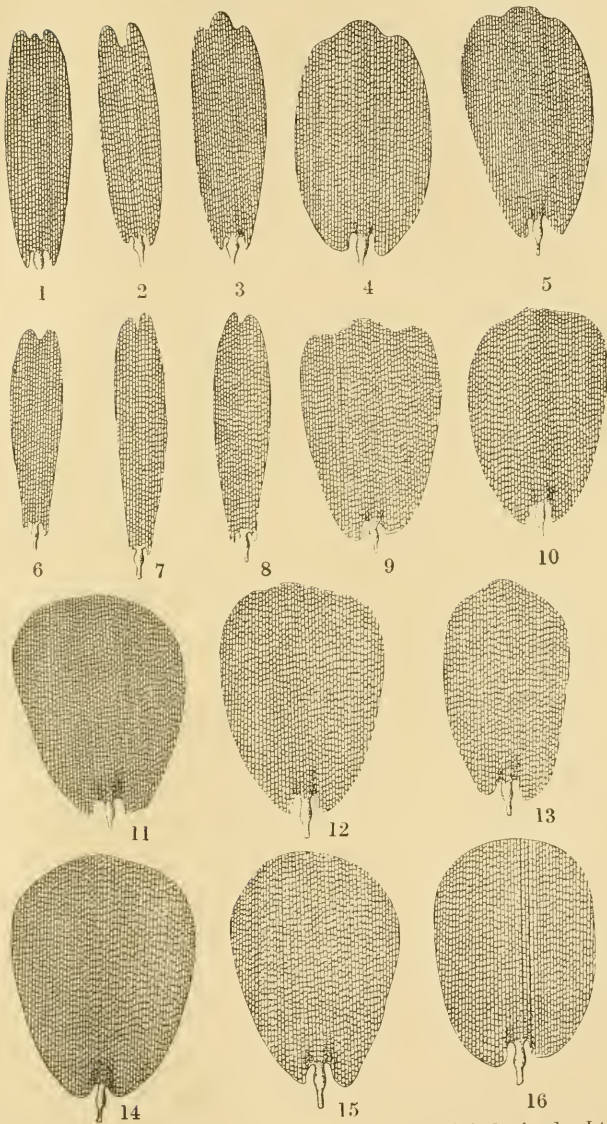
Let us then sum up the whole matter: The most essential

and constant differences between the two forms are differences of pattern. The structural differences are very slight and open to question. In my monograph of the genus I stated that "with our present conception of the evolutionary nature of species formation the precise limitation of what is called a 'species' has necessarily lost much of its importance, as compared with the recognition of the degrees of affinity which appear to obtain between the forms studied. . . . In many cases it is extremely difficult, if not impossible, to decide whether a form has yet passed over that dividing line which separates one true species from another. The difficulty experienced is merely a confirmation of our theories of species formation." *A. siliiana* does not appear to occur in precisely the same localities as *A. masamba*. The characteristics of *A. siliiana* as compared with *A. masamba* are equivalent to those I should regard as applying to a subspecies, *i.e.* a geographical race not entirely and specifically separate. M. Oberthür prefers to regard the two forms as distinct species. After all, it is of little real importance which view we adopt. The case is similar to that of *A. welwitschii* and *A. anemosa*.

Finally, I should wish to express my appreciation of M. Oberthür's most valuable and interesting contribution to our knowledge of the *Acraeas*, of M. Culot's exquisite plates, and of Professor Houlbert's beautiful drawings. The structural features of the *Lepidoptera* have too long been obscured by the dazzling beauty of their wings, and we shall look forward with pleasurable anticipation to further valuable communications from so ideal a collaboration as that of M. Charles Oberthür and Professor Houlbert.

EXPLANATION OF PLATE LXXIV.

- FIGS. 1-5. Scales from f.-w. apical area of *A. masamba*.
 6-10. " " " " " *A. siliiana*.
 11-13. " " " internal angle of *A. masamba*.
 14-16. " " " " " *A. siliiana*.



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SCALES OF ACRAEA.



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11, CHANDOS STREET, CAVENDISH SQUARE, W.

SESSION 1916-1917.

1917.

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XII. *The Rein-sheath in Plebeiid Blues: a correction of and addition to Paper VI.* By T. A. CHAPMAN, M.D., F.Z.S.

[Read October 4th, 1916.]

PLATES LXXV-LXXIX.

THE last paragraph of my paper on "The Pairing of the Plebeiid Blue Butterflies" contains one very confident but quite erroneous statement, that I desire to correct.

The material I was dealing with was scanty, and I did not know how to obtain any additional supplies. I was, however, so dissatisfied with the position in which I had left the matter, that I determined to follow it further.

I am now able to say something definite, and I hope correct, about the remarkable structure referred to. As a matter of fact, the sheath does consist of scales, but scales of such curious form and disposition that I am not prepared, whatever others may be, to blame myself severely for failing to recognise them as such, having preserved only two or three specimens.

The sheath, then, consists of scales, whose points of attachment are the "points" with which the surface of the rein is studded. These points are very small, quite unlike the usual sockets from which scales usually arise, but more like, as I described them, the traces of abortive hairs or scales. They must be the points of origin of the scales of which the sheath consists, but from which the scales so readily separate that it may be doubted whether they are at all attached to them, after the butterfly has emerged from the pupa. The scales are of a very unusual nature. The end, by which each was presumably attached to the surface of the rein, tapers to a point, that looks rather like a distal than a proximal end. The body of the scale is so curled and twisted as to be difficult to make out as to size or form; the distal end appears to be rounded. The twistings and curlings of neighbouring scales are so intertwined, as to obscure each other, and are the means that hold the scales together to form a cylinder.

The sheath is easily broken up, but into groups of scales, and separate scales are not easy to demonstrate. It is of elliptic section, its width being rather greater than is its dorso-ventral diameter.

The butterfly possesses this cylinder on emerging from the pupa, and appears to lose it as soon as pairing is over. One captured *in cop.* almost always still possesses it, but one taken otherwise very rarely, showing that the females of these butterflies, like those of so many Lepidoptera, remain quiescent and are rarely seen till pairing has taken place. The cylinder is so easily lost that it seems doubtful whether it retains any coherence by the scale attachments, and unless one is especially careful, it is more likely than not to be lost in preparing and mounting a specimen that still possesses it.

I have certainly several times, I fancy frequently, seen specimens *in cop.* in which the female did not possess the sheath. These may have been second pairings, or the sheath may have been lost before the first pairing.

The use of this structure probably is to give rigidity and support to the soft structure of the rein in finding its way to the base of the male genital cavity, and to maintain it in position, with some fixity, with the terminal plate in apposition with the aedeagus, so that penetration may take place. How this exact apposition was secured seemed to be rather puzzling, notwithstanding that the rein when full of fluid could be fairly rigid; but this did not explain how the correct position could be secured so rapidly as in fact it is, the actual pairing being apparently a matter of a second or two. The sheath must occupy with great accuracy the male genital cavity, so that the parts properly coincide.

The special character of the "furca" in the floor of the male genital cavity, appearing to support nothing nor attach any parts together, is probably related to the rein and its sheath. The rein (and sheath) would arrive at once in a position supported on each side by the branches of the fork, and resting in the hollow between them, filling the genital cavity so that the end of the sheath necessarily impinges against the short exposed portion of the aedeagus, and with the knee-like angle between the prop and the rein, at the base of the clasps. Though, no doubt, the difference in details of structure in the different species make this only a general description of the adaptation.

A question to which I cannot suggest an answer is, Why should it be lost so soon as pairing is over? It is no longer of any use, but is it now in any way injurious?

Its absence may give more room for the movement of the eggs to the ovipositor, and greater freedom to the actions of the structures involved in the important process of the fertilisation of each ovum.

The sheath in *coridon* is 2 mm. in length, 0.5 from back to front, and 0.7 from side to side. It looks as if constructed of a confused congeries of smooth rounded waves, each ending distally, however, in sharp rounded ends, which are the ends of the actual scales; these have no terminal teeth nor any striations. Each scale is curiously twisted, so that it is difficult to say what its size and outline would be, if it could be flattened out; but it is approximately 0.4 to 0.6 mm. long, 0.1 to 0.15 mm. wide at one-third from the free end, tapering fairly regularly to the attached point; it has a granular appearance, no striations as ordinary scales or rows of elevations like androconia. The granulations seem to be rather contents of the scale than structure of its walls. Various items of these details will be more easily grasped by reference to the Plates.

In *coridon* the sheath is tolerably cylindrical in form, but the two extremities are a little oblique to the main axis. In *bellargus* it is rather flattened in dorso-ventral diameter, more especially distally, where it is rather widened from side to side, giving it an appearance of a waist with spathulate extremity. In *icarus* it is rather expanded basally, narrows slightly towards the end, where it finishes with a more rapid, somewhat conical narrowing. *Astrarche* presents a form very similar to that of *icarus*. The difference between *coridon* and *bellargus* is less than my description perhaps implies; the sheath in *bellargus* could certainly not be described as cylindrical, but that of *coridon* has a slight terminal flattening, that could hardly however be called spathulate.

I have verified the presence of the sheath in *astrarche*, *icarus*, *coridon*, *bellargus*, *eversmanni*, *argyrognomon* and *damon*. Further research will probably demonstrate its presence in all these Plebeïids, but it seemed so desirable to make this correction to my paper as early as possible that I have not waited to carry the matter further.

This scale cylinder is, in itself, as remarkable as the

specialisation otherwise of these blues described in my paper, and is, of course, a detail of that specialisation. I am not aware that any similar structure has heretofore been observed.

EXPLANATION OF PLATES LXXV-LXXIX.

- PLATE LXXV. Two specimens of *A. bellargus* (*thetis*), side view, the prop and rein, clothed in the sheath, extended. $\times 10$. A. E. Tonge, photo.
- PLATE LXXVI. FIG. 1. Sheath of one of the specimens in last plate. $\times 30$. A. E. Tonge, photo. Mr. Tonge says that the blurring is due to passing traffic when photographing.
FIG. 2. Rein sheath of *A. coridon* separated (it separates almost too easily). $\times 25$. (Clark.)
- PLATE LXXVII. Rein of *P. icarus* with sheath broken into upper and lower halves. $\times 25$, and lower half of sheath. $\times 70$.
- PLATE LXXVIII. Portions of broken-up sheath of *A. coridon*. $\times 35$ and $\times 100$. This illustrates how the scales are intertwined and the difficulty of in any way separating out a single scale.
- PLATE LXXIX. Rein-sheath of *A. coridon*, nearest approach to separate (and unbroken) scales. $\times 200$.

XIII. *Resting attitudes in some Lepidoptera, examples of recapitulation in habit.* By T. A. CHAPMAN, M.D.

[Read October 4th, 1916.]

PLATE LXXX.

A CHANCE observation, recently, led me to make a few more that were available, and to the conclusion that the facts examined gave some indications of being instances of "recapitulation";* that is, of a habit or structure of some ancestor, though now possibly useless, persisting and having a place earlier in the development of the individual than it had in the ancestor.

The resting attitude of the great mass of the *Heterocera* is with the wings in the same plane as that of the surface on which the insect is resting. Even so there is a good deal of variation, as, for example, in Noctuae there is the flat position with the wings crossed as in *Agrotis* and *Noctua*, or held in a pent-house position as in *Taeniocampa* (*Monima*) and *Plusia*.

As my observations were on Geometers it is more apposite to note that in them the usual position is with the wings laid flat on the surface, forming a triangle, the inner margins being parallel with the body, either against it or covering it. (Pl. LXXX, figs. 1 and 3.)

It is perhaps necessary to remember that, practically without exception, after leaving the pupa and expanding the wings, the *Lepidoptera* place the wings together vertically over the back (in the resting attitude adopted by butterflies), in the larger species with the wings hanging down, the insect resting on a vertical or overhanging object; so that gravity appears to be, and often is, necessary to keep the wings straight whilst hardening and drying.

* "Recapitulation" was the name given by Haeckel to the theory that the ontogeny of the individual presented briefly in series the evolution involved in the phylogeny. It thus applies properly to a succession of structures in the evolution, but one habit or structure exhibited temporarily in the ontogeny representing a final habit or structure in an ancestor would have to be classified under the same term. See Haeckel, "History of Creation" (Ray Lankester), i, p. 309.

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In other species, not always very small, the insect may be on a horizontal surface; but the wings are held up vertically, and seem stiff enough to maintain this attitude during drying.

When the wings are dry and stiff this attitude is left, and the wings take the resting position normal to the species. What I have observed is, that this is not a strictly correct statement of what occurs in certain species, but that, by way of "recapitulation," the wings are deflexed to the position characteristic of the group (family?) to which it belongs, and later assume that belonging to the species itself. I noticed this fact in the case of *Acidalia virgularia* (*Eois incanaria*). So soon as the wings are dry, in the attitude with them closed dorsally, they are brought down to the surface on which the insect is resting, to the normal Geometrid attitude, with the inner margins of the wings parallel to the body. This position is maintained for a varying period, apparently so long as the insect remains undisturbed; in one instance, I noted as long as three hours and three-quarters, and it may be they often remain so till the evening flight. But if disturbed, the insect runs or flies, even as little sometimes as, say, half an inch, but settles down with the wing in the Acidalian position, viz. with the fore-wings well forward, showing a good portion of the hind-wing. This occurs even if the disturbance is only a few minutes after the wings are deflexed, and in no case is the Geometrid attitude afterwards assumed. The explanation that this was a case of "recapitulation" seemed quite probable; if it were so, then it might be observed in some other species. Unfortunately material for making further observations was not abundant, and, for instance, it did not occur to me, in time, to secure some pupae of *Smerinthus*, though I have a dim recollection, but no notes to say whether this is reliable or the contrary, that the position with the hind-wings well forward, in this and in some Lasiocampids, is not assumed till some time after the wings are dry. I had, however, several species of *Ephyra* (*Leucophthalmia*), and found that their habit in this matter was precisely the same as in *E. incanaria*. I also had pupae of *Selenia bilunaria*, which seemed to be a desirable species to observe, as its resting attitude is that of the butterflies, and therefore less like the ordinary Geometrid position than that of the *Acidalias*. I found that, in *bilunaria*,

when the drying attitude is left, the wings are deflexed, but not to a flat position, they are still raised so as to make, between the two sides, an angle of from about 110° to 150° , apparently according to whether gravity, in the position in which the insect happens to be, tends to make them more or less open. This attitude is maintained for something less than an hour; in various instances on touching the wings to ascertain whether they were still soft and this was still a drying position, the disturbance made the insect assume the butterfly attitude; in every case the wings were found to be quite firm. In this species the resting attitude is very different from the usual Geometrid one and is identical with the drying position, so that one would suppose that the one might very properly be continued into the other; but a close approximation to the Geometrid attitude is assumed in passing from the one to the other. In a few cases I thought it was omitted, but was never sure that I had not missed it, or that it was shortened or left out owing to some disturbance.

It may be observed that the intermediate attitude here is very close to the resting attitude of *Selenia tetralunaria*, but has the wings slightly more deflexed.

In dealing with the *Rhopalocera*, I may say that I observed carefully and in some numbers only three species, *Pieris rapae*, *Vanessa urticae* and *Thecla quercus*; this is no doubt a rather narrow basis, but for facility of description I assume that they are fairly representative.

It seemed desirable, opportunity offering, to consider the butterflies. In these the resting attitude is identical with that for drying the wings, viz. the erect dorsal one. I do not know that there is any exception to this rule, if we except the *Hesperidae*, some of which rest with the wings deflexed, and the *Erycinidae*, at least the South American species or most of them. These are not, however, in the ancestry of our palaeartic butterflies; some *Papilio*s are also known to rest with deflexed wings. The butterflies who adopt the "butterfly attitude" have cryptic undersides; those, like the *Erycinids*, that do not, have undersides not very different from the upper. The whole butterfly ancestry of the species I observed may be assumed to have used the "butterfly attitude" of rest.*

Therefore, unlike the Geometers referred to, which had

* I am indebted to Commander Walker and Mr. Kaye for reminding me of the *Erycinid* attitude.

a comparatively recent ancestry with deflexed wings, we have here to go back to the Skippers, or possibly the *Castnias*, for such ancestors, and one would regard it as probable that any memory of a deflexed position of rest had been entirely lost. Possibly this is so, yet in the process of expanding, or rather of drying the wings after expansion is completed, there is a phase, that does not seem to occur in the *Heterocera*, that strongly suggests that some reminiscence of the deflexed attitude still exists, but has been pushed backwards from the point just following drying, till it has become involved in the period of drying. In any case, whether it admits of this interpretation or not, this difference of procedure is obviously of interest, and seems to require some explanation. In butterflies, the wings are expanded, as indeed in most *Heterocera*, in approximately the resting attitude, but, when expanded, are definitely placed in the drying position, all nearly parallel, hind-wings close against fore-wings, but the fore-wings only touching at their tips and hind margins. Then begins the special butterfly process: after a few minutes the wings are separated, to such a degree that were they stiff the upper surfaces of the opposite wings would be at an angle of 90° at least with each other, but being limp the wings hang in somewhat bell-shaped fashion, as observed on the costal aspect. They are retained here for some thirty seconds, and again closed; they are then opened and closed, each phase occupying about half a minute, but varying a little, for some six to ten times, the wings gradually stiffening, not being opened so wide, and so losing the bell-form, the wings being nearly straight. In the last open positions the hind-wings separate from the fore-wings, so that there is an interval of a full millimetre between each adjacent pair of wings; finally the wings are closed, so that rather more than the tips touch, and very gradually are more closely approximated, so that the costae coincide for fully two-thirds of their length. This is the assumption of the true resting attitude; no further change of position occurs until the insect is disturbed, or takes flight, etc. This description refers more particularly to *Pieris rapae*, than to the other species observed.

This is a very different process from the typical Heterocerous one of suddenly throwing the wings back, keeping them there immovably till they are dry, and suddenly



Photo, A. E. Tonge.

**TWO SPECIMENS OF A. THETIS, WITH REIN EXTENDED AND CLOTHED
IN SHEATH $\times 10$.**





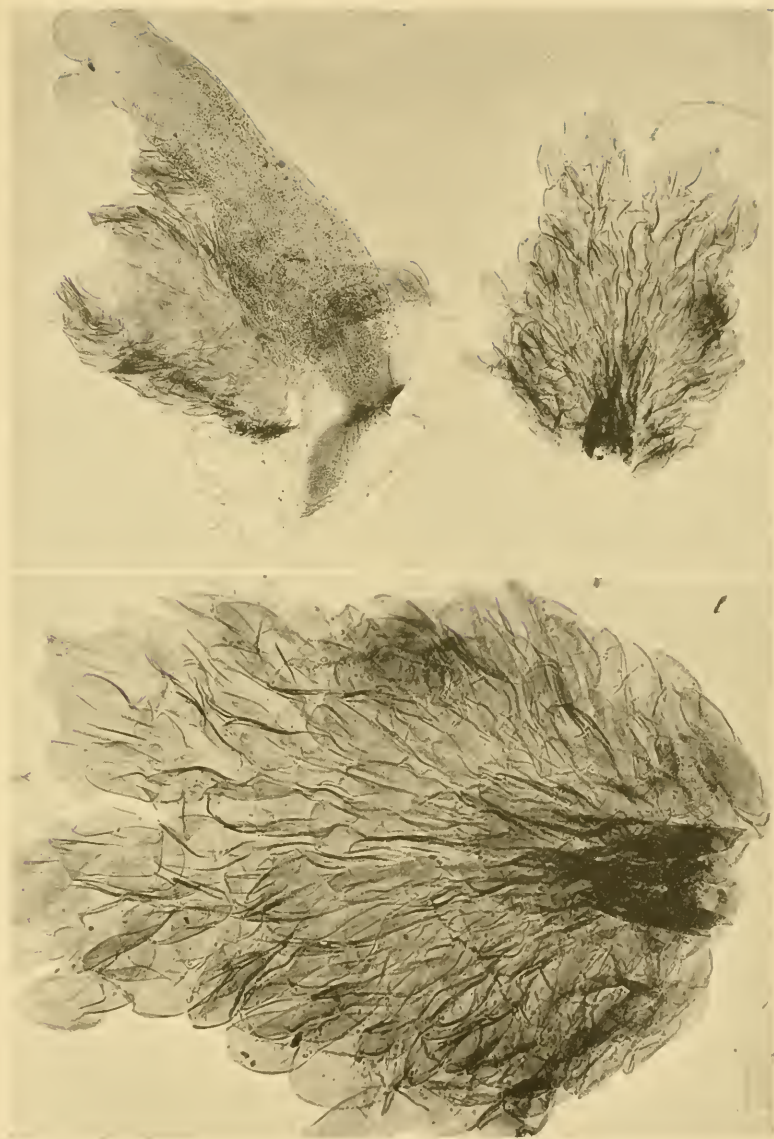
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REIN-SHEATH OF A. BELLARGUS, *in situ*, AND OF A. CORIDON, SEPARATED.

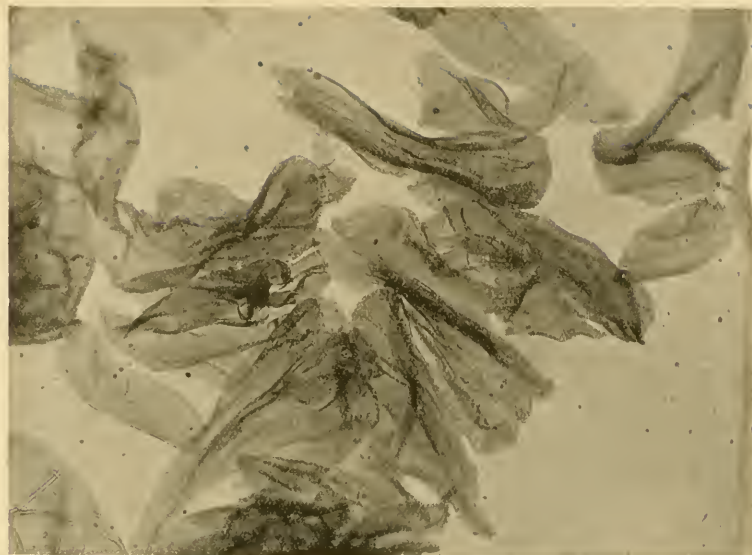




Photo, F. N. Clark.

REIN AND SHEATH (BROKEN ACROSS) OF *P. ICARUS* $\times 25$, AND LOWER PORTION $\times 70$.





Photo, F. N. Clark.

PORTIONS OF BROKEN-UP REIN-SHEATH OF A. CORIDON $\times 35$ and $\times 100$.





Photo, F. N. Clark.

SCALES OF REIN-SHEATH OF *A. CORIDON* × 200.



lowering them to the normal resting position. In these butterflies after the wings are thrown back, but before they are dry and stiff, there seems to be a temptation to assume the Heterocerous resting position, and just as the wings are all but dry, a separation of them occurs, suggesting the Hesperid position, with hind-wings only, lowered.

I add more detailed notes of some of the species examined, and include the actual times of the several phases as jotted down in the cases of two of the butterflies, where the movements are more complex than in the moths—

Oudemans' paper on the resting attitudes of Lepidoptera, published in 1903,* suggests a number of species on which observations might be made.

Leucophthalmia orbicularia having rather rapidly expanded its wings, closed them dorsally in the usual manner; it kept them so for some twenty minutes and then deflexed them, nearly flat to the surface to which the moth was adhering, but not pressed down on it; the fore-wings had their inner margins nearly but not quite parallel; that is, they were slightly apart at the anal angles, so as to show the body and a very narrow strip of the inner margin of the hind-wing, not unlike the resting attitude of *Odezia atrata*. It maintained this attitude for an hour and twenty minutes, and might have done so longer, but a jerk given accidentally when observing it, made it flutter as if to take wing. It then settled down a few inches away in the ordinary resting attitude, *i. e.* with the wings flattened closely to the surface on which it rested, and the fore-wings advanced so as to show some two-thirds of the hind-wings. (Plate LXXX. fig 2.)

June 27th, 1916.—A *Sel. bilunaria* ♀ had completed the expansion of the wings, which were thrown back in the usual Lepidopterous attitude of drying the wings, and which is also the usual rest attitude in *S. bilunaria*, at 10.50. At 11 the wings were deflexed, not to a horizontal position, but to an angle of about 120° between those of the two sides, or of about 30° above horizontal on each side—horizontal with reference to the line of the insect's body, supposed resting on a flat horizontal surface. As a matter of fact, the insect was suspended on a vertical surface, the head hanging back from it, so that the line of the body was an angle of about 25° from the vertical,

* "Verhandelingen der Koninklijke Akademie van Wetenschappen te Amsterdam" (2^{de} sect.), Deel X, No. 1.

the weight of the wings thus hanging tending to raise them from the level body plane. The suggestion is, that the wings would have been horizontal had the line of the body actually been so. 11.50, wings thrown back. If the surface from which the moth is hanging be gently placed horizontally then the wings fall to within 20° , sometimes little more than 10° from being horizontal also.

Pieris rapae.—The wings expand in six minutes, and then hang down quite straight, touching the opposite wing only by the tips. (Pl. LXXX, fig. 5 a.) The wings are after another six minutes separated; they are limp, and hang (as seen from the costal aspect), in somewhat bell-shaped fashion, outwards at the base and quickly curving, so that three-fourths of the wings hang vertically, the hind-wings closely touching the fore ones (b). Then they are closed again. Curiously, like *T. quercus*, the change from separation to shut and back again takes almost exactly a minute, the period of being separate varying, however, from 30" to 45", generally about 36" to 40" (c, d). In about six minutes the wings are not so limp, but a little straighter, and the hind-wings hang slightly separate from the fore-wings (e). In four or five more minutes the wings seem quite straight, and when separate the hind-wings are apart from the fore-wings (f). At the end of thirty minutes from the first movement of separating the wings, the period of separation is a little prolonged; the tips of the fore-wings now touch, but the costae are well apart and the hind-wings separate and, if anything, rather divergent, about 3 mm. from costa to costa. The wings hang thus, with faint opening and closing movements producing little effect, for ten to fifteen minutes, without completely closing; they arrive, however, after this interval at having the tips in contact and very gradually in some further ten minutes reach the permanent resting attitude (g, h, i). In separating the wings the movement is quick, almost sudden; the closing is slow, taking several seconds. In the "bell" attitude, if the wings, instead of being limp and drawn into the bell outline by gravity, were stiff, those of the opposite side would be in nearly the same plane, practically the geometric attitude of rest.

Pieris rapae emerged at 2.29 (really 1.29 p.m.).

2.35, wings fully expanded, quite straight, so that they hang with tips only touching.

- 2.39, wings with rather more than tips touching.
 2.41, wings separated.
 2.41.20", closed.
 2.41.40", separated; 2.42.13", closed.
 2.42.40", .. 2.43.10", ..
 2.43.35", .. 2.44.20", ..
 2.44.45", .. 2.45.25", ..
 2.47.15", .. with hind-wings rather separated
 from fore-wings; 2.47.58", closed.
 2.48.20", separated; wings straighter, less bell-shaped,
 hind-wings more separated from fore-wings;
 2.48.55", closed.
 2.49.25", separated; 2.50.0", closed.
 2.50.30", separated all but straight; 2.51.5", closed.
 2.51.30", .. 2.52.6", closed.
 2.52.40", .. 2.53.25", closed, hind-wings do
 not close till just after the fore-wings.
 2.54.15", separated, not so widely, wings very straight
 and very separate with slight movements;
 2.55.5", closed.
 2.57.0", wings separate with a little tremor, all spaced,
 and about 3 mm. from costa to costa of hind-
 wings; they closed for a few seconds at
 2.59; then fore-wings gradually closed so
 far that tips touched at 3.2.0"; but hind-
 wings remained separate and parallel with
 each other. At 3.11.0" the fore-wings be-
 came slightly closed, *i. e.* rather more than
 the tips touched. At 3.12 fully open again;
 3.16, closer, hind-tips 1 mm. across; on
 touching wings they close up, but open
 again, fore-tips separate and remain so at
 3.20. At 3.25 wings are closed so as to
 touch for distal half; afterwards gradually
 closed to normal resting position, *i. e.* costae
 together for the distal four-fifths.

Plate LXXX, fig 5 indicates the attitudes referred to.

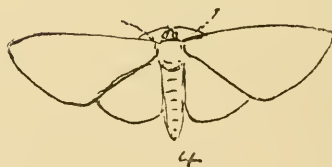
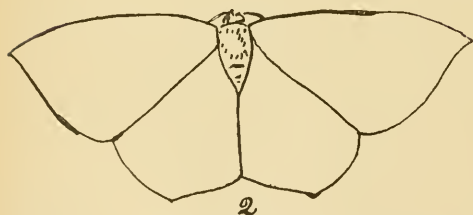
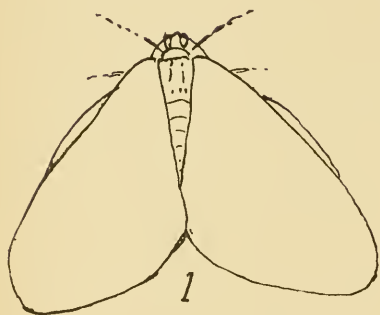
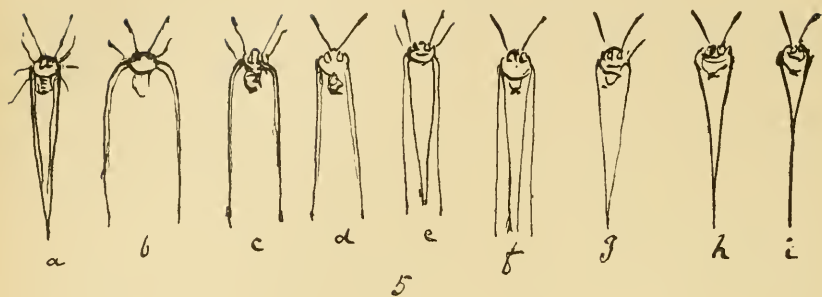
In the case of *V. urticae*, the wings are fully expanded in from four to seven minutes after leaving the pupa shell, and are then placed in the dorsal position, closely pressed together with the little rotatory movement with which many *Lepidoptera* accomplish the throwing of the wings back into the dorsal attitude. During the next three or

four minutes the wings are several times slightly separated and again closed almost immediately, and for the following five minutes the wings remain open for slightly longer periods, and when open assume more of the attitude that is taken at about 20 to 25 minutes after emergence, the wings hanging down in nearly the normal resting attitude, but separated from each other by spaces that make the apices of the fore-wings nearly $\frac{3}{8}$ of an inch apart and those of the hind-wings less than half this. This attitude is maintained for some 20 minutes, when the normal resting attitude is permanently assumed.

Vanessa urticae.—9.21 a.m., emerged; 9.26, expanded, but not quite straightened; 9.27, not quite straight, but closed; 9.29, straight, still closed; 9.30, opened; 9.31, closed; 9.32, open; 9.33, closed; 9.33 $\frac{1}{2}$, opened, with a rotating movement; 9.34, closed; 9.35, open; 9.36 $\frac{1}{2}$, closed; 9.38, open; 9.38 $\frac{1}{2}$, closed, then opened. Remained more or less open; at 9.45 the lower wings were rather separate, *i. e.* none of the wings were touching each other; 10.10, have been gradually closing, and are now much less open, but still rather open. Thereafter gradually closed to natural resting position.

Another specimen emerged, 9.25; 9.31, wings expanded and closed; 9.33, open; 9.35, closed for a few seconds; 9.38, closed; 9.45, opened; 9.46, closed and then opened, all wings separate; remained so for some time, but at 10.10 are less open; 10.12, closed at tips; 10.15, closed to middle of costa; 10.45, closed for two-thirds of costa, which is very near the closure of normal resting attitude.

In *T. quercus*, as soon as the wings are expanded, which takes place very rapidly, they are closed over the back into the ordinary resting attitude, and remain so for several minutes; they then separate so that only the tips of the fore-wings touch, and remain so for about 40 seconds; then they close again so that the costae of all four wings are close together, except about a fourth of their length at the base, and remain so for about 20 seconds. This change of attitude—separate 40 seconds, closed for 20 seconds, varying very little from an exact minute for the two phases—continues for about 16 or 17 minutes, then it is observed that when separate they have not been touching at the tips for a few times, and now they are all quite separate at about equal distances apart, rather wider apart at hind margins than the width of insect's thorax; the



ROUGH DIAGRAMS TO SHOW ATTITUDES OF LEPIDOPTERA AT AND AFTER EXPANSION OF WINGS.

fore-wings, in fact, hang straight down, the hind-wings are apart from them as far as they are from each other; the opening and closing goes on as before for about another ten minutes, then they close permanently, but not at first so closely as they are a little later. A specimen touched at this period flew off and settled down with wings tightly closed, as it were with only one costa (except at base) for all four wings.

EXPLANATION OF PLATE LXXX.

These are merely rough diagrams to show the positions of the wings, and are probably accurate enough to serve that purpose.

FIG. 1. Normal rest position of *Geometrae* (after Oudemans) ($\times 2$).

FIG. 2. Rest position of *Ephyra punctaria* (after Oudemans ($\times 2$). These two figures show the temporary (recapitulative) and permanent positions of rest as observed in *Leuco-phthalmia orbicularia* and *omicronaria*.

FIGS. 3 and 4. Temporary (recapitulative) and permanent rest positions in *Eois incanaria* ($\times 2$).

FIG. 5. Various positions (more or less consecutive) of the wings in *Pieris rapae* during drying. The figures represent the costal margins of the wings as seen from the front—
a. Normal (of Lepidoptera) drying position assumed as soon as the wings are expanded.
b. Bell-shaped position assumed just after. *a* is then returned to.
c, d, e, and f, with others intermediate then follow, with *a* between each pair. Finally the permanent resting position is assumed, first as *g*, the wings gradually closing up viâ *h* to *i*, in which two-thirds to three-fourths of the upper surfaces of the opposite wings are in contact.

XIV. *Micropteryx* entitled to ordinal rank; Order ZEUGLOPTERA. By T. A. CHAPMAN, M.D.

[Read October 4th, 1916.]

PLATES LXXXI-XCII.

THE object of this short paper is to call attention to a fact in the anatomy of the species of the genus *Micropteryx*,* that appears so far to have escaped observation—at any rate, I am not aware of any record of it—and which is yet one of primary importance, with reference to the position of the genus in any classification.

It might give this paper a more imposing length if I fully quoted Walter's † account of the mouth parts of *Micropteryx*, and my own paper on the larva, ‡ and especially to transfer in full Packard's discussion § of these papers, in which he founded for *Micropteryx* a sub-order PROTO-LEPIDOPTERA, or LEPIDOPTERA LACINIATA, a discussion occupying three and a half pages of his Monograph on the Bombycine Moths. Packard notes a further character, viz. "the male genital armature neuropteroid, exerted, dorsal, lateral, and sternal appendages very large."

These papers are, however, fairly accessible, and under present conditions it seems a duty to make a paper as short, instead of as long, as possible.

Packard would have been justified, on the facts before him, in placing *Micropteryx* in a new order, instead of a sub-order. However this may be, the further structural

* *Micropteryx*, Hubner, seems to be the name to which this genus is entitled. In my paper on the larva I adopted the name *Eriocephala*, and Packard did so also. This is a name given by Curtis, and sinks as a synonym; but it had (and has) the advantage of referring to this genus only, whereas *Micropteryx* for long included *Eriocrania* also, and has even been applied, but of course wrongly, to *Eriocrania*, to the exclusion of *Micropteryx* proper (*calthella*, F.).

† Dr. Alfred Walter, "Jenaische Zeitschrift für Naturwissenschaft," vol. 18, p. 755, 1885. (74)

‡ T. A. C., Trans. Ent. Soc., 1894, p. 335.

§ Dr. A. Packard, Mem. Natural Academy of Sciences, Washington, vol. vii, p. 58, 1895.

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character I call attention to might, perhaps, alone, justify its ordinal separation, but, taken with the other characters, seems to remove it entirely from the Lepidoptera. Indeed, it remains difficult to suggest that *Micropteryx* has any lepidopterous character except the possession of scales. The neuration is also, perhaps, *primâ facie*, lepidopterous; but both this particular neuration and the possession of scales are to be found in insects having no claim to be lepidopterous. I have been aware of this particular structural character for many years, but only recently has it occurred to me to co-ordinate it with the other structures in the genus.

The Order Lepidoptera is specially distinguished by the female genitalia possessing two openings—a terminal one for oviposition, and one in the 8th segment for pairing; and in connection with this only nine segments can be counted in the abdomen of the female imago, instead of ten as in the larva pupa and male imago.

I hope in another communication to discuss how the missing segment is to be accounted for; this is, however, immaterial for the present purpose, which is to compare the apparently nine segments with two genital openings of all female Lepidoptera, with the ten segments and no genital opening except in the 10th segment in *Micropteryx*. This fact by itself seems to be sufficient to prevent *Micropteryx* being classified as belonging to the Lepidoptera, even in a sub-order.

There is a point that I ought, perhaps, to deal with. Cholodkowsky * says that *Nematois metallicus* (*scabiosellus*) differs from other Lepidoptera in that the female has only one sexual opening, and Prof. W. Hatchett Jackson † appears to accept this conclusion. Collating Cholodkowsky's description of the anatomy of the *Nematois metallicus* with my own observation of the structures in the Aculeate Lepidoptera, the first thing that occurs to me is that Cholodkowsky did not appear to understand that the inner rods with their dagger point belonged to a different segment to that of the outer rods, and in oviposition travelled beyond them, and as well as piercing formed also the ovipositor. The ovipositing opening is near the end of the inner rods (terminal segment). He describes the

* "Zeitschrift f. Wissensch.," Zoologie, vol. xlii, p. 562 (1885).

† "Morphology of the Lepidoptera," Trans. Linn. Soc., Zool. 2d, vol. v, p. 149.

rods as one piece, cutting the opening, and the egg being placed therein from another opening. Further, the rods (bristles) are dorsal to the viscera, certainly to all sexual openings; but Cholodkowsky describes them as ventral to the vagina he describes. This may have been a clerical error: if so, then it is possible that the opening he mentions may have been that of the 8th segment, since it is certain that he overlooked that in the 10th segment (the inner rods (bristles)), viz. the real ovipositor.

I may refer to Dr. Wood's paper in the "Ent. Mo. Mag." (vol. xxvii, 1891).

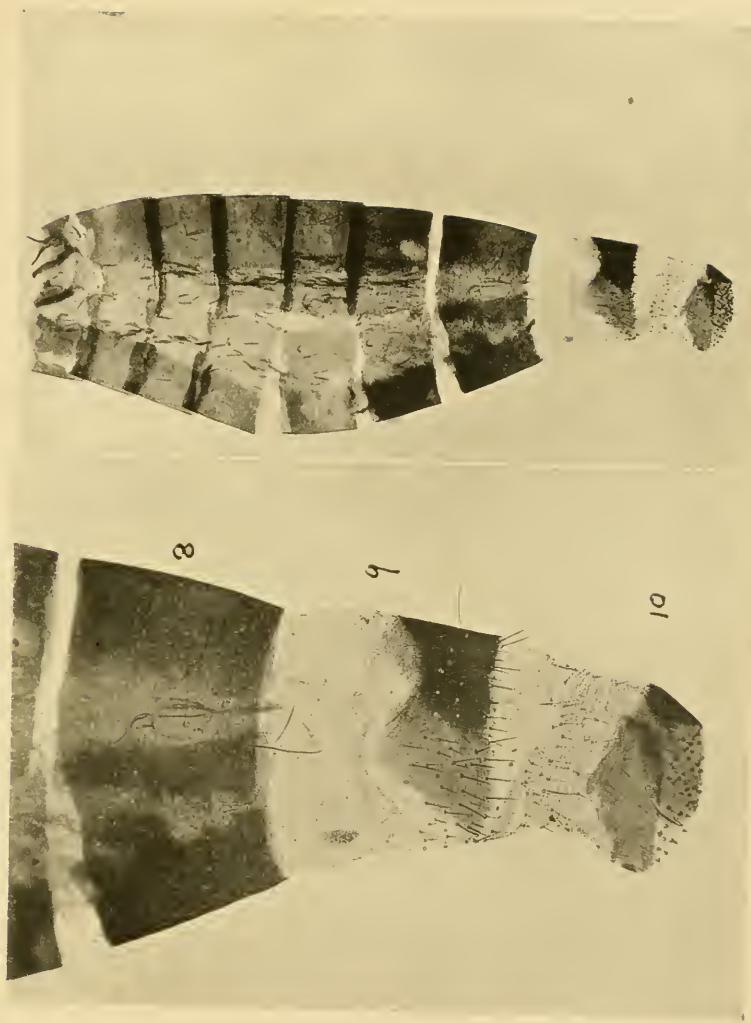
Whether or no the Lepidoptera originated from some form similar to *Micropteryx*, it probably arose from one with only a terminal female opening, and it seems not unlikely that the second forward opening in the 8th segment arose (in *Eriocrania*, the forerunner of the Aculeate Lepidoptera) from the difficult position of the (otherwise) single opening on the ventral surface of a sharp knife. It is, perhaps, going a little beyond the real subject of this paper, but the structure of the female pupa of Lepidoptera shows an opening that is, perhaps, in view of the imaginal structure, most easily described as in the 8th (abl.) segment, but may also be taken to be really in the 10th. The appearance is as though the opening belonged to the 10th, but had somehow been pushed forward, the 10th segment being continued forward to the posterior angle of the opening, and the 9th impinging on the sides of its posterior half.

I am not qualified to weigh the possibility of the single (10th segment) opening dividing into two, and the anterior one thus passing forward, leaving its track in the well-known configuration I have referred to, but the pupal appearances strongly suggest it.

Zeugloptera* seems to be a reasonable name for the New Order which this compels us to recognise, and is suggested by Mr. Durrant.

The appended photographs of the abdominal segmentation of the abdomen in the females of *Micropteryx* show that there is no opening in any segment of the abdomen except at the extremity, and that the 8th segment is a well-developed one. Though I have examined scores of specimens and mounted a good many, I find few of my

* Ζεύγλη = *jugum*, Πτερον = *ala*.



Photo, F. N. Clark.

MICROPTERYX THUNBERGELLA, ABDOMEN OF FEMALE.





Photo, F. N. Clark.

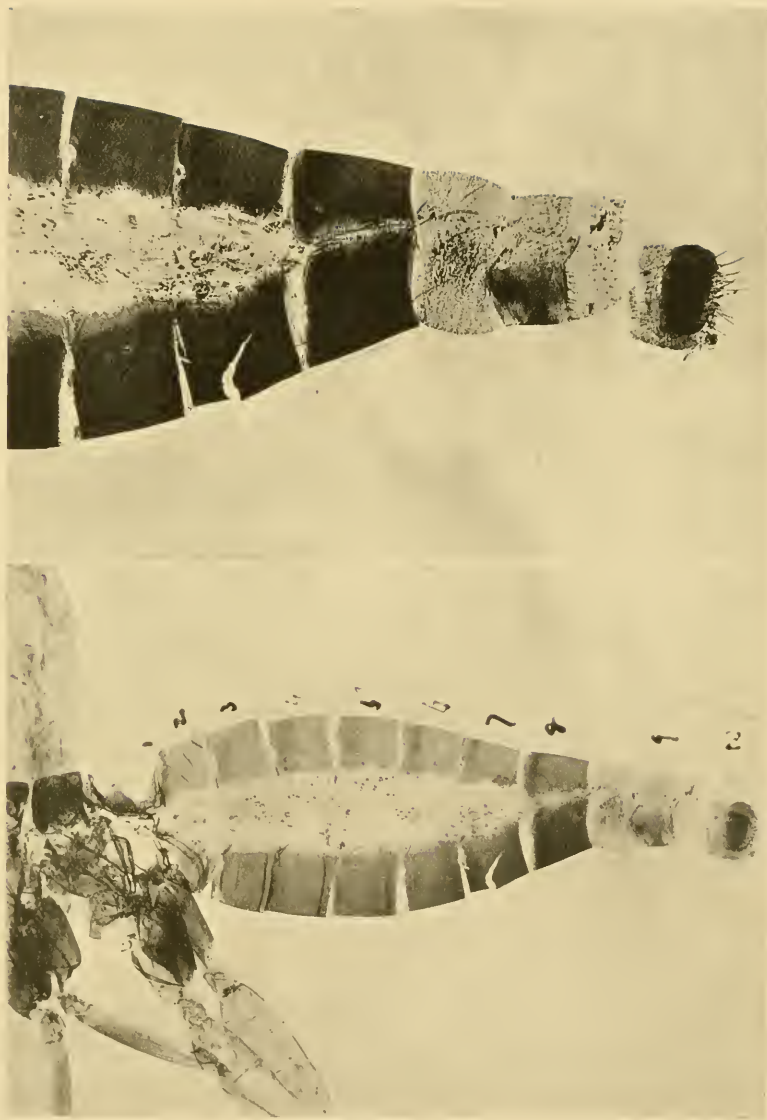
MICROPTERYX CALTHELLA, ABDOMEN OF FEMALE.



MICROPTERYX SEPELLA, ABDOMEN OF FEMALE.

Photo, F. N. Clark.

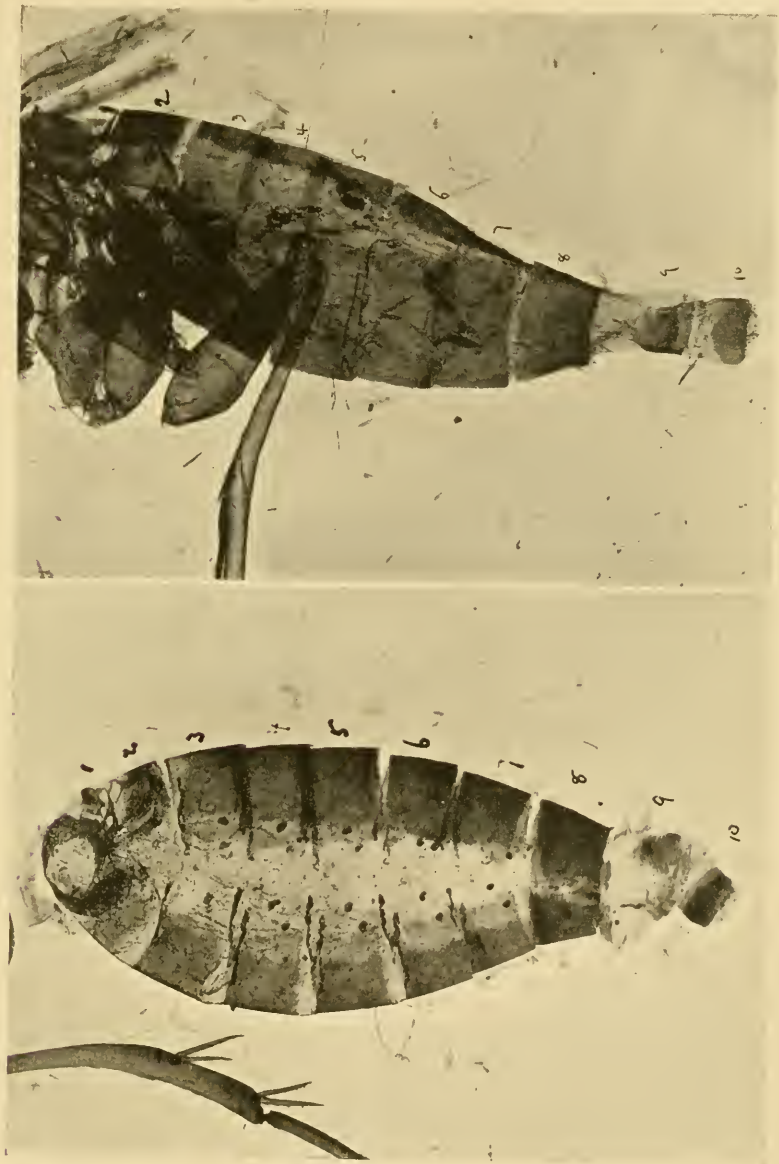




Photo, F. N. Clark.

MICROPTERYX CALTHELLA, ABDOMEN OF FEMALE.





Photo, A. E. Tonge.

MICROPTERYX SEPPELLA AND CALTHELLA, ABDOMEN OF FEMALE.





Photo. F. N. Clark.

**ERIOCRANIA SEMIPURPURELLA, TERMINAL
SEGMENT OF FEMALE.**





Photo, A. E. Tonge.

**MICROPTERYX AMMANELLA, MALE
APPENDAGES.**

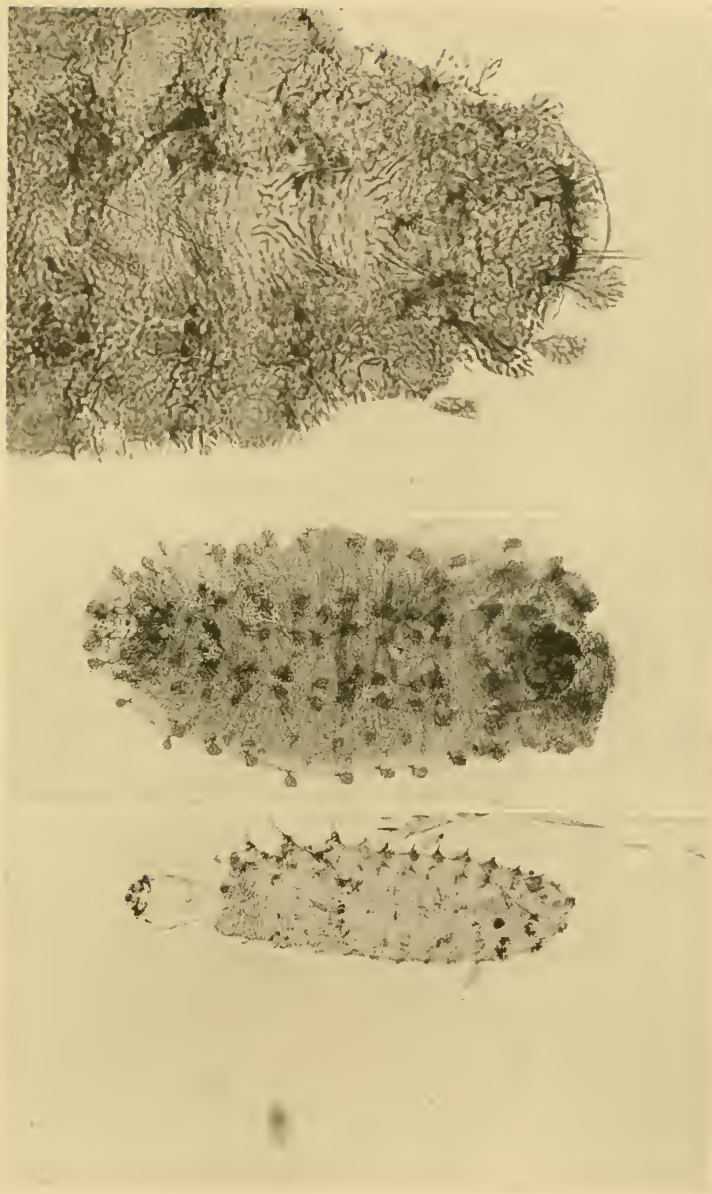




Photo, F. N. Clark.

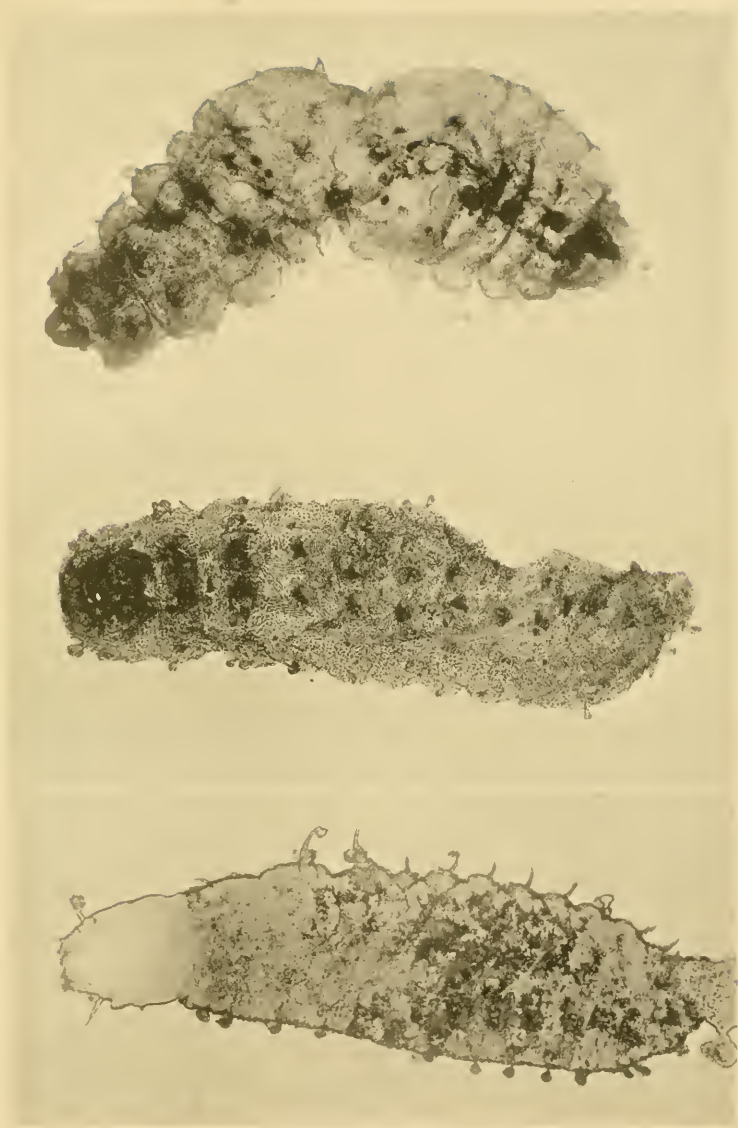
**PORTIONS OF HEADS OF MICROPTERYX ALLIONELLA
AND SEPELLA.**





Photo, F. N. Clark.

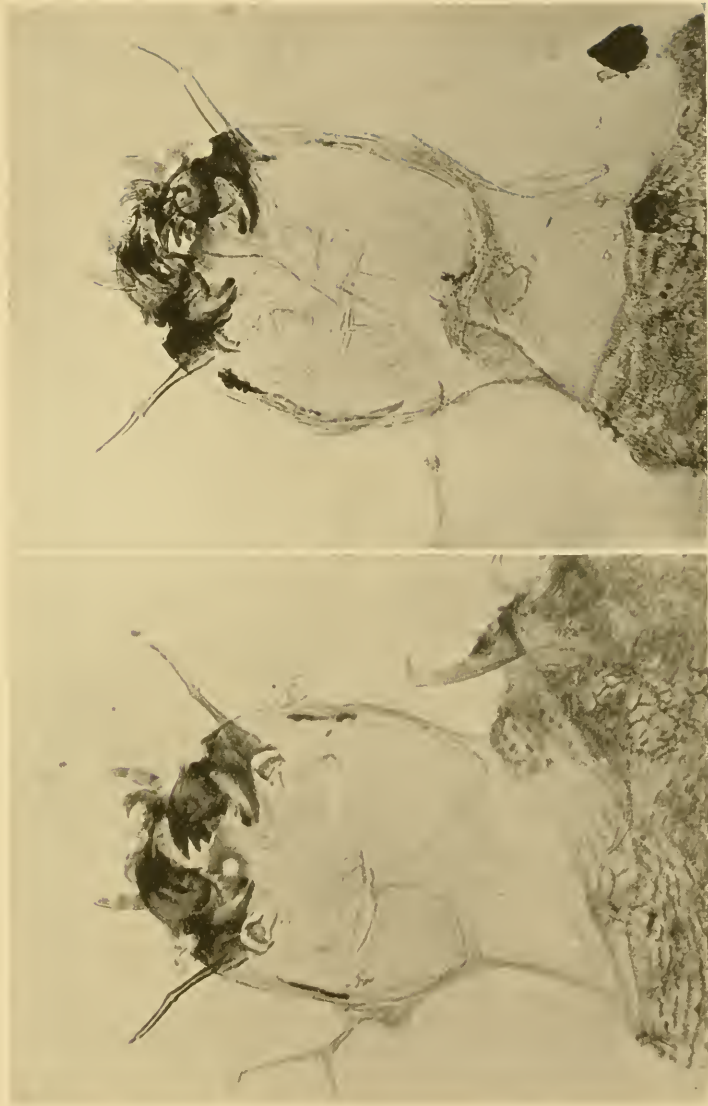
LARVA OF MICROPTERYX CALTHELLA (2) AND ALLIONELLA.



Photo, F. N. Clark.

LARVA OF MICROPTERYX CALTHELLA.

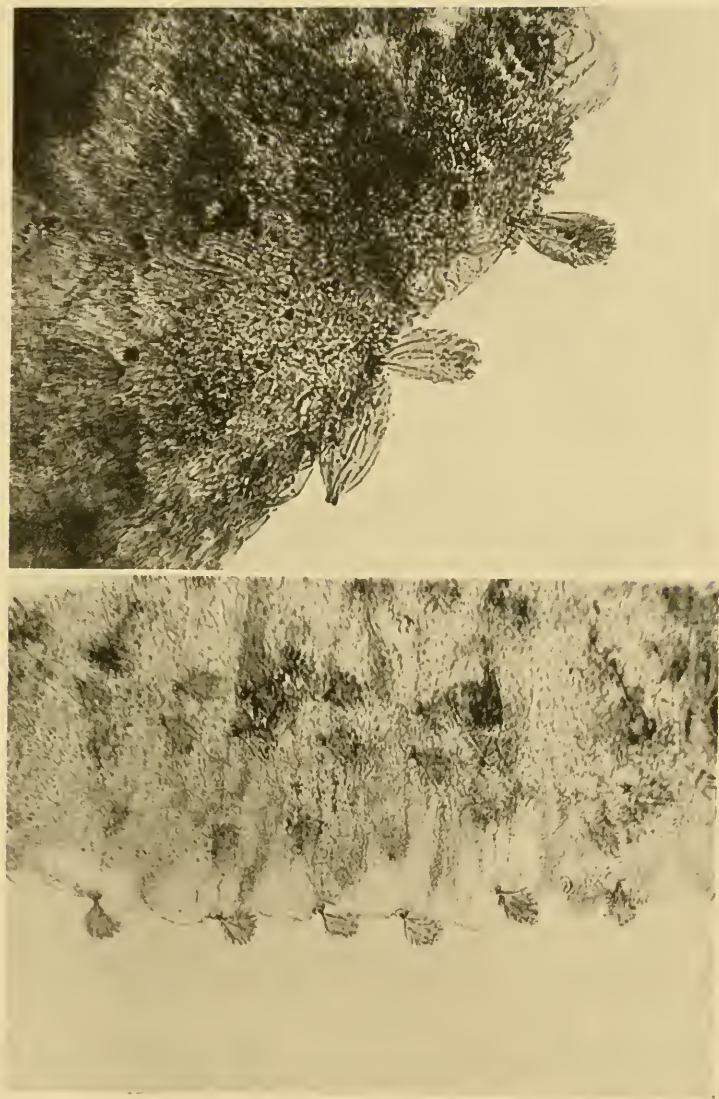




Photo, F. N. Clark.

MICROPTERYX CALTHELLA, HEADS OF LARVA.





Photo, F. N. Clark.

LARVA OF MICROPTERYX CALTHELLA.



examples lend themselves to good photographic demonstration; but those selected are probably sufficient to fully show the facts in question, and even to demonstrate them, though not, of course, so simply as an examination of actual specimens at once does.

I add some photographs of specimens of the larvae that I have had on slides for over twenty years, as well as of other specimens of the same date showing the mouth parts of the imago and the male genital appendages.

These may be of assistance to those who do not care to refer to the original papers already referred to.

EXPLANATION OF PLATES LXXXI—XCII.

- PLATE LXXXI. Abdomen of female *Micropteryx thunbergella*, $\times 40$, and last three segments, $\times 80$, shows that no opening exists except terminally. The little cloud at a perhaps critical point on the 8-9 intersegmental membrane, is a scrap of interior contents, not completely cleared, of which other portions may be seen in the two preceding segments.
- PLATE LXXXII. Abdomen of *M. calthella*, $\times 25$, and another specimen, $\times 50$; in the latter the 3rd to the 7th segments have got twisted and folded, the terminal segments are telescoped as in position of repose. Most of the preparations here shown were made many years ago, without the present use of them in view; those here photographed are selected from a number as being most apposite.
- PLATE LXXXIII. *Micropteryx seppella*, whole abdomen, $\times 25$, and end segments, $\times 50$.
- PLATE LXXXIV. *Micropteryx calthella*, ♀, whole abdomen, $\times 25$, last segments, $\times 50$. By some accident the specimen has got broken in the 9th-10th intersegmental membrane.
- PLATE LXXXV. *Micropteryx calthella*, ♀, abdomen (with portion of thorax, $\times 30$, and *M. seppella* (abdomen only), $\times 30$).

- PLATE LXXXVI. *Micropteryx ammanella*, ♂, to show the permanent exertion and massive structure of the male appendages.
- PLATE LXXXVII. End of abdomen of *Eriocrania semipurpurella* to show the contrast with *Micropteryx* and the apparent ostium, *o*, on the 8th abdominal segment.
- PLATE LXXXVIII. Portions of heads with mouth parts of imagines of (upper) *Micropteryx allionella*, and (lower) *M. seppella*, both $\times 100$.
In both the maxillary palpi are broken off—a portion of one is seen at top of upper photograph; the maxillae with lacinia and galea are fairly seen in both figures, the mandibles best in the lower one. The letters refer: *a*. antenna, *g*. galea, *l*. lacinia, *lbr*. labrum, *lp*. labial palpi, *mn*. mandible, *mx*. maxilla, *st*. stipes, marked at position where palpus broken off.
- PLATE LXXXIX. 1. Larva of *M. calthella* in first instar $\times 100$, head, strongly exerted by pressure; the three legs and eight false legs are well seen.
2. Larva of *M. calthella* in second instar, $\times 100$, head retracted; the positions of the skin appendages are well seen.
3. Last segments of larva of *M. allionella*, $\times 25$, show something of the skin appendages and the two terminal bristles.
- PLATE XC. 1. Larva of *M. calthella* second instar, $\times 75$.
2. *Micropteryx calthella*, larva in second (third?) instar, $\times 50$, head retracted; the skin texture and appendages are seen.
3. *Micropteryx calthella*, larva in last instar, only one that spun a cocoon and died therein, $\times 25$.
- PLATE XCI. *Micropteryx calthella*, portions of larva in first and second instars, $\times 250$, showing skin appendages.
- PLATE XCII. *Micropteryx calthella*, heads of two specimens of first-stage larva, $\times 250$, showing antennae and mouth parts, and in one specimen a leg enters the picture and some skin texture is seen.

XV. *The Evolution of the Habits of the larva of Lycaena arion*, L. By T. A. CHAPMAN, M.D.

[Read October 4th, 1916.]

IN presenting my observations on *L. arion* last year to the Entomological Society, I confined myself to the bionomics actually observed; nor had I thought out more than some very vague ideas as to how the remarkable habits of the larva had come about. A luminous comment by Mr. Bacot, however, made a starting-point for endeavouring to co-ordinate our knowledge towards its explanation. Like many such valuable suggestions it seems so simple and so probably true, that one feels sure that one surely had thought of it all the time. Yet I don't suppose that I or any one else had clearly done so till Mr. Bacot brought his trained acumen to bear on the point. Mr. Bacot's supposition is that "the doing away with moults after the entrance to the nest is a precaution against the temptation to the ants of a soft, newly-moulted larva." The initial point in the evolution of these habits would probably be that found in the case of those "blues" whose larvae are collected by the ants and placed on food-plants actually on the ants' nest, as occurs with *argyrognomon*, *coridon* and *bellargus* and probably other species. It may be a question whether the nest is not actually extended towards a suitable plant, but where this occurs plants and ants' nests are both numerous, so that their coincidence in locality is necessarily frequent. It might be said that the ants do take these larvae to their nests, as they leave them, when at rest, on the root stocks of their food-plants, and cover them with loose material; and I have seen ants remove a small larva that they appeared to think in danger when I disturbed them. A slightly deeper enclosure in the nest, and a cannibal proclivity on the part of the larva, would initiate the *arion* habit.

The normal number of moults in Lycaenines is four, and the normal instar for hibernation of those that hibernate as larvae is the third instar. I have not found any accurate record of these points in regard to the congeners of *arion*
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(*euphemus*, *arcas*, *alcon*), but, as they hibernate as half-grown larvae, the probability that they have the usual number of moults and hibernate in the third instar is very great. Nor, even should they deviate from this as regards one moult, as one or two *Lycaenines* occasionally do in one or other of these particulars, they equally form a base from which we may believe *arion* started in developing its extraordinary habits. In that case we may with considerable certainty assume that at first *arion* was carried into the nest in the third instar, and there hibernating initiated the remarkable indifference the ants show towards the larva, which would then be quite harmless, though they are now enemies that one would expect to be dreaded and combated.

It is probable that some of the larvae so carried in chose to take another moult before hibernating, as occurs in *A. pheretes* (Trans. Ent. Soc. 1912, p. 403), and, feeding in the interval, their cannibal tastes would enable them to get on by eating the larvae of the ant. Once this habit was acquired, further progress would in a sense be simpler, though there would remain the difficulty of two moults to be made in the ants' nest, and contentment with the diet of ant larvae in the spring to be acquired and fixed. If we assume an occasional variation in the instar for hibernation from the third to the fourth, accompanied frequently with an actual diminution of the size of the larva in these instars, we make a further step. It is very likely that the variation in the instar of hibernation from the third to the fourth is really due to some privation of the larva, that made it badly grown and nourished in the third instar and ill-equipped for hibernation. My experiments on the larvae of *Agrotis comes** and others showed that starvation often led to an extra moult; here, of course, the moult is not an extra one, but an antedating that would be of similar effect.

These larvae in the fourth instar would not be much larger than the usual third-stage larva, and would be equally within the power of the ants to carry. We do not know whether the ants would prefer a larger or smaller larva, but probably the latter, as that has been the direction in which *arion* has varied. A tendency to vary towards diminished size would also be involved in the causes leading

* E. M. M., vol. xxxii (1896), pp. 54, 80.

to hibernation in the fourth instar. As to losing the fourth moult, this would present few difficulties, the most parallel case I know of being that of *Acronycta alni*, which has lost a moult as compared with its nearest relatives. The loss is associated with the remarkable change from the bird-dirt-like young larva to the handsome and conspicuous last-stage one. Now and then an individual resumes the lost instar and presents a stage intermediate between the two forms—obviously a form that is neither flesh nor fowl and therefore has been lost, but not so completely as not to reappear sporadically. *Moma orion* presents in each brood a larger and a smaller race, the former with one more moult.* *O. antiqua* and many other species present examples showing that the losing or gaining of a moult is not an infrequent occurrence. *Orgyia antiqua* has, in fact, in each brood two races—one with a moult less than the other, and each with a moult less in the male than in the female; this is probably correlative, along with the long period over which the eggs of one brood go on hatching, with the fact that this single-brooded (in England) species is on the wing from early summer till late autumn, fresh specimens emerging during several months.† To return to *L. arion*.

We may admit that whilst still plant-feeders they were less cannibalistic than now; but, as it is a characteristic not infrequent in other blues, they would take not unreadily to eating ant larvae, and we may assume that a certain percentage survived the difficulties of a purely animal diet (*Calymnia trapezina*, e. g., can be reared on oak (or other) leaves, or entirely on other larvae), and the dangers from the ants, which would be greater just after moults. If so much be granted, and it seems all very simple and straightforward, the advantages of protection during the winter and an assured dietary would largely balance the disadvantages and dangers. These would be eliminated as certain larvae dropped a moult and were accordingly at an advantage, and assuming as possible they were first carried in in the third instar, a diminution in size at moults would lead to a change to fourth instar for the translation. This diminution in size would be favoured, if the carnivorous habit was advantageous from a nutritive aspect; since the larvae that grew least on thyme and so got earlier into the

* Ent. Record, vol. iii, p. 220.

† E. M. M., vol. xxiii, p. 224.

nests would benefit, and also the ants would more easily transfer them.

The assumptions here made are not very far-fetched, and if they be granted it becomes possible to understand how such a remarkable life-history became evolved. It is to be remembered that this history refers only to *L. arion* (probably also to *arionides*, which though a distinct species is exceedingly close to *arion*), and that its congeners (*euphemus*, *arcas*, *alcon*) have ordinary Lycaenine life-histories, so that the evolution is comparatively modern and does not involve an ancestry including other species, and therefore does not imply a number of conditions probably unknown to us. That is to say, there can be no doubt that *L. arion* itself developed these curious habits, and did not inherit them from any other species with ant-hosts. To settle certain points that at present we can only guess, it is necessary to know the precise life-histories of the congeners of *L. arion*, especially how many moults they have, and in what instar they do hibernate. Though all those larvae are known, I cannot find definite records on these points. I have reared *melanops* and *cyllarus* and have had the early larva of *L. alcon*, when it mined in the tissues of *Gentiana pneumonanthes*, but I carried it no further; it is, however, well known that *euphemus*, *arcas*, and *alcon*, which are certainly congeneric with *arion*, pass the winter as partly-grown larvae, presumably in the normal third instar.

Cyllarus and *melanops* are not congeneric with *arion*, and both, I think, pass the winter as pupae.

We want actual observation of how the ants collect to one food-plant on the nest the larvae of *coridon*, *thetis*, *argyrognomon* (these, I feel sure, are so collected), and probably others. This habit might easily merge into one of carrying the larva into the nest. In the three species I have mentioned the cannibal habit hardly exists, so that a larva in the nest would almost certainly perish of starvation, and thus no *arion* habit would be initiated. Perhaps the most remarkable fact as regards the hibernation of *L. arion* is that it does so as a half-grown larva in the last instar. No other Lycaenid is known to do so. This change of habit must have developed after the use of the ants as hosts was established, and is perhaps the most difficult fact in the life-history of which to suggest the development.

In discussing various of those matters later with Mr. Bacot, he makes certain comments that may lead us further; but, at any rate, a short note of them may clear up some points and present others as yet insoluble. Were the larvae not *always* carried in in last instar? This seems very improbable, as the only larvae of Lycaenines that hibernate in last instar do so when full-fed. The carrying in would be done probably in third instar, and at the same time and at any rate later, but at first much more rarely, in fourth instar, but previous to a fourth moult. The ants would be likely to attack a larva when soft just after moult, but probably did so rather infrequently, but sufficiently often to make the dropping of the fourth moult advantageous. All this, however, may be incorrect, and the actual adaptation more easy, if it be the case that *Lycaena* (as now represented by *euphemus*, etc.) only moult three times, and so forth.

How does *Liphyra brassolis* manage its moults? It is clearly regarded by the ants inimically, and has a suit of very strong armour-plate.

Would the ants not select the smaller larva, first of third instar, and, as the selection diminished the size of the larvae in each instar, then of fourth instar?

In view of the comparatively gigantic larvae of *argyrognomon* I have seen ants carrying, viz. small in last instar, it seems more probable that the ants took larvae of any size, since fourth-instar hibernating larvae would not be too large for them, and that the diminution in size was the result of an effort to reach as early as possible the more nutritive food afforded by the ant larvae, *i. e.* of course that larvae that were sooner in such better circumstances had a survival advantage. Mr. Bacot asks is there anything known of the danger from ants to the external feeding species at the period of the moult, or, a parallel question, is there any suggestion of a specially quick rehabilitation of the honey-gland in contradistinction to other details after a moult? So far as I can say I think the answer is that we know nothing on these points. The larvae I have found on plants on ants' nests have been in various instars, so probably quite escape attacks at moulting; but this is only guessing. The ants also build tents over individual larvae, and obviously regard them as valuable cattle to be carefully tended and defended, but they *may* eat a tempting larva nevertheless, but I feel tolerably sure that they do

not. It is also the case that the larvae leave these tents to feed, and return to hide themselves in the ground amongst the debris covering the ants' nest—a habit that obtains even if the soil beneath the plant has no ants' nest in it, as they nevertheless hide in the soil by day if they can get under it, or if they cannot penetrate it, then amongst the plant stems close to the ground. It is therefore possible to say that the larvae protect themselves in this way during moulting.

I feel interested in all this as mere speculation, for others I may submit that its value consists in showing that whilst we have solved some important and interesting problems in the life-history of *L. arion*, we have opened the view of others that will require probably even more careful work and prolonged observation and experiment to solve them.

(October 2.) Since writing the above, I have received from Mr. Harold Powell some material bearing on the life-history of *L.alcon*. The mature larva described as green, etc., lives, according to report, on *Gentiana pneumonanthe* in spring, and I have already referred to its first stage. Mr. Powell found the food-plant bearing many eggs; when he came to examine them, however, he discovered the curious circumstance that they were all empty, the larva escaping from the lower aspect of the egg, leaving it looking intact and apparently full—a circumstance that only occurs in any Lycaenine, whose eggs I have had, as a really rare accident. The young larvae, however, had not bored directly into the plant tissues beneath, but had apparently entered the flowers.

Mr. Harold Powell, however, sent me heads of *Gentiana pneumonanthe* (Sept. 22, 1916) in the flowers of which larvae of *L.alcon* had fed; unfortunately they had practically all left the flowers for some unknown place (for hibernation). An examination of the flowers showed, however, abundance of eggshells, generally laid on the calyx, from which the larvae had escaped from the under surface, entering the still unopened flower. A close search was rewarded by cast heads of the first instar, and one dead larva in this instar. Skins cast at the second moult were abundant, *i. e.* there were usually several, often four or five, in one flower. One dead larva was found, just about to moult for the third time; inside the skin was the rather immature fourth-instar larva.

It may be that all the larvae reach the fourth instar (like *arion*) before hibernation; but since all the third-instar larvae had gone, presumably to hibernate, and only this one taking another moult was left, I take it to have been an exceptional individual taking an additional moult (as occurs in *phetes*). So exceptional, however, as to be usually a failure, as in this case. Such a variation occurring in (the original) *arion* would obviously facilitate the acquisition of its peculiarities as regards moulting. Of course *L. alcon* may have the same habits as *L. arion*; we do not certainly know, but the mature larva is known and has a green coloration, like most of our other Lycaenids. The swampy places where *G. pneumonanthe* grows are not suitable for abundant ants' nests, and they would have to be abundant, as the butterfly swarms in the locality whence Mr. Powell sent me the flowers, and many flower-heads had a large number of eggs on them, probably each laid separately; the larva has a well-developed honey-gland. The flower-feeding larvae of *L. arion* are fiercely cannibalistic; the numbers of *L. alcon* that live amicably together in the same flower show that it is entirely free from such a habit.

If *arion*, then, like *L. alcon*, occasionally entered the fourth instar before hibernating, the question as to moults resolves itself merely into losing the fourth moult; but not really quite so simply as this, since the fact is not so much the loss of a moult as the loss of an instar, viz. the fourth, the third moult not resulting in a penultimate, but in the last instar. This is the fact in *Acronycta alni*, and should be as easily obtained in *L. arion*.

XVI. *Gynandromorphous Lepidoptera*. By E. A. COCKAYNE,
M.A., D.M., F.R.C.P., F.E.S.

PLATES XCIII-CIV.

[Read October 4th, 1916.]

THE rarity of gynandromorphous Lepidoptera and the difficulty of obtaining them in a condition fit for dissection has stood in the way of the examination of their internal anatomy. The internal organs have been investigated and described in about twenty perfectly or almost perfectly halved examples. Eight of these in *Amorpha populi* I figured and described in the Journal of Genetics. Six of those previously described were also examples of gynandromorphs of this species. Since these were published I have dissected two more *Amorpha populi* and one *Amorpha hybridus* Steph. (*A. ocellatus* ♂ × *A. populi* ♀). As in the former examples the *populi* were from Newman's strain, as was the female parent of the hybrid. The hybrid was bred by Mr. Sydney Whicher, to whose generosity I am indebted for the specimen.

The first *A. populi* (R ♂, L ♀) showed in all external characters perfect halving, and the colour, dark grey, was the same on both sides. On dissection it proved to have on the right side a testis, vesicula seminalis, vas deferens, glandula accessoria, ductus ejaculatorius and penis, and on the left side an ovary with four follicles, oviduct, spermatheca or receptaculum seminis, cement gland, and bursa copulatrix. It was, in fact, a true genetic hermaphrodite without any reduplication of organs and with only one defect, absence of the ductus bursae or seminis. The external genitalia showed on the last segment a small uncus continuous in the usual way with the tegumen and cingula, and on the left a half ovipositor with its coarse tactile hairs and directing-rod. Opposed to the uncus was the gnathus, and between them lay the anus. The less distal segments showed a similar halved arrangement of male and female structures. There was a nearly perfect right valve (14) and harpe (15) and a much smaller left valve and harpe. Behind and between lay a normal ring-

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wall (13) allowing the passage of a penis (7) narrower than usual but with well-formed oedaeagus, vesica and cornuti, the latter in two groups, a large group of large spines and a small group of small ones.

The tegumen and cingula (16), which in the normal male form a complete ring or girdle of stout chitin with a lateral hinge on each side, ended in the gynandromorph slightly to the left of the middle line. Thus on the male side all the parts were present, but the uncus and penis were small. The uncus is in reality a double organ, and in many groups is bifid. It is homologous with the two halves of the ovipositor.

The uncus was small because it was only half the ordinary double uncus, and I regard the narrowness of the penis as being due to the same cause. It was small because it was formed from only half the normal primitive epithelial mass of cells. There was reduplication of the clasping apparatus, valve and harpe, and partial reduplication of the cingula. On the left side was a small malformed bursa copulatrix and caput bursae, an abnormally small ostium bursae or genital opening and a normal rod of the ninth segment.

Thus the female parts were all present, but with the exception of the rod, a paired organ, all were small in size owing to their origin from half the usual number of epithelial cells.

The second gynandromorphous *A. populi* was not perfectly halved, the right side was predominantly female, and the left predominantly male. The wings on the left approached the female in shape, and the antenna on the left showed the coarse hairs peculiar to the male, though much less well-developed than those on the right. The colour, red brown, was the same on both sides.

Internally there was only one gonad, an ovary with four follicles, which lay on the right side of the body. There was also an oviduct, cement gland, spermatheca and very small bursa copulatrix and caput bursae, but no ductus seminis. On the male side there was only a penis with a soft saccular mass of chitin representing the blindly ending ductus ejaculatorius.

The external genitalia showed a completely halved arrangement. On the left side of the tenth segment was a small uncus and on the right a normal half ovipositor, with its directing-rod. Opposed to the uncus was a gnathus of small size, and between them lay the anal opening. On

the left were two valves and harpes rather compressed, the valve and harpe lying internally near the female organs being smaller and more distorted. There was a penis sheath, a narrow but perfect penis and a cingula, perfect on the left side but on the right very thin and soon ending by gradually disappearing in the thin chitin of the female side. On the right side was a small ostium bursae, from which ran a long thin tube, opening into a small twisted bursa copulatrix, with a small curved caput bursae. The directing-rod of the ninth segment was normal in size and shape.

The condition of the external genitalia in both gynandromorphs is the same in all important points.

The gynandromorphous hybrid was perfectly halved, being male on the right side and female on the left. The antenna and palpus of the right side showed perfectly developed male characters, those on the left female (Plate XCIV). The hair on the thorax and abdomen was longer and thicker on the right side, the division being accurately in the middle line. The abdomen was stouter on the left side.

The wings failed to expand, but those on the right side were darker and the basal patch of the hind-wing was larger and darker on the right side than the left. On both sides the characters were intermediate between those of the two parent species.

Internally the insect had no male organs, except the lower end of the ductus ejaculatorius, which formed a dilated sac opening into the penis, and there were no female organs except a bursa copulatrix of small size, and a cement gland of most abnormal shape.

The cement gland had a very narrow duct with an unusually large dilatation in its course, and the gland itself was double, one branch ending in a very small thin tubular part, the other in a tubular portion equally thin but longer, though not nearly as long as that of a normal gland. The duct ended in a mass of chitin near the neck of the bursa, and which probably represented the undeveloped vagina.

Thus, though the secondary sexual characters of both sexes were perfectly developed, the insect possessed neither ovary nor testis.

Externally the genitalia showed a perfectly halved condition, male on the right side and female on the left.

There was a small uncus and narrow sickle-shaped

gnathus enclosing the anal canal on the right side and a perfect half ovipositor and directing-rod on the left. A valve lay on the right side, distorted and possessing a curious prolongation of very thin chitin, with an up-curved, knob-like extremity. There was also a malformed harpe. A small piece of chitin (13) probably represented the ring-wall or penis sheath, and the penis itself was very short and was tilted so that the vesica pointed ventrally. The very small cornuti on the vesica resembled those of *ocellatus* rather than those of *populi*, a condition usual in male hybrids, in some of which no cornuti at all are present.

The cingula was present only on the right side, and ended abruptly in the mid-line. On the left side there was a thin, rounded piece of chitin external to the ovipositor, of the nature of which I am uncertain.

The ostium bursae was very small, and the bursa itself small and ill-formed. The rod of the ninth segment was normal.

The hybrid showed a perfectly halved condition of the external genitalia without reduplication or defect, and it is interesting that, although in the female hybrid male external organs are always found usually in the form of a coarse mosaic, none occur on the female half of this gynandromorph.

A comparison between the diagrams of the genitalia of the gynandromorphs, which are drawn partly as transparencies, with those of the genitalia of normal male and female *populi*, will make it easy to understand the exact degree of departure from the normal which the various structures in the gynandromorphs exhibit.

These three gynandromorphs, to my mind, are a further proof that the same underlying cause can produce true lateral genetic hermaphrodites, halved or lateral gynandromorphs with one or more gonads of one sex only, or without gonads of either sex, but with external structures of both sexes (primary somatic hermaphrodites).

The differences appear to me to be due to a failure of part of the genital tract to develop, a failure which is specially liable to affect the sexual gland itself.

With regard to the external genital organs, the ideal condition would be that in which exactly half the organs of each sex would be present. This cannot occur except in the case of the paired organs, such as the ovipositor and directing-rod, the rod of the ninth segment in the

female, and the valve and harpe in the male. In the case of these it is generally met with, but there is a tendency in the case of paired organs, which lie contiguous to one another, for the half-sized mass of epithelial cells, which theoretically should give rise to one full-sized member of a pair of paired organs, to produce actually an imperfect and undersized pair instead.

This occurs most often in the case of the valve and harpe in the male.

It does not occur in the case of the rod of the ninth segment, because the rods develop far apart, not close together, like the valves.

In the case of unpaired structures, especially those which are tubular or saccular, the half-sized mass of primitive cells gives rise to a complete tube or sac, which is reduced in size, and often imperfect in form.

Examples of this kind of structure are the penis in the male and the ostium bursae and bursa copulatrix in the female.

This explains the narrowness of the bursa and slenderness of the penis usually found in halved gynandromorphs.

Entire failure of a part to develop occurs less often in the external than in the internal organs, but in a genetic hermaphrodite, which I described and figured, the whole of the external genitalia of the female side failed to develop, whilst those on the male side showed reduplication.

They were, however, situated laterally on the male side of the insect and not centrally. Mr. Bethune Baker kindly called my attention to the account he published in these Transactions in 1891, of the external genitalia of a halved gynandromorph of *Eronia hippia* var. *gaea*. It is mounted laterally, and the point I wish to bring out is not clearly shown in his beautiful and accurate drawings. He has allowed me to examine the specimen, and I agree with all he says, except that what he regarded as combined valve and ovipositor I consider to be a valve lying over a half ovipositor. Examination of it from above and below with careful focussing has convinced me that the specimen agrees with the majority of gynandromorphs of this kind, and that the arrangement of the parts is that shown in my diagrams (Plates CIII and CIV). On the left side of the terminal segment one can see a half ovipositor with its rod, on the right a narrow uncus, from which runs as a half girdle the tegumen and cingula. The saccus, a structure not

present in *Amorpha*, is very narrow, being another example of an unpaired organ reduced in size because it is developed from half the usual number of cells. From the other side of the saccus runs a small piece of cingula, an example of partial reduplication of what is really a paired structure, which, like the uncus, has become fused. Two valves are present, though not quite normal in shape, and the penis is more slender than usual. The female half is the more interesting.

In the normal *gaea* there is a most elaborate ostium bursae, guarded by two folds of chitin, covered with coarse, curved hairs, and in the ventral wall of the bursa itself is a dense mass of chitin with two wings covered with short, thick spines, a structure corresponding to the signum of the geometrid bursa.

In the gynandromorph the ostium has only one of the chitinous folds present, that lying on the left or female side.

The whole bursa is small in size, and only the left wing of the signum is present (Pl. CIV).

This is the best proof I have met with that the small bursa of the gynandromorph represents a half bursa. The primitive cell mass, half the usual size, could complete the tubular neck and saccular body of the organ, but could not develop more than one half of such an elaborate structure as the chitinous fold guarding the ostium or the signum in *gaea*.

THEORY OF ORIGIN OF HALVED GYNANDROMORPHS.

When I published my paper in the *Journal of Genetics* in 1915 I was unaware of the earlier writings of Morgan on this subject. In his first paper, published in 1905, "An alternative interpretation of Gynandromorphous Insects," he suggests that two spermatozoa may enter the same egg, and that one of these develops without any fusion of its nucleus with the nucleus of the egg, whereas the other fuses in the usual way. The independently developing spermatozoon derived solely from the male parent produces the male part of the perfect insect. The other, combined with the ovum, produces the female part, which is thus derived from both parents.

The theory is alternative to that put forward by Boveri, who thought that there was a premature division of the egg nucleus, one half of which combined with the whole

nucleus of a single spermatozoon and gave rise to the male portion of the gynandromorph, the other half developed parthenogenetically and gave rise to the female portion.

In his second paper, in 1907, Morgan reiterated his theory, and in support of it brought forward Toyama's gynandromorphous *Bombyx mori*.

The larva of this insect was striped on the left side, and the imago was female on this side; the right side of the larva was plain and of the imago, male. The striped condition of the larva is a Mendelian dominant over the plain. Morgan regards the striped female half as being derived from the combination of a spermatozoon carrying the recessive "plain" character with an ovum carrying the dominant "striped" character, and the plain male half as being formed from another spermatozoon, which entered the egg and developed without any fusion with the nuclear substance of the egg.

Boveri's hypothesis rests on the condition met with in the gynandromorphs of the Eugster hive of bees. In these insects Newell has shown by the following experiments that drones inherit the characters of the queen. An Italian yellow queen crossed with a Carniolian grey drone produced yellow workers and queens, and the drones were yellow also. A Carniolian grey queen and an Italian yellow drone produced yellow workers and queens, but the drones were grey. This shows that yellow is dominant over grey, and that drones are produced from unfertilised eggs, and derive their characters from the queen or female parent only.

Boveri carefully examined some of the Eugster gynandromorphs preserved in spirit, and in spite of the loss of colour he made out that the male parts were maternal and the female parts paternal in their characters. The colour of the male parent was dominant over the colour of the female parent.

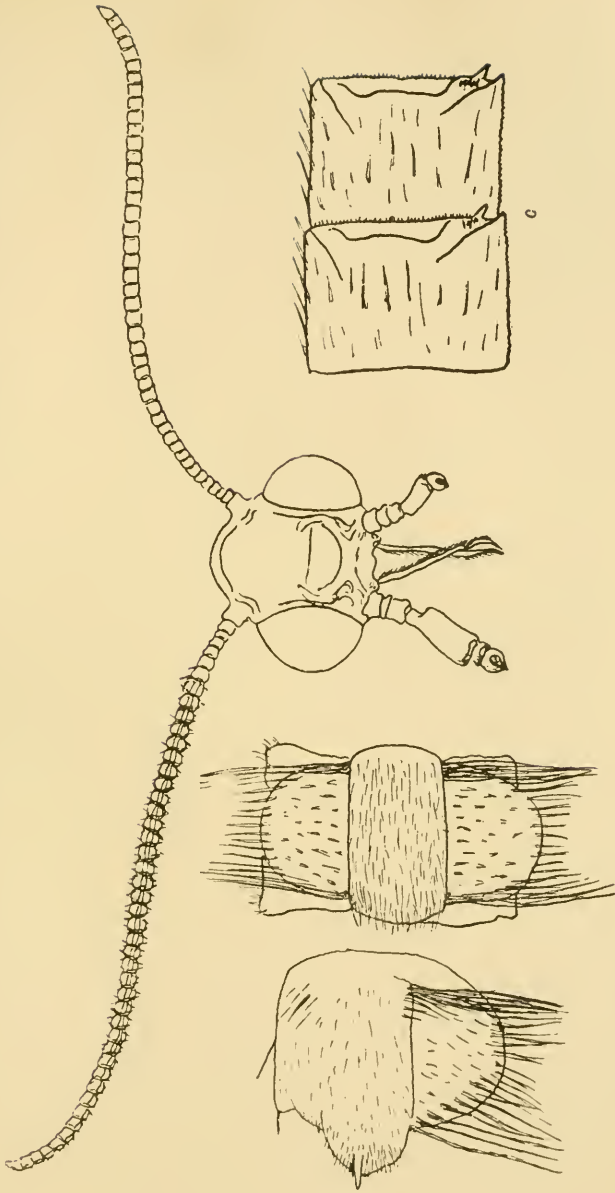
Mehling made an independent examination of the material and arrived at the same conclusion. The condition found in these bees supports the view that the male parts are derived from the unfertilised part of the ovum, the female from the fertilised part. Another hive of bees has recently been met with at Terek-Gebiet in the Northern Caucasus, and has produced many gynandromorphs, some of which are halved. They were the offspring of an Italian queen by an unknown drone, probably of the form known as *Apis mellifica remipes*. These gynandromorphs, according



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Gynandromorphous Amorpha populi.

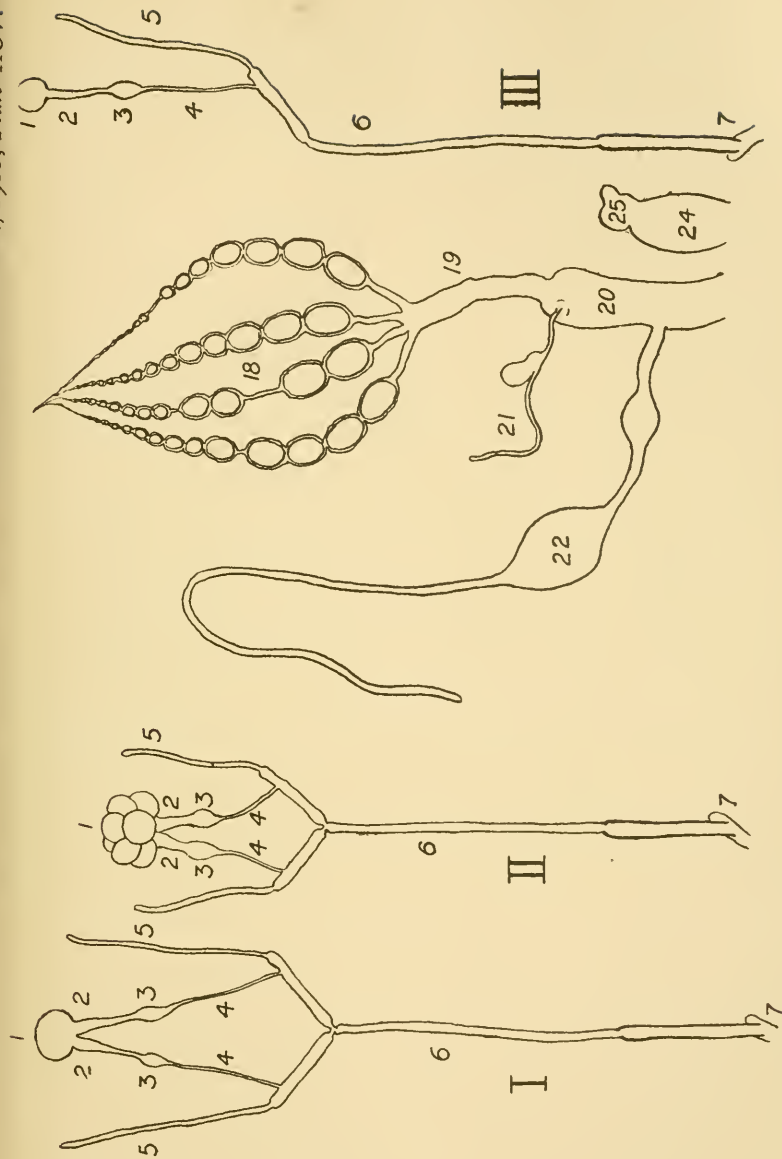




a
E. A. Cockayne, del.

b
Head of gynandromorphous *Amorpha hybridus*.

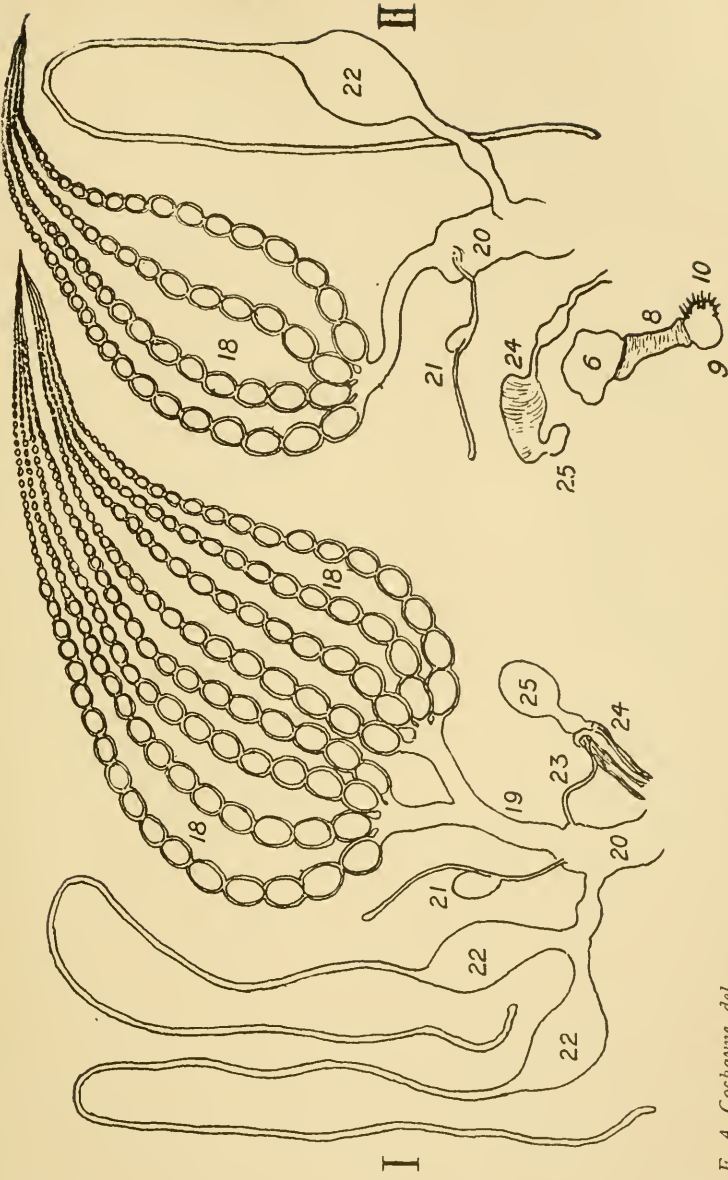




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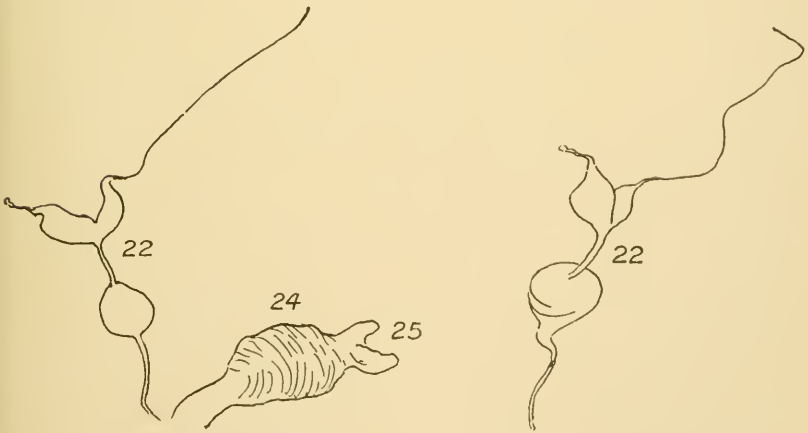
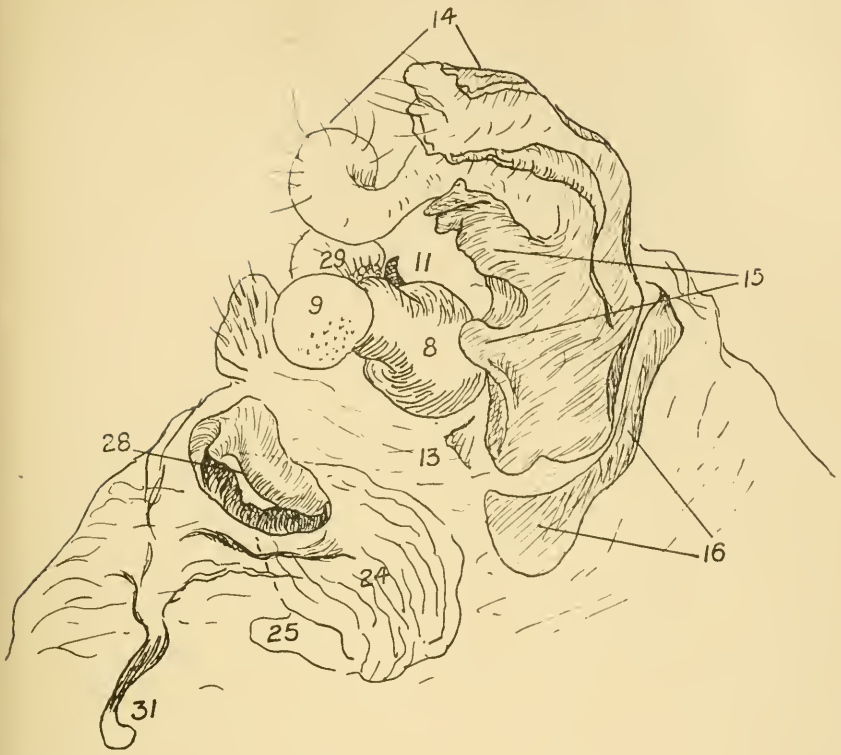
Internal genitalia of (I) Normal male, (II) Intersex, (III) gynandromorphous *Amorpha populi*.





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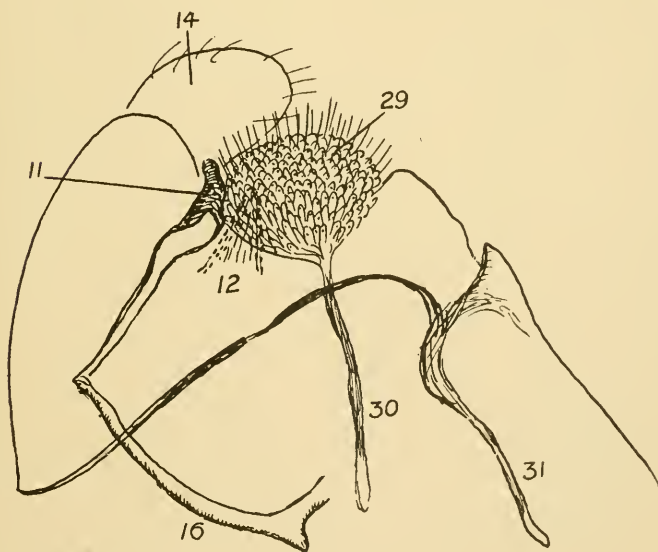
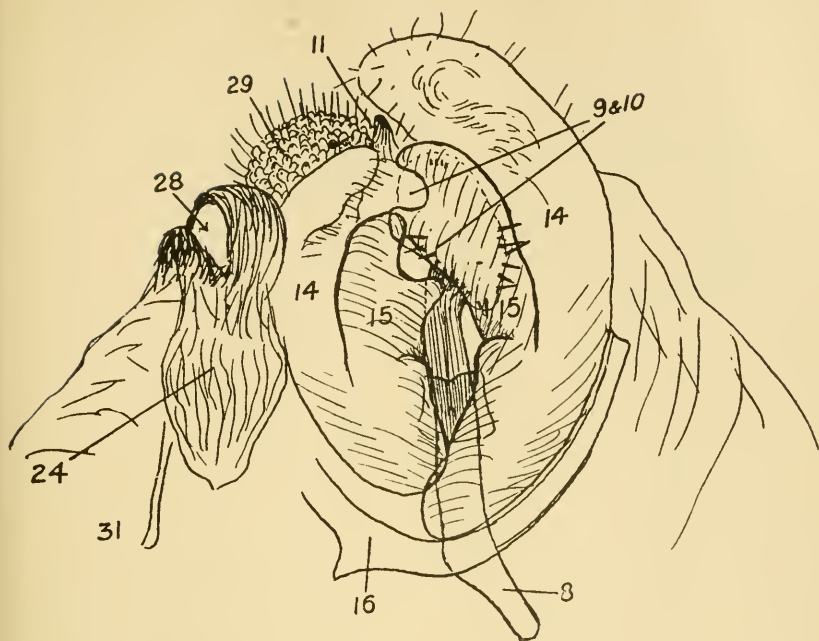
Internal genitalia of (I) Normal female, (II) gynandromorphous *Amorphia populi*.



E. A. Cockayne, del.

External Genitalia, Cement Gland, and Bursa copulatrix and Cement Gland of gynandromorphous *Amorpha hybridus*.

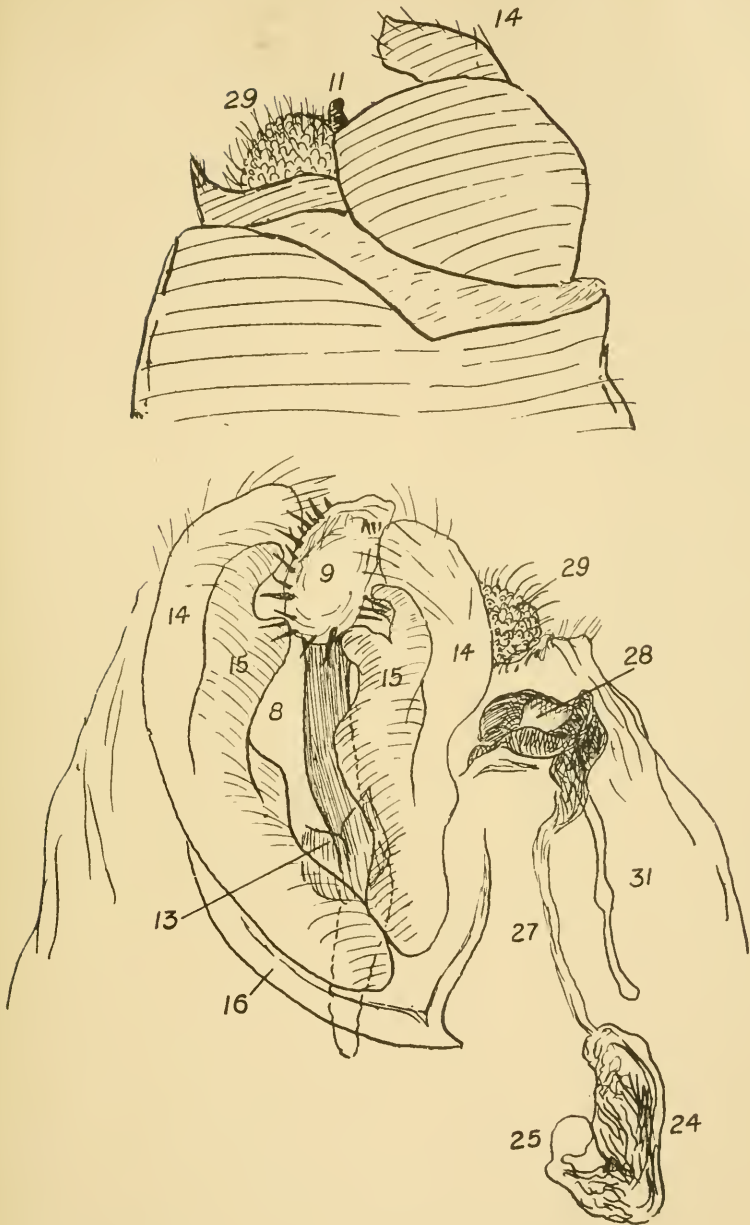




E. A. Cockayne, del.

External genitalia of gynandromorphous *Amorpha populi* (No. 1).

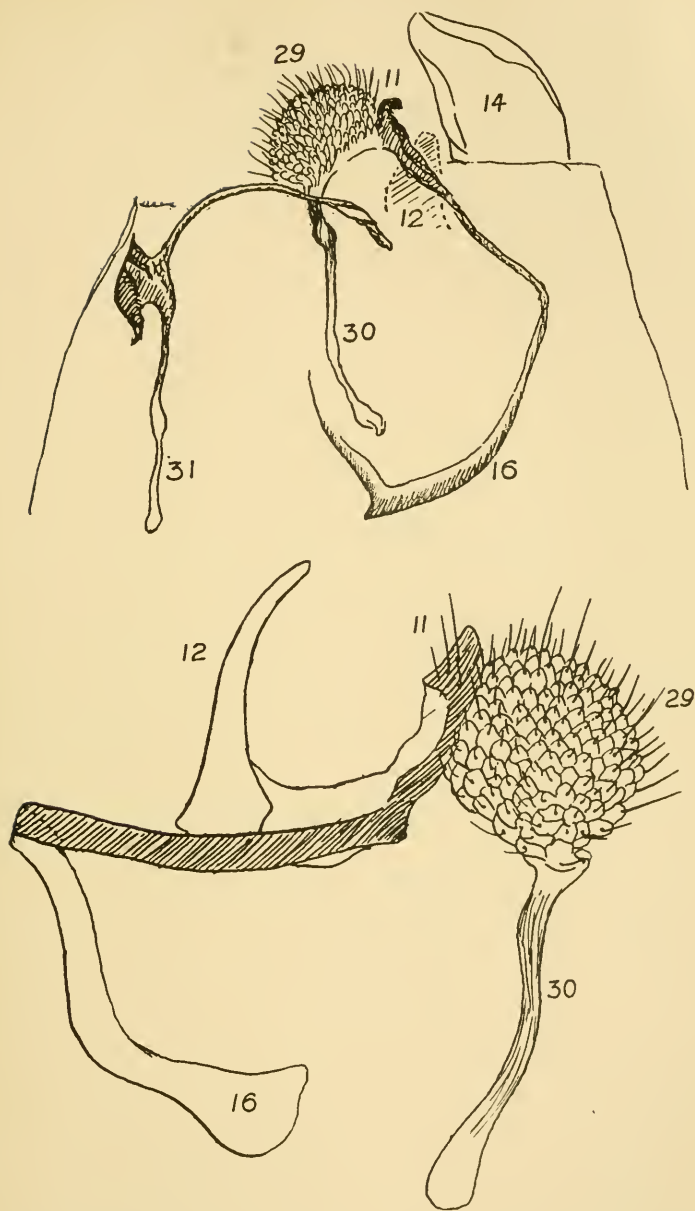




E. A. Cockayne, del.

Dorsal and ventral views of external genitalia of gynandromorphous *Amorpha populi* (No. 2).

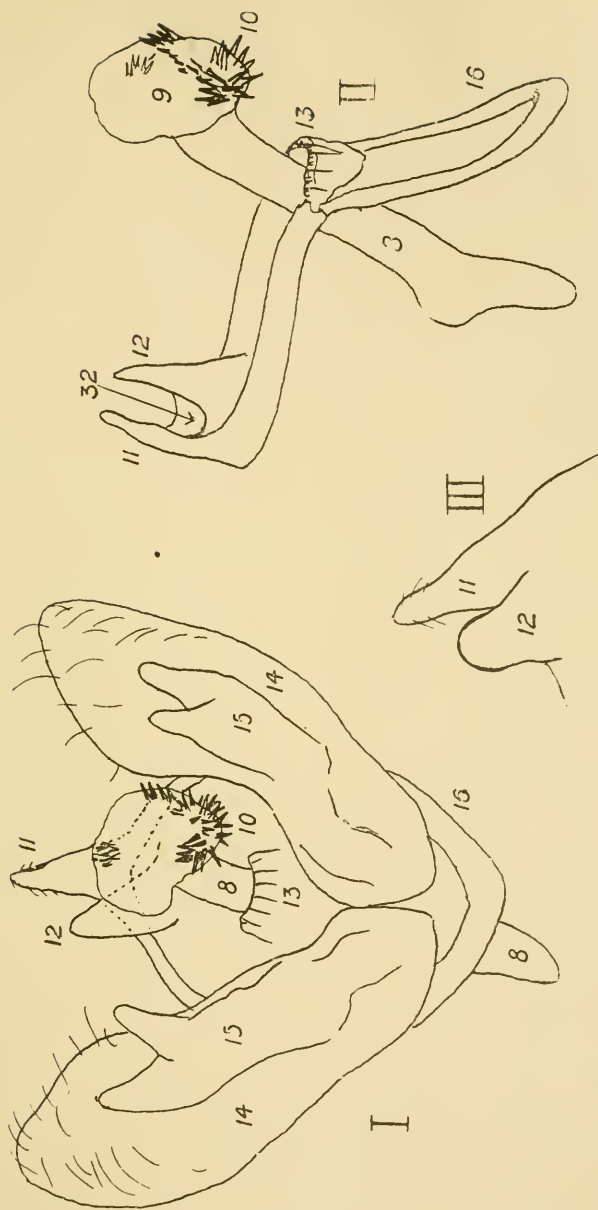




E. A. Cockayne, del.

Dorsal views of external genitalia of gynandromorphous *Amorpha populi* (No. 2) and of gynandromorphous *A. hybridus*.

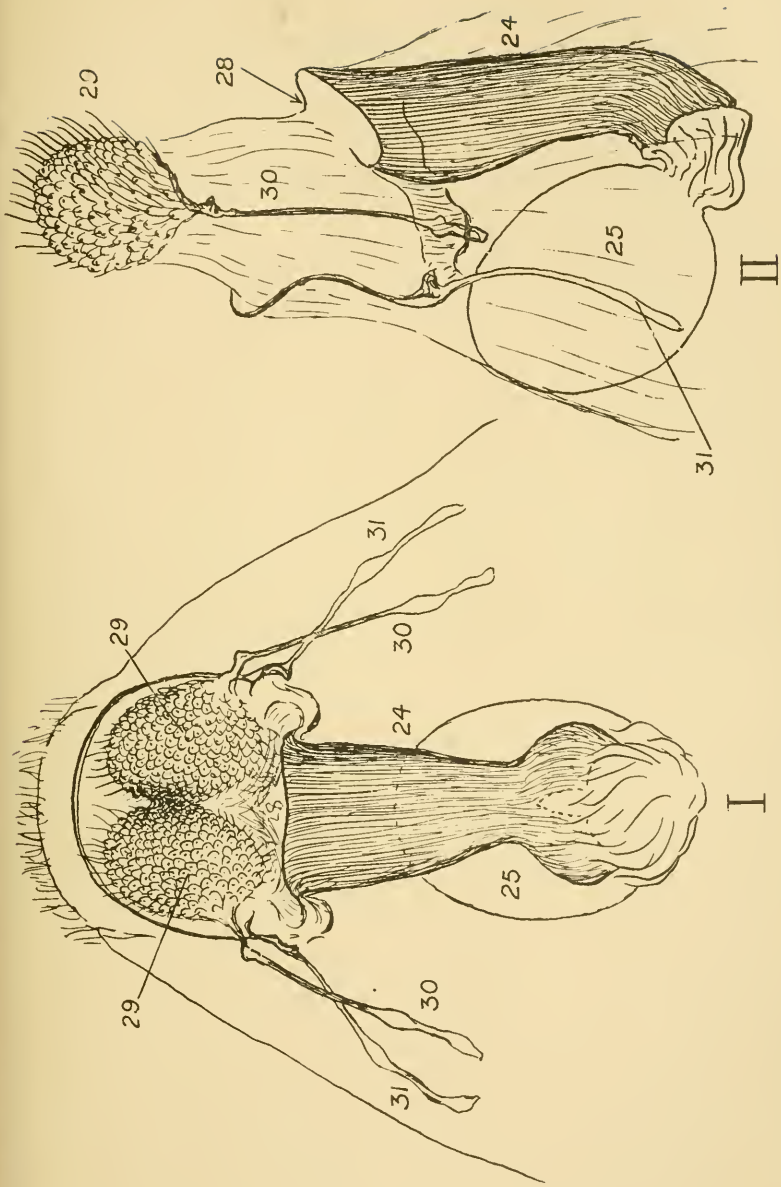




E. A. Cockayne, del.

Ventral and lateral views of external genitalia of normal male, and ventral view of uncus and gnathus of intersex, of *Amorpha populi*.

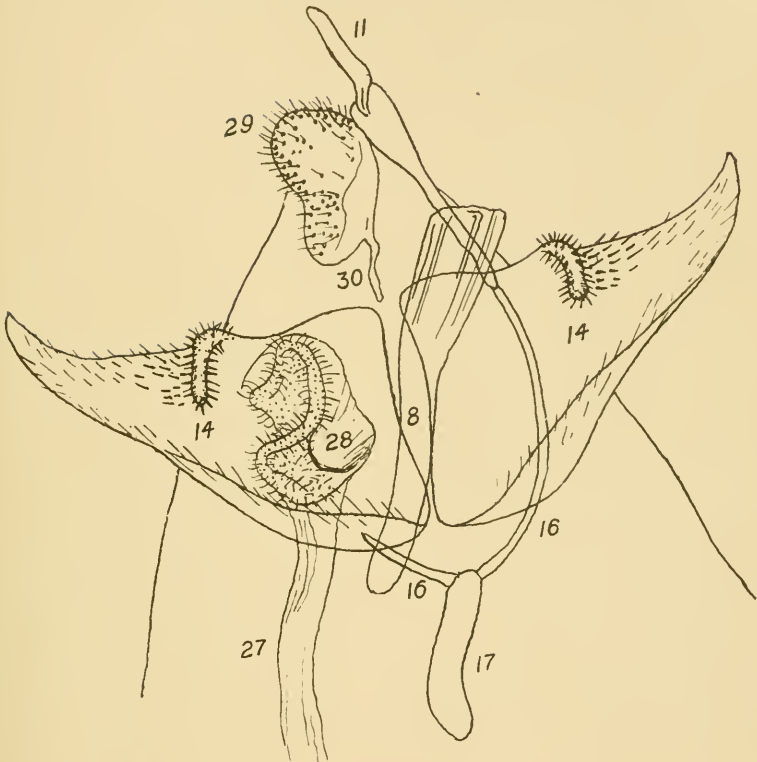




E. A. Cockayne, del.

Ventral and lateral views of external genitalia of normal female *Amorpha populi*.

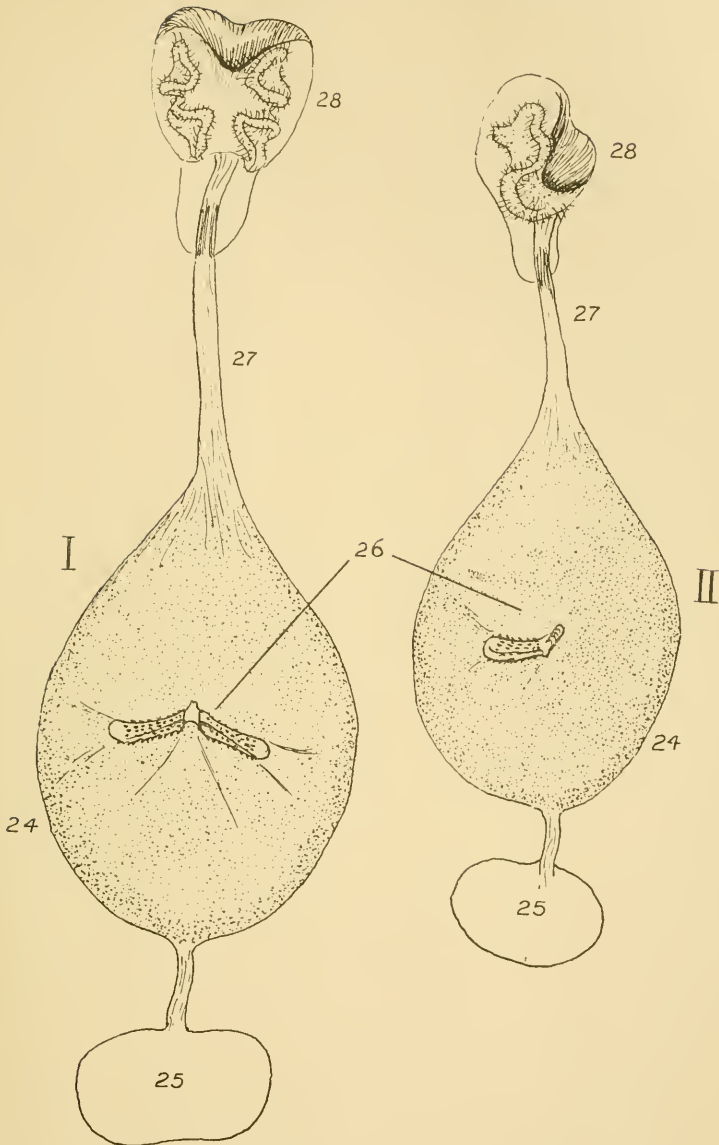




E. A. Cockayne, del.

Diagram of ventral view of external genitalia of gynandromorphous
Eronia hippia var. *gaea*.





E. A. Cockayne, del.

Bursa copulatrix and ostium bursae of (I) normal female,
(II) gynandromorphus *Eronia hippia* var. *gaea*.



to von Engelhardt, who has described and figured them, show a condition opposite to that met with in the Eugster gynandromorphs.

Morgan's third and most important contribution to this subject, "Mosaics and Gynandromorphs in *Drosophila*," was made in 1914, and gives an account of those which appeared in his mutant stocks of the fruit fly. In some of them the male side or male portions showed maternal characters, in others paternal and in others both maternal and paternal characters. The first group would fit in with Boveri's theory, the second with Morgan's, but the third cannot be explained by either, and must be due to "mitotic dislocation" occurring at an early cleavage stage. To prove this, Morgan devised an experiment. He crossed a female *Drosophila* homozygous for the sex-linked characters of yellow body colour and white eyes with a male with normal sex-linked allelomorphs, grey body colour and red eyes, but possessing in addition the recessive non-sex-linked character of ebony body colour.

One gynandromorph was found amongst many thousand offspring. It was partially male on one side, partially female on the other, but on both sides had a grey body and red eyes. This proves that the male side had received a sex-chromosome from the father, the male in *Drosophila* being heterozygous for sex, and a non-ebony chromosome from the mother.

The female side also showed characters derived from both parents.

Morgan concludes that at some early stage of division a sex-chromosome failed to pass from one pole and became lost.

He also points out that all three groups of mosaics and gynandromorphs can be explained on this hypothesis, whereas neither of the other hypotheses will cover more than one of the three groups.

This was the view which I put forward independently and supported by the conditions met with in halved gynandromorph hybrids and in heterochroic gynandromorphs. Several halved gynandromorph hybrids have been met with, and all have shown characters derived from both parents on both sides. One such is described by Standfuss in a hybrid *Saturnia pavonia* ♂ × *S. spini* ♀, the others occurred in *Amorpha hybridus* Steph. (*S. ocellatus* ♂ × *A. populi* ♀).

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One was bred at Wiesbaden and is described by Schultz, right side male and left side female; another was described and figured by Birchall. Neither of these had ova in the abdomen, though the female side was fuller than the male side.

Two others were bred from the same parents by Mr. Sydney Whicher: one has been described in the previous part of this paper, the other is figured in the *Entomologist*, 1915. In these both sides show both maternal and paternal characters.

In heterochroic gynandromorphs the one side or part is of one sex and shows a colour variation often a Mendelian dominant, which is not sex-linked, and the other side or part shows the corresponding Mendelian recessive colour and is of the opposite sex. Many of these are known, but the exact parentage has been recorded but seldom. Four were obtained in one brood of *Hemerophila abruptaria* by Simmons, from a cross between a light and a dark parent.

1. Right side male and ab. *brunneata*, Tutt. (melanic), left side female and typical.
2. Right side male and ab. *brunneata*, left side almost entirely typical and female.
3. Right side female and ab. *brunneata*, left side male and typical.
4. Right side male and ab. *brunneata*, left side female and typical.

The melanic ab. *brunneata* is dominant over the buff-coloured typical form, and the parents must have been a homozygous recessive and a heterozygous dominant for colour. The combinations of colour and sex in these gynandromorphs could not have arisen except by both sides having received characters from both parents.

The suggestion put forward by Doncaster that a gynandromorph arises from the fertilisation of an ovum possessing two nuclei by two spermatozoa is possible, and would explain the occurrence of heterochroic insects, simple gynandromorphs and heterochroic gynandromorphs. Doncaster has demonstrated the existence of such ova and shown that both nuclei can be fertilised independently. It is, however, very improbable that the two nuclei of such an ovum would be different in constitution, and unless this were the case heterochroic gynandromorphs like the

abruptaria bred by Simmons could not occur in the same family, except in cases where both parents were heterozygous for colour. In this case one parent was homozygous and one heterozygous, and so Doncaster's explanation is an unlikely one.

Harrison has recently described a remarkable hybrid *Ennomos subsignaria* ♂ × *E. quercinaria* ♀. The individual was a male with all the characters, external shape and colour and structure of the external genitalia, on the left side like the male parent, *subsignaria*, and on the right side intermediate between the two parent species. To explain its origin Harrison suggests that it arose from the entry of two spermatozoa into a single ovum, and that the nucleus of one of them fused with the nucleus of the ovum and formed the right side with its mixture of maternal and paternal characters, whilst the other developed independently and formed the left side, a purely paternal product.

The explanation is quite possible, since in most Lepidoptera it is the male which is homozygous for sex and the female heterozygous. Had Harrison's hybrid been female on both sides his explanation would have fallen to the ground.

Nevertheless, though it will fit in with Morgan's first theory, it is susceptible of explanation on the theory which Morgan put forward in 1914, and I advanced in 1915.

Harrison says that though these hybrids show a mixture of paternal and maternal characters with some preponderance of the *subsignaria* features, the secondary hybrids segregate on mendelian lines, *subsignaria* and *quercinaria* characters behaving very much like single mendelian units. Thus Harrison's specimen may be regarded as a case of heterochroism without gynandromorphism, and it is almost certain that ordinary heterochroic specimens arise from a normal fertilisation between a single spermatozoon and a single ovum, in which the mitosis in an early cleavage, usually the first, is abnormal.

Thus there are absolute proofs that gynandromorphs, including heterochroic examples, do arise from a normally fertilised ovum, and it is probable that examples of simple heterochroism arise in the same way. The proofs are three in number: first, the gynandromorph of *Drosophila* of known parentage, bred by Morgan; secondly, the halved

hybrid gynandromorphs, and, thirdly, the heterochroic gynandromorphs of *Hemerophila*, bred by Simmons.

There is no actual proof that they ever arise in the way Boveri or Morgan in 1905 and Harrison in 1916 suggested, but, on the other hand, there is no proof to the contrary.

The condition in the Eugster gynandromorph bees, which is the chief support of Boveri, is no longer such valuable evidence in the light of the opposite condition met with in von Engelhardt's. Toyama's *Bombyx mori* and Harrison's hybrid *Ennomos* may be explained on Morgan's first theory. But the condition in all these insects can be explained by his second theory, the one theory which has received definite proof, and it is more probable that all arise in one way than that they arise in three different ways.

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EXPLANATION OF NUMBERS ON PLATES.

- | | |
|---|--|
| No. 1. testis. | No. 17. sacculus. |
| 2. calyx. | 18. ovary. |
| 3. vesicula seminalis. | 19. common oviduct. |
| 4. vas deferens. | 20. vagina. |
| 5. glandula accessoria. | 21. spermatheca or recep-
taculum seminis. |
| 6. ductus ejaculatorius. | 22. cement gland. |
| 7. penis. | 23. ductus bursae or
seminis. |
| 8. oedaeagus. | 24. bursa copulatrix. |
| 9. vesica of penis. | 25. caput bursae. |
| 10. cornuti of penis. | 26. signum of bursa. |
| 11. uncus. | 27. cervix. |
| 12. abdominal sternite of
tenth segment = gna-
thus of Chapman, often
called scaphium. | 28. ostium bursae. |
| 13. penis sheath or ringwall
of Zander. | 29. ovipositor. |
| 14. valve. | 30. directing-rod of ovi-
positor, rod of tenth
segment. |
| 15. harpe. | 31. rod of ninth abdominal
segment. |
| 16. cingula or vinculum of
Pierce. | 32. anus. |

EXPLANATION OF PLATES XCIII-CIV.

PLATE XCIII.

Gynandromorphous *Amorpha populi*.

Upper figure No. 1.

Lower figure No. 2.

PLATE XCIV.

Head of Gynandromorphous *Amorpha hybridus*. $\times 7$. *a*. 28th segment, *b*. 16th segment of right antenna, *c*. 16th and 17th segments of left antenna. $\times 65$.

PLATE XCV.

- I. Internal genitalia of normal male *Amorpha populi*. $\times 2$.
- II. Internal genitalia of intersex of *Amorpha populi*. $\times 2$.
- III. Internal genitalia of gynandromorphous *A. populi* (No. 1).
 $\times 2$.

PLATE XCVI.

- I. Internal genitalia of normal female of *Amorpha populi*. $\times 2$.
- II. Internal genitalia of gynandromorphous *Amorpha populi*
(No. 2).

PLATE XCVII.

External genitalia of gynandromorphous *Amorpha hybridus*. $\times 12$.
Cement gland and bursa copulatrix and cement gland of gynandro-
morphous *A. hybridus*.

PLATE XCVIII.

External genitalia of gynandromorphous *A. populi* (No. 1).
Upper figure ventral view. $\times 13$.
Lower figure dorsal view.
Both drawn as partial transparencies.

PLATE XCIX.

Upper figure: Dorsal view of external genitalia of gynandro-
morphous *A. populi* (No. 2), viewed as opaque object.
Lower figure: Ventral view of external genitalia of gynandro-
morphous *A. populi* (No. 2).

PLATE C.

Upper figure: Dorsal view of external genitalia of gynandro-
morphous *Amorpha populi* (No. 2). $\times 12$.
Lower figure: Dorsal view of portion of external genitalia of
gynandromorphous *Amorpha hybridus*.

PLATE CI.

- I. Ventral view of external genitalia of normal male *Amorpha populi*.
- II. Lateral view of external genitalia of normal male *A. populi*
with valves and harpes removed.
- III. Ventral view of uncus and gnathus of intersex of *A. populi*.

PLATE CII.

- I. Ventral view of external genitalia of normal female of *Amorpha populi* in retracted position. $\times 12$.
- II. Lateral view of external genitalia of normal female of *A. populi* in extended position.

PLATE CIII.

Diagrammatic representation of ventral view of external genitalia of gynandromorphous *Eronia hippia* var. *gaea*.

PLATE CIV.

- I. Bursa copulatrix and ostium bursae of normal female of *Eronia hippia* var. *gaea*. $\times 15$.
- II. Bursa copulatrix and ostium bursae of gynandromorphous *E. hippia* var. *gaea*. $\times 15$.

XVII. *The relation between the secondary sexual characters and the Gonads and accessory sexual glands in Insects.* By E. A. COCKAYNE, M.A., D.M., F.R.C.P.

[Read November 15th, 1916.]

THE remarkable effects of the secretions of the ductless glands on the development of the secondary sexual characters in the vertebrates makes it of great interest to examine the evidence for and against the existence of a similar relationship in insects. In mammals and birds we know that in the male the interstitial cells, or cells of Leydig, which lie between the seminiferous tubules of the testis, produce a secretion which causes the normal development of the secondary sexual characters in the male at puberty. Removal of the testes before puberty prevents their appearance, but atrophy of the seminiferous tubules in no way affects them. The testis is a double organ, each part having its own distinct function. In the ovary a similar state of affairs appears to exist, but has not been so clearly demonstrated.

Besides this comparatively simple relationship between the interstitial glandular part of the gonads and the secondary sexual characters, the ductless glands exert an influence upon one another. For instance, over-activity of the cortex of the suprarenal gland produces sexual precocity, under-activity of the pineal body produces a similar effect; but under-activity of the pituitary body delays the appearance of secondary sexual characters. These stimulating or restraining effects seem to be due to the action of the internal secretions of these glands on the gonads, causing an increase or decrease in the secretion of the interstitial cells, and so only indirectly hastening or retarding the appearance of secondary sexual characters.

But it must be remembered that long before these cells become active we find well-marked differences in the two sexes, and such differences still remain if the cells be removed and are present even in cases where the gonads have never developed at all. It is only some of the more striking differences, which appear at the time of puberty, and which are due to the activity of the gonads.

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The short account of the action of the ductless glands given above is that most commonly accepted as correct, but it must be mentioned that Blair Bell and others consider that they all have an equally powerful influence on the development of the secondary sexual characters, and that, although alike in appearance in the two sexes, the pituitary, suprarenal, and other glands of the male and female, produce internal secretions as unlike as those of the ovary and testis themselves.

It is important to examine what evidence there is for and against the existence of a similar control in insects. The best evidence is afforded by—

(1) Experimental castration and transplantation of the gonads in Lepidoptera.

(2) Temperature experiments in Lepidoptera.

(3) Stylopisation in Hymenoptera.

(4) Gynandromorphs and Intersexes.

Castration experiments have been performed by Oudemans, Kellogg and Meisenheimer.

Oudemans removed the testes or ovaries from larvae of *Lymantria dispar* before the penultimate and last moults; thirty out of sixty survived. Castrated males copulated and castrated females tried to lay, but merely deposited the tuft of wool with which the normal females cover their eggs; their external appearance was unaffected.

Kellogg experimented on silkworms, *Bombyx mori*, and in no case was any change in the secondary sexual characters produced.

Meisenheimer castrated 600 larvae of *Lymantria dispar* and bred 186 imagines. Those operated on before the second moult always died, but some survived which were operated on between the second and third, and third and fourth moults. None of the imagines were altered in appearance.

Transplantation of the ovaries or testes into larvae of which the testes or ovaries had been removed also failed to alter their secondary sexual characters; nor was any effect produced by forming artificial hermaphrodites, though the transplanted gonads grew.

These experiments are against the existence of a relationship between the gonads and secondary sexual characters such as is found in vertebrates.

By means of heat or cold acting for varying periods on the pupae of certain Lepidoptera the females can be made

to assume in some degree the colour and structure characteristic of the males, and the males, though to a less extent, can be made to approach the females in structure and colour.

Merrifield by means of heat obtained females of *Gonepteryx rhamni* having the yellow colour of the males, and Standfuss obtained females of *Perisomena (Saturnia) caecigena* with feathered antennae, though these are simple in the normal female. Kosminsky by subjecting pupae of *Lymantria dispar* to cold produced in some males an alteration of the colour and shape of the scales towards those found in the females, and in females he produced a colour nearly as dark as that of the males, a shape in the scales very like that found in the opposite sex, and shorter feathered instead of longer simple antennae. The testes and ovaries were smaller or unaltered in size, and the ova were always infertile. He considered that the mal-development of the sex-glands was not associated with the alteration in colour and structure, because those with the most normal glands were sometimes those with most marked alteration in secondary sexual characters.

The parasite *Stylops* in the bees *Andrena labialis* and *chrysoceles* may produce in some females an approach to the male in colour and to a smaller extent in structure, and in some males a similar but less marked approach to the female. In other specimens no effect is produced. The ovaries are reduced to about one-quarter their normal size. In other bees no effect on the secondary sexual characters is produced, though the ovaries are equally reduced in size. These observations, published by Geoffrey Smith and Hamm, like the temperature experiments, fail to show a direct relationship between the gonads and the secondary sexual characters.

The conditions found in gynandromorphs afford us still more definite evidence. In halved gynandromorphs there is perfect development of the secondary sexual characters of the male on one side and of the female on the other; yet the most varied arrangement of gonads and accessory glands are met with. In the normal male there are two testes and glandulae accessoriae; in the female two ovaries, two cement-glands and the receptaculum seminis or spermatheca, probably also a secretory gland. In gynandromorphs secondary sexual characters of the male may be perfectly developed not only in the absence of the testes

and glandulae accessoriae, but also in the presence of one or two ovaries, one or two cement-glands and the spermatheca. Similarly the secondary sexual characters of the female may be normally and fully developed in the absence of ovaries, cement-glands and spermatheca and in the presence of the gonads and accessory glands of the male. Thus the presence of gonads and glands of the one sex has no modifying influence on the secondary sexual characters of the other sex, even in the absence of the gonads and glands proper to it. In some cases where gonads and accessory glands of both sexes are present the secondary sexual characters of both sexes are also present—male characters on the side of the male organs and female on the side of the female organs. The gynandromorph *Amorpha hybridus* described in the preceding paper also proves that secondary sexual characters of both sexes may be present, male on one side, female on the other, though neither testis nor ovary be present. Indeed, in this case the accessory glands of both sexes were also absent with the exception of a distorted cement-gland.

The ducts, vasa deferentia, vesiculae seminales, and ductus ejaculatorius in the male, oviducts, vagina, bursa copulatrix and cervix in the female, can also be completely absent without affecting the development of the secondary sexual characters, so that it is evident that their epithelium produces no secretion which influences the development of the secondary sexual characters.

In the peculiar gynandromorphous *Agriades coridon* var. *roystonensis*, of which I have published descriptions in the Journal of Genetics and in these Transactions, scales of a structure peculiar to the male were found usually on the wings of one side only, yet no male internal organs were present, and in most instances the female organs were perfectly formed. The ovaries in all cases were of equal size and fully developed.

In some primary hybrid hawk-moths of the genus *Amorpha*, of which a list has been published recently by Dannenberg, and of which *A. ocellatus* ♂ and *A. populi* ♀ and *A. ocellatus* ♂ × *A. austati* ♀ are the best known, females are replaced by insects in which the external genitalia are roughly symmetrical, but show a mosaic of male and female characters. The male and female parts are for the most part fully formed, and are not intermediate in characters between the two sexes. Ill-formed

ovaries and female accessory glands are present, but no male internal organs are found. Other primary hybrids occasionally show a similar condition. On the other hand, a primary hybrid *Ennomos* bred by Harrison showed fully-developed male organs including two testes, and yet parts of the external genitalia and some external somatic characters were purely female in appearance.

Many secondary hybrid *Saturnias* (emperor moths) and *Bistoninae* show a very coarse mosaic of male and female somatic characters, including the external genitalia, though their internal organs are entirely female.

The secondary hybrid *Amorpha daubi*, Standfuss, *A. ocellatus* ♂ × *A. langi* ♀, also has females replaced by gynandromorphs or intersexes. This is also the case with many mongrel *Lymantrias*, though in these the external genitalia are intermediate between those normally found in the two sexes. Here, again, we have several examples of male secondary sexual characters where all the male internal organs are absent and all the female present, and one example of the opposite condition.

The chief argument against the castration experiments is that they can only be performed comparatively late in the larval stage, and it has been suggested that at this stage an internal secretion has been produced and already acted on the tissues of the body in such a way that they are able to attain to their full sexual differentiation, even after the gonads have been removed. Such an argument cannot be advanced in the case of halved gynandromorphs in which the failure of development of the sexual organs when it occurs must take place at a much earlier period, and still less can it be advanced in the case of the hybrid gynandromorphs or "intersexes."

The whole of the evidence derived from experimental castration, and from the study of halved gynandromorphs and of intersexes, seems to prove definitely that the secondary sexual characters are in no way dependent on the gonads or any other portion of the internal sexual apparatus. There is, however, no proof to be derived from them that some gland quite independent of the sexual organs does not produce an internal secretion comparable to that of the interstitial cells of the vertebrate testis and ovary.

But if we examine the condition of affairs in mixed and transverse gynandromorphs even this possibility seems

to be excluded. Gynandromorphs are occasionally met with in which the head or head and thorax show fully-developed male characters and the rest of the insect shows female characters. In others exactly the opposite condition is met with.

When the whole of the external structure of the head or thorax shows male characters it is almost certain that the structures within are male in constitution also.

If this be admitted one can exclude any part of the head, thorax or abdomen as the possible site of a gland producing an internal secretion, which causes the development of the secondary sexual characters in insects.

Thus we are reduced either to accept the view that in insects the tissues are sexually differentiated from the first, and do not need the stimulus of any internal secretion in order to attain the fullest development; whereas, in vertebrates, although the tissues are sexually differentiated from the beginning, the differentiation cannot be completed without the influence of the internal secretion of the gonads and other glands.

Or we must accept an alternative explanation such as that of Geoffrey Smith, that there is in all animals a sexual formative substance, which in some is capable alone of perfecting the sexual characters, but which in others requires the co-operation of the internal secretion of the gonads. It is difficult to accept the former hypothesis even in the case of insects, because the parasite *Stylops* in bees and subjection to abnormally high or low temperatures in butterflies and moths can in some instances modify the secondary sexual characters at a late stage of development.

But on the latter hypothesis, unless the evidence derived from a study of gynandromorphism be untrustworthy, the sexual formative substance must be produced in various parts of the body if not by all the tissues.

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XVIII. *An Intersex of Amorpha populi.* By E. A. COCKAYNE, M.A., D.M., F.R.C.P., F.E.S.

[Read November 15th, 1916.]

THE specimen was sent to me for dissection by Mr. L. W. Newman, who had noticed that although the head, thorax and wings appeared to be male, the abdomen was full and rounded like that of a female.

Dissection showed that the testes were large and lobulated, the four follicles of the two testes forming a cluster; whereas normally the two testes are fused and the eight follicles twisted spirally assume an almost spherical form. In the abnormal specimen the eight follicles were white, but in normal specimens the capsule of the fused organs is a deep yellow colour. Careful measurement showed that the calices, vesiculae seminales and vasa deferentia were broader and the glandulae accessoriae broader and shorter than in a number of normal males. Serial sections taken through the whole organ showed numerous spermatozoa and some spermatocytes in all the follicles, and in some there were a few objects, which appeared to be large cells with deeply stained basophile nucleus and cytoplasm. These were kindly examined by Dr. Goodrich, who thinks they are probably masses of spermatozoa closely crowded together, but they may be abnormal cells. The external genitalia were mounted and measured. The penis and uncus were both shorter and broader than in normal males, the gnathus, 10th abdominal sternite, was very short and broad, and ended bluntly instead of tapering gradually. It was only about half the length of a normal scaphium. The valves were not evenly spread, but they were of normal length. The cornuti on the vesica of the penis were fewer than normal, about forty-five small and large were counted. The normal penis has about fifty-six. No minute cornuti were seen at all, though they are usually numerous. Plate XCV, fig. 1, shows the internal organs of a normal male, fig. 2 shows those of the abnormal individual.

The chief interest of the specimen lies in the fact that

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Goldschmidt in crossing European *Lymantria dispar* with its large Japanese race, var. *japonica*, obtained individuals in some broods which were only distinguishable from males by possessing small flecks of light colour, like that of the female, equally distributed over all four wings. These he called first "Weibchenmännchen" and later "Intersexes." Internally some had normally shaped testes, but others had lobulated testes without any yellow pigment in the capsule. He gives a figure on p. 296 of his paper, which can be compared with mine.

Most of those with normally shaped testes had spermatozoa and spermatocytes only, but in some of the lobulated testes there were in addition small or large numbers of oocytes and ova.

The external genitalia of Goldschmidt's specimens were male in character, but with some modification of shape. The penis, uncus, saccus and valves were shorter and broader than normal. In addition to the "Weibchenmännchen," numbers of moths were bred which showed a more striking mixture of male and female characters, and in his earlier papers Goldschmidt called these male and female gynandromorphs; but wishing to distinguish them from ordinary halved gynandromorphs, which must arise from a different cause, he has grouped all of them under the name "Intersex."

The resemblance between this specimen of *A. populi* and these *Lymantrias* is so close in most respects that I am inclined to think it must be of the same nature. Like the *Lymantrias* it arose from crossing various races of British *populi* for several generations.

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XIX. *Observations on the Growth and Habits of the Stick Insect, Carausius morosus, Br.; intended as a contribution towards a knowledge of variation in an organism which reproduces itself by the parthenogenetic method.* By H. LING ROTH, Keeper, Bankfield Museum, Halifax. Communicated by Prof. E. B. POULTON, D.Sc., M.A., F.R.S.

[Read October 18th, 1916.]

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INTRODUCTION.

The stick insects dealt with in this paper are descended from a few specimens given me some years ago by Dr. Clubb, Director of the Liverpool Museums. With the
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exception of three almost black specimens, they are all the progeny of one female hatched out of an egg from the original lot. The three black specimens are the offspring of some of the others received from Dr. Clubb.

The young and fully grown insects were kept under observation in inverted glass bell-jars of various sizes, each one furnished with a small glass or pot receptacle filled with water and well-washed sea-sand, in which were placed the food-plant cuttings. I had at times over forty of these jars in use, containing altogether some 400 specimens. The temperature of the room in which they were kept was regulated as much as possible between 56° F. and 64° F., although it did fall to 52° F. during some very severe cold days in the first winter.

As regards the measurements made, it is as well to note that it is easier to measure dead than living specimens, and in a few cases where it was not possible to measure the living specimens with approximate accuracy these specimens have not been included in the series commented on.

The reference or series numbers given in the tables are given consecutively—there has been no picking and choosing—and the gaps indicate other groups, or series, or egg lots, etc., undergoing observation for other purposes, or may be traced to specimens which have dropped out through death or the development of some malformation, or on account of having been killed off as not further required, etc.

I wish to express my sincere thanks to Dr. Walter M. Tattersall and Dr. A. D. Imms for valuable assistance in preparing this paper.

As regards the position of *Carausius morosus* among the Phasmids, the late Mr. Meade-Waldo kindly wrote me: "*Carausius*, Stal., Rec. Orth. iii, p. 8 (1875)—Type *C. strumosus*, Stal., from Java. *C. morosus*, Brunner v. Wattenwyl, the species with which we are concerned, was described for the first time in Die Insekten-familie der Phasmiden, Lief 2, p. 268 (1907), and is thus not included in Kirby's Catalogue of Orthoptera. There are no synonyms to *C. morosus*, though some authors have considered the genera *Carausius* and *Dixippus* as the same. Kirby in his catalogue gives *Dixippus*, Stal., as a synonym of *Lonchodes*. Brunner divides the Phasmidae into two large groups: *Phasmidae areolatae* and *Phasmidae anareolatae*—

Tribus 1, *Clitumini*.

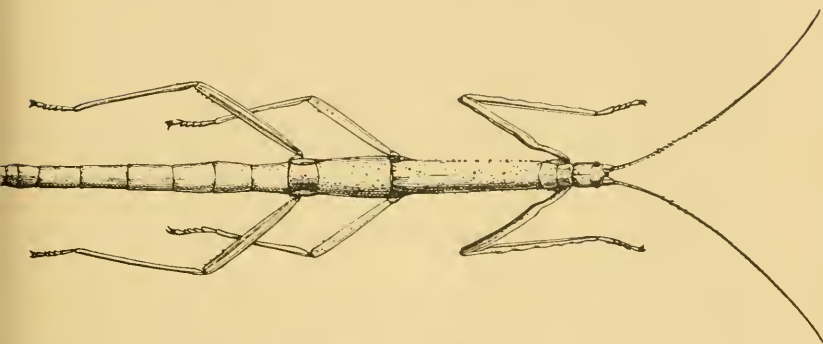
Tribus 2, *Lonchodini*, to which *Carausius* belongs.

Tribus 3, *Bacunculini*.

These three tribes are distinguished from the three other tribes in this group by the short median segment. All the *Lonchodini* are Asiatic or Australian species. The nearest ally to *Carausius* is *Dixippus*, which Brunner separates as follows—

Carausius—mesosternum longitudinally carinate.

Dixippus—mesosternum not carinate.”



Carausius morosus, Br.

GENERAL NOTE.

During the daytime the nymphs and insects are lethargic; lie about in every conceivable attitude with their appendages generally more or less parallel with the body, unless their position requires a leg or two differently placed for support. They are not easily roused, and when roused do not attempt to run away for more than about a couple of decimetres. They look more like portions of leaf-stems or twigs, on which they are more difficult to distinguish than at night when their appendages are in full play. Quite young nymphs prefer the underside of the leaf to rest on. They frequently hang together closely packed.

When handled they often feign death, and have a knack of slipping away backwards out of one's hand, while in falling their claws seem able to catch at almost anything. Their pads appear to assist them to walk and climb on fairly smooth surfaces, but I do not think this ability to be a case of suction, for if placed on a piece of plate glass, the

surface of which has been well washed with water and then with alcohol, and the glass be tilted, they very quickly fall off. In their declining days they frequently lose the use of their claws, and then hang on by their elbows.

COLOUR.

The colour was generally green or fawn, often speckled and varied considerably in different insects, so that pale green or olive, light green, dark green, greenish fawn, fawn, dark fawn and reddish fawn were common enough.* Dark brown (almost black) is rare.

At birth the insects are a greenish brown, which changes to green or olive or fawn at the successive moults. After the colour is once pronounced there is hardly any change, thus of 26 mature insects under observation under the same conditions for 11 weeks, 1 changed from reddish fawn to darkish fawn, 1 from lighter to darker green, and 2 from olive to fawn, 19 remained the same colour as when first observed. This was the only special observation I took on change in colour. Three died (having finished egg-dropping).

Three dark brown, nearly black specimens came from normal-coloured parents. Their eggs produced 1237 nymphs, and 467 of these grew to maturity with the usual olive, green or fawn colouring. I had not accommodation to rear the rest, but I ascertained later that if the colour is to be brown it shows itself already at the 1st ecdysis. Altogether I obtained 8 dark brown specimens, and all these finished by becoming nearly black.

Schleip † found the darker insects shorter than the green ones, and gives the average length of ten dark red or black insects as 69·3 mm., of ten yellowish-red insects as 74·6 mm., and of ten green ones as 76·3 mm. I did not find this so;

* The range of colours therefore agrees closely with that of MacBride and Jackson ("The Inheritance of Colour in the Stick Insect, *C. morosus*," Proc. Roy. Soc., Ser. B, vol. 89, p. 109). J. C. Fryer illustrates two specimens of female *Clitumnus* (? *cuniculus*), one of which is a light fawn and the other a pale green or olive (Journ. of Genetics, iii, Sept. 2, 1913). Curiously enough, H. Blanc speaks of the single colour (*homochromie*) of *Dixippus morosus* (Bull. Soc. Vaud. Lausanne, 5 Ser. xlix, No. 179, p. xxv).

† Waldemar Schleip (Freiburg in Br.), Der Farbenwechsel von *Dixippus morosus* (Phasm). Zool. Jahrb. Abt. f. Allgem. Zool. u. Phys. d. Tiere, xxx, 1911, p. 78. He treats *Dixippus morosus* as the same as *Carausius morosus*, p. 46.

my shortest black measured 69 mm., and the two other blacks measured 74 and 78 mm. respectively (the average of 34 specimens from one parent being 80.1 mm.). I did not get the gradations in colour up to dark brown or black which Schleip shows on his coloured plate—in fact, between the dark brown (almost black) and the darkest fawn there was a big gap.

INCUBATION-BOX.

The eggs for incubation were placed in small glass-capped circular card-board boxes, with a thin layer of sand on the bottom. The sides were perforated by means of pins, and the boxes numbered on the inside (*not* on the lids). These boxes were placed in rows in a shallow wooden box (an old chocolate manufacturer's packing-box), the necessary moisture being provided by wet folds of clean blotting-paper well soaked afresh daily. The wooden box being badly made with an ill-fitting lid allowed amply for the circulation of the air.

INCUBATION.

In the incubation-boxes the incubation varies from 137 days to 297 days, thus covering an extreme range of 160 days. Those nymphs which hatched out up to 254 days' incubation were healthy and apparently in normal condition, but one which hatched out at the end of 297 days was very feeble, drank sparingly, and, although it was ready for a drink every one of the 6 days it lived, its abdomen remained contracted laterally and it did not eat at all, while usually about 50% have commenced eating on the third day after hatching out.

The accompanying table shows that more than 50% of

TABLE I.—NO. OF DAYS OF INCUBATION.

Days.	No. Hatched.	Percent. Hatched.	Days.	No. Hatched.	Percent. Hatched.
137-140	7	1.7	231-240	1	0.2
(141-150	131	31.8	241-250	1	0.2
(151-160	86	20.9	251-260	1	0.2
161-170	42	10.2	261-270	0	—
171-180	42	10.2	271-280	0	—
181-190	49	11.9	281-290	0	—
191-200	30	7.3	291-300	1	0.2
201-210	10	2.4			
211-220	9	2.2	Total	412	99.9
221-230	2	0.5			

the nymphs are hatched out after 141 to 160 days' incubation, and a further 32% fairly evenly distributed in the next 30 days (161 to 190 days), after which there is a considerable drop.

The variation in the number of days required for incubation by eggs dropped during 24 consecutive hours by any one individual insect is great, the range varying from 6 to 92 days. I am unable to account for this. I do not think it to be due to unsuitable, *i. e.* to too low a temperature, as the nymphs and insects thrive well at 15° C. (59° F.). Nor do I think it due to want of moisture, for of 71 unhatched eggs examined from 421-580 days after having been dropped, in 67 (= 94%) the contents were still quite moist. It is, generally speaking, the last nymph to emerge which makes the big jump in the range. I have not made any experiment to ascertain whether the extreme range is due to dryness, but H. H. P. and H. C. Severin have shown that dryness at the time of hatching with *Diapheromera femorata*, Say, has a marked retarding effect on the emergence of the nymph from the egg (Jour. Econ. Ent. 1910, p. 481).

TABLE II.—RANGE OF INCUBATION OF EGGS DROPPED IN 24 HOURS BY INDIVIDUAL INSECTS.

Series No.*	Eggs in 24 Hours.	Days of Incubation.										Range in Days.
24	5	163	170	177	192	206						43
25	3	166	168	176								10
26	4	176	181	186	210							34
27	4	179	201	212	227							48
28	4	189	208	217	246							57
29	6	184	192	194	196	198	198					14
30	8	178	182	182	183	183	192	197	198			20
33	5	186	187	189	193	195						9
34	9	169	177	178	180	181	183	184	188	189		20
35	9	182	185	185	185	192	192	194	196	207		25
36	5	186	189	194	200	201						15
37	6	190	198	199	203	214	240					50
59	8	162	176	181	183	183	188	192	254			92
104	8	144	145	148	148	148	149	150	150			6
107	6	143	144	147	150	152	162					19
146	9	146	146	147	147	152	153	157	157	217		71

* Only a portion of those observed are given, but sufficient to give a general idea of the results.

INCUBATION UNDER DIVERSE CONDITIONS.

In order to test the method of incubation above described I experimented as follows :—Three lots of eggs were taken, which had been dropped by the same set of insects in the same twenty-four hours on three different occasions. One lot was placed in the usual hatching-box (B) just described, the second lot on the surface of sand (S), and the third lot on the surface of mould (soil) (M). Moisture was conveyed to the sand and mould by occasional light sprinkling, but mostly from below by means of a dipper. In the course of the incubation some of the eggs sank below the surface of the sand and mould. The nymphs from the sand and mould had, on emergence, access to water, but those from the box had not, and probably in consequence of this we find the box produced on an average shorter nymphs than the sand and mould, thus: M's average = 12·4 mm., S's = 11·9 mm., and B's 11·2 mm., but, in view of the results of observations on the extension of nymphs after hatching out, this is of little importance.

In so far as duration of incubation is concerned (Table III) the mould gave the quickest results, the nymphs hatching out on an average in 124 days with a range of 31 days (115–146), against the sand's average of 146 days with a range of 54 days (131–185), and the box's average of 151 days with a range of 31 days (141–172).

TABLE III.—INCUBATION UNDER DIVERS CONDITIONS.

Species number	153	157	158
Where placed	Hatching-box	Sand	Mould
Quantity of eggs under observation	62	62	63
Total weight of eggs—gramms	·345	·311	·322
Average weight of eggs—millegrams	5·569	5·182	5·511
Period of incubation—days	141–172	131–185	115–146
Range of incubation—days	31	54	31
Average No. of incubation days	151	146	124
Total No. of eggs hatched	58	48	46
Percentage of eggs hatched	93·5	77·4	73·2
Total No. of fertile eggs	61	58	50
Percentage of fertile eggs	98·4	93·5	79·4
Percentage of fertile eggs hatched	95·1	82·8	92
Average length of nymphs when hatched	11·4	11·9	12·4
Change in outside appearance of shell	None	Slight	Marked

As regards the quantity of fertile eggs hatched out, the highest percentage was reached from the box, thus: B = 95.1%, M = 92%, and S = 82.8%.

In this experiment in no case was any nymph found to have succumbed through inability to emerge completely after once breaking through, as happens occasionally to the extent of about five per thousand in the usual incubating-box arrangements.

The fact that on the mould the incubation proceeded quickest would tend to show that it is the best of the three media, for, in Nature, the quicker this process goes on the less risk to the embryo—the lesser number hatched out being a sacrifice to the safety of the existence of the species.

Whether the corrosion, if I may so call it, of the eggs from the mould has anything to do with lowering the percentage of hatching out I am unable to say, but it would appear that the natural risks being overcome or reduced to a minimum in the box incubation, that method is the best for laboratory experiment.

PARTHENOGENESIS.

These stick insects belong to a Family in which parthenogenesis appears to be the rule, and my experience with them bears out the existence of the general law. The female from which I reared 354 insects up to the egg-bearing stage may or may not have been fertilised by a male. Her offspring were allowed to mix freely with one another until the last ecdysis was reached, when they were successively segregated, and every one of these which reached maturity dropped eggs. The assumption is, that there was consequently no male amongst them. Subsequently I separated 34 larvae (offshoots of some of the 354) on hatching out, and these with one exception all turned out egg-bearers. The one exception, No. 40, had a malformation at the penultimate abdominal segment, and took 170 days to get through the nymph stadia, instead of the average 136 days. It was a poor eater, consuming about one-sixth of the food consumed by the others, and remained thin and lethargic to the end.

A MALE.

I had one other non-egg-producer, a descendant of one of Dr. Clubb's lot, which turned out to be a male. Dr. Imms dissected it, and found "well-developed reproductive

organs. The latter appeared to be functional and showed no sign of degeneration. I made a preparation of the contents of the testes, and found that spermatozoa were present in various stages of development, but the number of mature ones was relatively small. The vesiculae seminales were large and filled with a thick fluid. They contained, however, scarcely any spermatozoa. Judged from these facts the example was not yet fully mature." This specimen had not increased in size for over five months, and, with the small quantity of mature spermatozoa present, the suggestion of a possible degeneration having taken place occurs to one.*

Its form and slow growth induced me to separate it from the others, not that I thought it a male, but because it was different from the others. Its noticeable difference consisted in the longer proportion of its legs to its body than is the case with females.



Egg capsule of *C. morosus*, with and without lid.

FORM, SIZE AND WEIGHT OF EGGS.

The egg is contained in a capsule, the general shape of which is somewhat similar to a flattened cask, and having consequently an oval cross-section, flat at one pole and semispherical at the other. The flat end is covered by a lid, which consists of a platform with encircling ridge, and in the middle there is a light buff-coloured glossy cap. This cap is only partially perforated in the centre; the apparent hole is closed by a very thin skin, the use of which may be to admit air and moisture by endosmosis, for the

* "Mr. K. G. Blair exhibited a ♂ and two ♀♀ of a stick insect (? *Lonchodes*, sp.) which is usually parthenogenetic, the ♂ being excessively rare, and which he had bred for several generations without any specimen of this sex appearing (Trans. Entom. Soc. London, 1911)." In Proc. Zool. Soc. 1915, p. 155, Miss A. C. Jackson mentions that out of about 3000 *C. morosus* which she reared, seven males were identified.

chorion itself seems to be too solid and close-grained to admit either. The capsule rounds off immediately below the lid. On one of the flattened edges between the middle and the spherical pole is the mark of the ovary attachment, in the form of a dark narrow ridge completely encircled by another ridge, the whole about 1 mm. long.* Not infrequently a lid or cap is found at both poles, but the one cap is then generally more or less malformed and the platform hardly discernible. So far none of the eggs with opposing capsules have hatched out, nor is it likely that they will do. Where these opposing processes exist the mark of the ovary attachment is not clear. I have one egg with two caps on one and the same platform.

The total length of the egg capsules varies generally from 2·7 to 3·2 mm., 504 specimens measured giving an average length of 2·8 mm. Some capsules are as short as 1·2 mm., but are rarely met with, and anything under 2·6 mm. does not hatch out.

The outer surface of the capsule is a dull brown grey, rough to the touch, and under the microscope shows convolutions somewhat similar to those of a pancreas. This

TABLE IV.—WEIGHT OF EGGS.

Quantity weighed.	Total weight in Gramms.	Average Weight in Millegramms.	
62	·345	5·569	} Each lot collected represents the number of eggs dropped during the previous 24 hours and was weighed the same day.
63	·322	5·511	
77	·4	5·195	
29	·149	5·138	
66	·342	5·55	
62	·311	5·182	
40	·222	5·1	
100	·51	5·01	} Weighed by } From my stick insects. C. Fielding } From others. 4 days' collection.
190	1·035	5·446	
689	3·636	5·277	

* The egg is almost identical externally with that of *Carausius hilaris*, Br., which is, however, smaller and apparently more oval in shape. See Amelie Elkind, "Les Tubes ovariens et l'ovogène chez *Carausius hilaris*," Br. Lausanne, 1915, p. 14.

C. morosus and *C. hilaris* differ as follows: *C. morosus* has the anal segment truncate, with only a slight triangular emargination; *C. hilaris* has the anal segment produced into two lobes with the apex obtuse (Brunner and Redtenbacher, Monograph of Phasids, R.M.V.).

roughness is probably the cause of the capsule's easy adherence to any object however smooth if the surface be only slightly moist. The inside of the capsule is, on the other hand, very glossy, and under the microscope shows complex reticulations.

The weights are of eggs dropped by full-grown insects of all ages after the sixth ecdysis.

Six eggs dropped by the undersized full-grown insect, No. 159, weighed .023 gr., or on average 3.833 milligrams.

FERTILITY OF THE EGGS.

In determining the quantity of fertile eggs dropped by the individual insect under observation all the remaining eggs were, several months after the date of the last hatching out of the others, broken open and examined. The number of eggs found to have been fertile, but unhatched, were then added to the number which hatched out, and the total treated as the quantity of fertile eggs. The following table gives the results of the examination of four batches of eggs.

Eggs dropped at the commencement are as fertile as those dropped at a later stage; 24 eggs dropped in the first week by various beginners all hatched out, and out of another lot of 26 first eggs dropped by any insects, 22 hatched out = 84.6%. Of 2 eggs, the last dropped by different insects, 1 hatched out.

TABLE V.—FERTILITY OF THE EGGS.

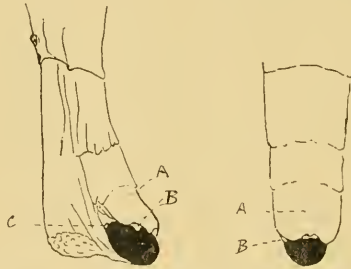
	Original Specimen.	No. 38.	No. 39.	No. 42.	Total.
Quantity of eggs hatched	428	450	405	382	1665
Found fertile but not hatched	18	24	46	2	90
Total fertile eggs	446	474	451	384	1755
Unfertile eggs	114	100	107	78	399
Total eggs dropped	560	574	558	462	2154
Percentage of fertile eggs	79	82.6	80.8	83.1	81.5

OVIPOSITION.

After the sixth or last ecdysis, from which proceeding the insect emerges very attenuated, the same as after every ecdysis, the ovaries begin to develop.

I have only seen the egg produced on three occasions. The emergence was slow and deliberate—it was, in fact, mere egg *dropping*. On one of these occasions I happened

to notice the egg just as it was about halfway out. This was at 9.15 a.m. At 11.2 a.m. the egg *dropped* to the ground. There seems to be a special process, the function of which is to retard the ejection. I attempted in another way to ascertain whether there was any quick expulsion or shooting out by placing the insects on top of a rod amongst plenty of food in the centre of a large shallow box, the bottom of which was covered with a layer of white sand. The sand was intended to prevent any rebound when the egg reached the floor. But the experiment was not a success in so far as conclusive proof was concerned, for although the few eggs dropped were found lying within two decimetres of the rod's socket, the insects themselves were continually escaping. The eggs emerge with the cap-



A and B Portions of Last Abdominal Tergum.
 C Special Egg-holding Process.
 D Egg lid.

sule end pointing inwards. The insect makes no provision whatever for the care of its young.

Observations were made on 39 specimens to ascertain how soon eggs are dropped after the last ecdysis, the sixth. The result expressed in days is as follows: 18, 24, 18, 30, 16, 20, 19, 18, 20, 18, 16, 15, 15, 16, 17, 15, 12, 17, 14, 13, 15, 16, 16, 19, 17, 16, 19, 16, 15, 20, 16, 13, 18, 14, 17, 16, 15, 15, 14. Eliminating the record of one insect which dropped her egg 30 days after the last ecdysis, for her whole period of development was abnormal, we find the dropping of eggs takes place from 12 to 24 days after the last ecdysis, giving a range of 12 days with an average of 16.5 days.

ABNORMALITIES.

The results of the observations on 32 insects, as regards their duration of life and egg-production, are given in

Table VI. This table, in which the insects are arranged according to their length, gives the total egg-production per insect, the average daily production per insect, and the average production per millimetre length of the insect. It also gives the days lived in the First Period of life or that of growth from hatching out to, and inclusive of, the last moult, and the Second Period, or that of reproduction and decay, from the last moult to death.

Before going into details it may be as well to point out the peculiarities of some of the insects which, if abnormal, may have affected their duration of life and egg-production.

The "Original" with 346 days of life was a very good egg-producer, but with a low average per day. Her life may have been prolonged by the fact that the temperature of the room in which she was observed was not kept up to an average of over 16° C., as I was then under the impression that these stick insects were European and not Indian. But this explanation (of more than the normal number of days lived in the Second Period) cannot hold good for No. Ex. 18, her grand-daughter, which suffered from an external blood clot* and lived the longest of any in this period. No. 22 had two constricted abdominal segments. No. 159 was anomalously short, being 62 mm. long, which is very much below the average length of the fifth moult; whether she had grown with less than the usual average increase at each ecdysis, or had not completed the whole six, I am unable to say; but it is quite likely she had only moulted five times, for dissection shows eggs already formed in stick insects which had not yet passed the last moult. No. 42 was brown, almost black, and not a descendant of the "Original," but belonged to the same lot; she lived 29 days after dropping her last egg. No. 94, which was also under observation for food consumption and ate about 20% less food per day than the others, had a short life and a low egg-production. No. 89 lived 28 days after dropping her last egg. No. 38, like No. 42, was also nearly black, and not a descendant of the "Original," but she was a better egg-producer and long-lived in the Second Period; the same applies to No. 39. No. 83 was only a tolerable

* Exudation of blood from the thorax in Orthoptera has been observed by Ch. Hollande and has been named by him Autohemorrhée; he ascribes it to a break caused by pressure on the small exsertile chitinous vesicles which are not provided with retractile muscles (Archiv. d'Anatomic Microscopique, xiii, 1911-12, p. 299).

producer; when hatched out in order to free her hind-legs from the shell I asphyxiated her temporarily and accidentally cut off one foot, which was not regenerated. No. 41 developed a constriction like that of No. 22, and an external blood clot like that of No. 18. No. 100, which dropped the most eggs of any, was deformed by interpolated abdominal plates (see illustration), which evidently in no wise affected her productive powers. I had other insects similarly deformed and likewise good egg-bearers. No. 43 lived 30 days longer in the First Period than any others except the deformed No. 41. No. 65 abstained from food for 29 days before succumbing.

EGG-PRODUCTION.

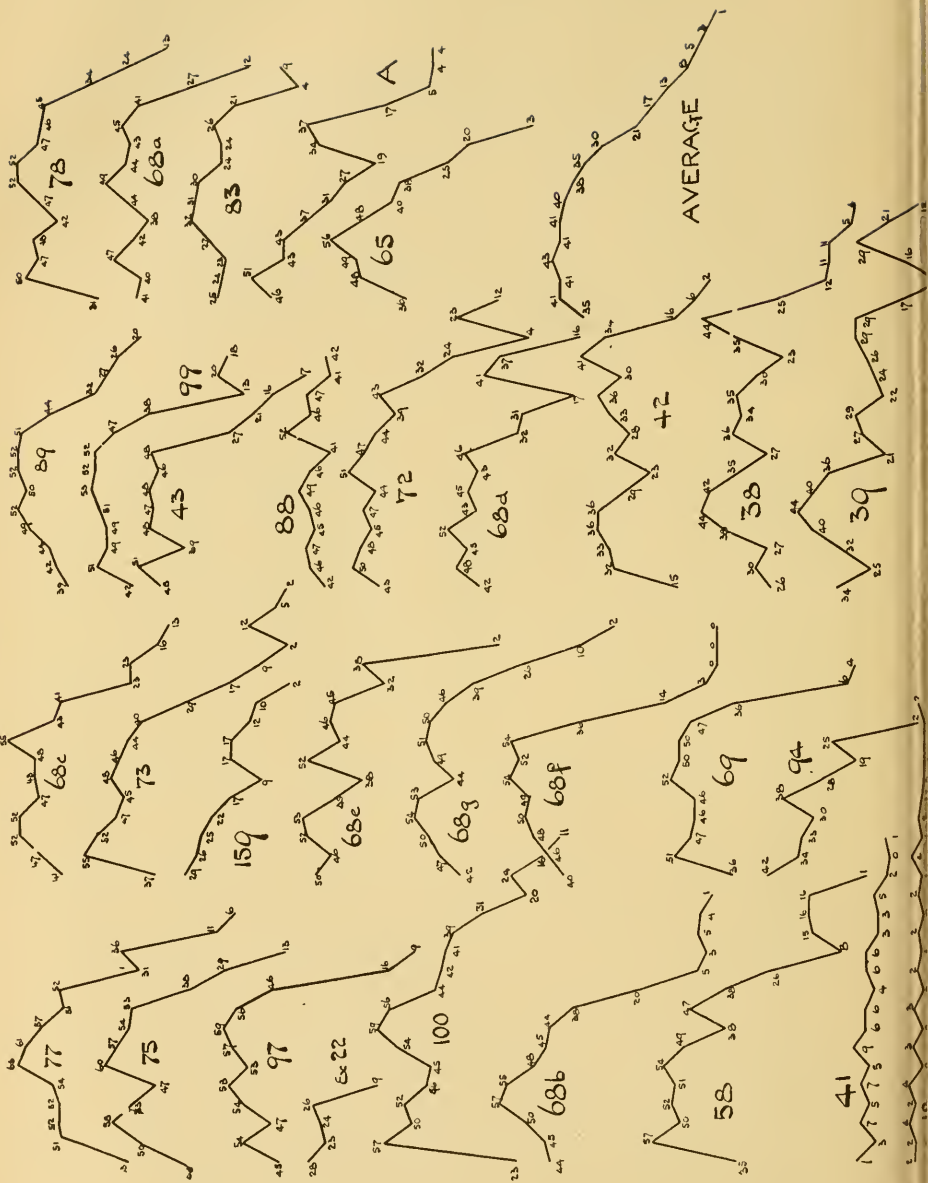
In Diagram I, the egg-production has been arranged in spells of 15 consecutive days each, ignoring the quantity dropped during the first spell of 15 days, during which the daily average is only $\cdot 5$ eggs. The curves all seem to follow a general plan, viz. the greatest maximum per spell of 15 days occurs almost immediately after the commencement of egg-dropping, each succeeding maximum being lower than the last, and ending usually in a sudden drop with an occasional final rise.

There are, however, many deviations from this plan, some due probably to the individual peculiarities already referred to.

The average egg-production is 480 per insect, the highest total reached by any one insect, No. 100, amounting to 712 eggs.

The largest number of eggs laid in one day by one insect (No. A) was 11, which happened to be her start off with egg-dropping. Quantities of 10 and 9 are rare, but 8 and 7 eggs dropped in 24 hours by one insect are not rare, while 6 in a day are common enough. The highest total recorded for 3 consecutive days is 20 (by No. 97), equal to 6.6 per day, and for 15 consecutive days 63 (by No. 77), equal to 4.2 eggs per day. The average number of eggs dropped by all the insects under observation as per Table VI is 1.8 per day, but if we eliminate the imperfect or weak parents we get a more normal average of 2.2 per insect per day. The average record is affected in two ways: (1) by the interval elapsing between the last ecdysis and first egg-dropping, and (2) by the number of days lived after the last egg has been dropped. As regards the first interval, it is present

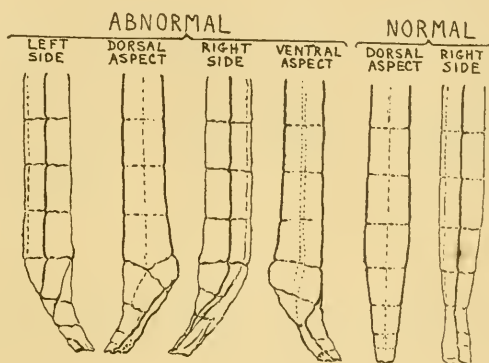
I. DIAGRAM TO ILLUSTRATE NUMBER OF EGGS PRODUCED IN 15-DAY SPELLS



in every case with a very even average of days, and so may be left out of consideration. As regards the later interval, there is considerable variation. Nos. 88 and 68e died in the midst of their egg-dropping, so there was no interval; No. 42 died 29 days after her last egg was dropped; No. 43 died 30 days after, while No. 68f died 45 days after dropping her last egg, and so on.

Excepting the case of No. 159, the abnormally short insect, there does not appear to be any actual correlation between the size of the insect and the quantity of eggs it can produce.

For instance, one insect 73 mm. long produced 595 eggs, and another 83 mm. long produced 536 eggs, or 59 eggs less, although it was 10 mm. longer. Four insects 79 mm.



long each produced respectively 443, 513, 536 and 591 eggs, and so on.

As regards the quantity of eggs produced per mm. length of the insect, two insects 75 mm. long each produced 4 and 7.4 eggs per mm. length respectively, while 6 insects 81 mm. long each produced 4.5, 5.5, 6.1, 6.8, 7 and 7.5 eggs per mm. length respectively. The average number of eggs produced per mm. length of the parent (exclusive of the original, which was not measured, and the abnormal, Nos. 18, 22, 41 and 159) is 6.5.

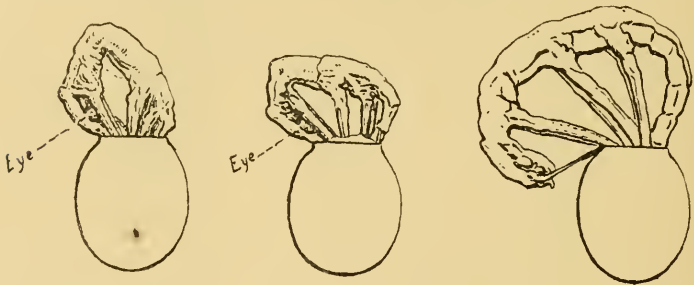
There does not seem to be any seasonal differences in the rise and fall of egg-production, which is quite independent of the time of year. Nor does the egg-production, in so far as quantity is concerned, depend absolutely on the number of days lived (Second Period); thus No. 78 lived 229 days and produced 578 eggs, while No. 38 lived 327

days and produced 574 eggs, or 4 eggs less for 98 more days of life.

EMERGENCE FROM THE EGG.

In outward form there is very little to distinguish the nymph when hatched out from the perfect imago after the sixth and last ecdysis except the size, although the segmentation of the thorax and of the antennae is not so clear in the newly emerged nymph as later on. The stick insect is therefore ametabolous or homomorphous. It is also menognathous, and from the time of hatching out until death it does not change its habits.

More nymphs hatch out during the night or in the early morning than in the daytime. When the nymph is



Nymphs hatching out, but which succumbed in the act, owing to the adherence of some of their appendages to the inside of the shell.

ready to emerge it forces up the cap and platform of the egg, which come away together, and then struggles out. I have not witnessed the pushing aside of the cap, nor am I sure that I have seen the first appearance of the head. The two hatchings out I witnessed, in which the heads were still bowed down when I first saw them, occupied under two minutes each. The heads may have been kept bowed down by a momentary adhesion of the antennae or fore-legs to the inside of the shell, as does occasionally happen, and if the nymph is unable to overcome this adhesion it succumbs. The adhesion of a hind-leg causes inconvenience for a time, as the nymph has then to drag the empty capsule about with it, and is hampered in its movements until the shell drops off. I have occasionally observed a nymph lose an entrapped appendage in its attempts to get free.

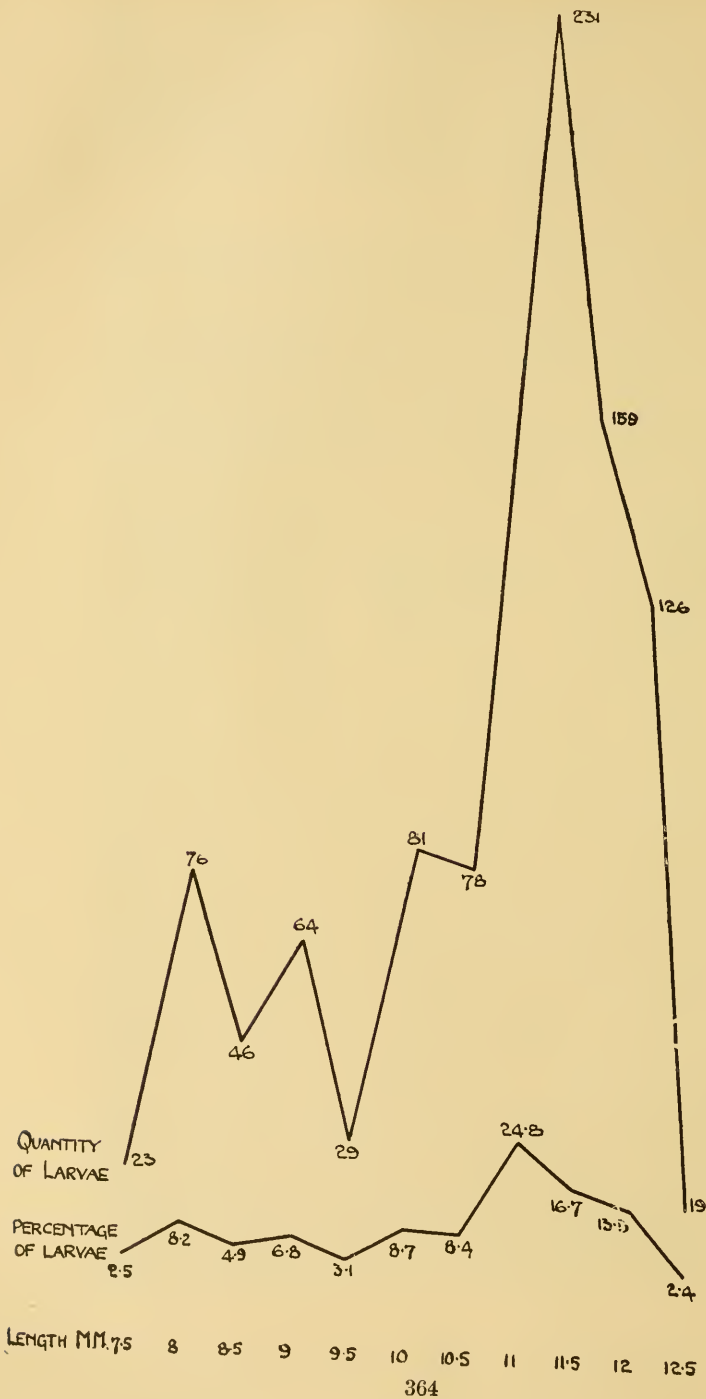
I think the normal emergence is by the pronotum coming out first, followed more or less simultaneously by the head and mesonotum, etc. That would correspond to the position of the nymph when about to slip out of its old skin at every ecdysis.

INCREASE IN LENGTH DURING THE FIRST TWENTY-FOUR HOURS AFTER EMERGING FROM THE EGG.

The growth of the nymphs from hatching out to the first ecdysis is perhaps not the least interesting part of a stick insect's life. As a preliminary to the investigation of this growth it was necessary to obtain accurate measurements of the size of the young immediately after emergence. To overcome the difficulties of accurately measuring living specimens the newly hatched young were, for several weeks, immediately killed and then immediately measured. The results of the measurements of 932 newly hatched young are shown graphically in Diagram II. The measurements were made to the nearest half-millimetre. The upper curve gives the details of the actual measurements, and the lower curve expresses these results in the form of percentages of the total number measured. The range in size of the newly hatched young is from 7.5 mm. to 12.5 mm., and the curve representing this range shows a more or less gradual rise with certain irregularities to 10.5 mm., a sharp maximum at 11 mm., and a less gradual fall to 12.5 mm. The average size of these 932 specimens is 10.5 mm., which is very close to the maximum of the graph. The results appear to indicate that a certain proportion of the nymphs are hatched out before the normal size is attained. Hence 25.5% of the hatchings, *i. e.* those under 10 mm. in length, might be expected to undergo one ecdysis more than those hatched out above that length; but this does not occur in so far as my experience goes, for such undersized nymphs as I have kept under observation went through the same number of ecdyses, *i. e.* six, before arriving at the same perfect state as those hatched 10 mm. long or over.

When newly hatched nymphs are placed on the upper side of a leaf they behave in various ways, *viz.* they rarely feign death, they remain stationary, or they walk to the edge of the leaf and attach themselves to the underside, or in their struggle to get away they run off in an excited manner with the abdomen curled over backwards (very

DIAGRAM TO ILLUSTRATE LENGTH OF 932 LARVAE ON HATCHING OUT



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different from their position in the egg), and tumble off the leaf; but generally they bend the head down, bringing the mouth close to the surface of the leaf as though in search of food. This search ultimately proved to be a search for moisture, which when found is imbibed with avidity. Occasionally the nymphs remain quietly imbibing water for as long as seven minutes, at other times much less, and at times only imbibing when their mouth was pushed into the moisture previously placed on the leaf.

It was in watching this imbibition that it became obvious to me that within a few hours of hatching out the nymphs rapidly increased their length by several millimetres per day, average 2·7 mm. in 24 hours.

Further examination showed that whether moisture was imbibed or not the increase was, with few exceptions, general. Of 164 newly hatched specimens put under observation, of which 47 were under 10 mm. long at emergence, all except 5 had increased to over 12–15 mm. long, or to an average length of 13·3 mm. at the end of 24 hours. This increase was probably due to the moisture taken up, for when not supplied with moisture the extension was slower. It cannot be due to food partaken, for during the first 24 hours hardly anything is eaten. Out of 206 specimens placed under observation only 56 ate at all, and the amount partaken was so infinitesimal, about a square millimetre or less, that it can be left out of consideration. The swift increase in length during the first 24 hours is the more extraordinary when we consider the results obtained in the life records of 26 specimens. From the date of hatching out till the first ecdysis, *i. e.* during an average period of 26 days, the average increase was only 10·1 mm. or under ·5 mm. per day. It is perhaps not correct to speak of the increase during the first 24 hours as a growth, but it should rather be spoken of as a physical extension or stretching out of the tissues after getting away from the confinement of the shell, which is largely aided by any moisture imbibed. The process is in all probability comparable with the universal phenomenon in Crustacea to stretch immediately after moulting.

THE GROWTH TO THE FIRST ECDYSIS.

Subsequent to the extension which takes place, as already described, during the first 24 hours after hatching out, the nymphs commence to feed and to *grow* (Table

VII). This growth continues for 17 to 24 days (average about 21 days), during which time it increases in length at the rate of $\cdot 35$ to $\cdot 7$ mm. per day, or a total increase of 3 to 5.5 mm. This is the only period of its life during which it grows *without* shedding its outer skin, for the differences in length, if any, observed during the stadia between the successive ecdyses are infinitesimal. Towards the end of the 21 days or so the nymph has become very rotund, the abdominal segments bulge out very distinctly, it ceases to feed, and consequently to excrete, and remains quiescent. These are the outward evidences that ecdysis is about to take place.

THE ECDYSIS.

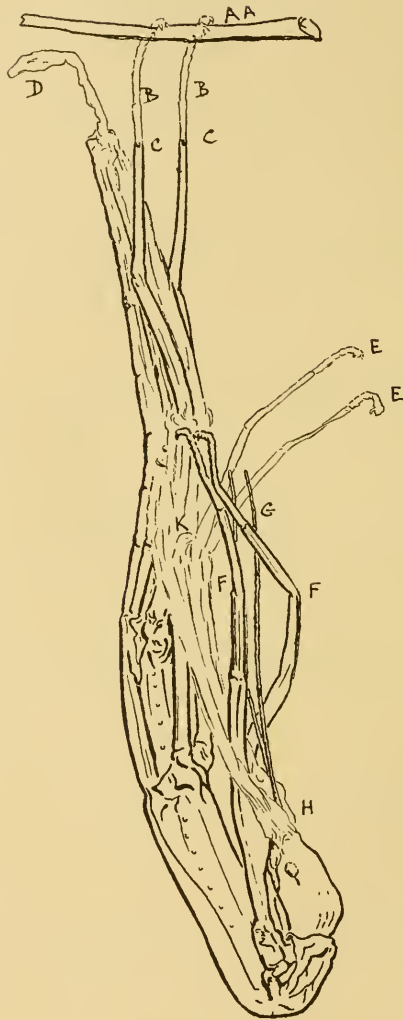
The fasting indulged in preparatory to slipping out of its old skin increases from 2 to 6 days, according to the number of moults it has or has not gone through. As per Table XIV, the average number of days' fast for the first moult is 2.7, and for the sixth moult 4.5.

As the moment approaches when the old skin is to be discarded the nymph gets into position by suspending itself from a twig or other object by its hind-legs, allowing the other two pairs to extend loosely more or less at right angles to its body and the antennae equally spread out. It takes 3 to 4 minutes to get into this position. Before it has quite settled to this it sways its body laterally in the way common to all the insects, but it ceases to do so when settled, and if there is any body movement during the ecdysis it somewhat resembles a faint longitudinal tremor, which becomes pronounced only when the slipping out is not progressing satisfactorily. There is no further lateral movement nor any turning nor twisting. The preliminary common lateral movement may do something towards easing the skin preparatory to discarding the old skin, but it is quite a distinct movement from the rare one observed in the actual ecdysis.

After hanging for a very few minutes in the position indicated the nymph attaches its fore-legs to the femurs of the middle-legs, or occasionally to the twig or leaf from which it is suspended, if close enough. This brings the head to point upwards instead of downwards and more than parallel with the body, so that the head is at an acute angle with the pronotum and the pronotum is at right angles to the mesonotum, while the metanotum remains

TABLE VII.—CONSUMPTION OF FOOD (F) IN SQUARE MM. AND LINEAL GROWTH (G) IN MM. PER DAY FROM HATCHING OUT UP TO AND INCLUSIVE OF THE FIRST ECDYSIS.

Series No.	187		188		190		191		192		193		194		195	
	F	G	F	G	F	G	F	G	F	G	F	G	F	G	F	G
Hatched Days																
1	2	11.5	—	11.5	—	11	—	11	—	11	—	11	—	11.5	—	12
2	0	11.5	2	12	0	12	0	12	0	12?	0	11	0	11.5	0	12
3	0	12	2	13	3	12	0	12	0	11.5	0	11.5	1	11.5	0	12
4	3	12	3	13	3	12	0	12	0	11.5	0	11.5	0	11.5	0	12
5	12	13	6	13	0	12	0	12	9	12	9	11.5	7	11.5	0	12
6	5	13	10	13	0	12.5	0	13	5	12	8	12	2	11.5	4	12
7	9	14	8	14	9	13	9	13	7	12.5	12	12	4	11.5	8	12
8	13	14.5	9	14	5	13	9	14	11	13.5	9	12.5	8	12	10	12
9	13	15	15	14.5	5	13	18	14.5	18	14	9	13	5	12	5	12.5
10	15	15	8	15	9	13	13	15	14	14	8	13.5	3	12	7	13
11	8	15	25	16	12	14	8	15	6	14.5	9	14	6	12.5	10	14
12	0	15	16	16	9	14	20	16	20	15	9	14	7	13	7	14
13	27	15	16	16	6	14	12	16	15	15	11	14.5	10	14	8	14
14	0	15	0	16	11	14.5	18	16	14	15	4	15	11	14	12	14.5
15	11	15.5	18	16.5	21	14.5	10	16	19	15	10	15	7	14.5	13	15
16	0	16	0	16.5	18	15	9	16.5	15	15.5	9	15	14	15	12	15
17	0	16	0	16.5	20	15	6	16.5	0	15.5	6	15	10	15	9	15
18	0	16	0	22.5	17	15.5	0	16.5	0	15.5	0	15	3	15	5	15
19	0	16	0	16	14	16	0	16.5	0	15.5	0	15	0	15.5	0	15
20	0	20.5	0	16	10	16	0	20.5	0	21	0	19.5	0	15.5	0	15
21	0	Ec	0	16	6	16	0	Ec	0	Ec	0	Ec	0	15.5	0	Ec
22	0	Ec	0	Ec	0	Ec	0	Ec	0	Ec	0	Ec	0	Ec	0	Ec
F Total	120		131		176		132		153		113		98		111	
F per mm. G	13.3		11.9		19.5		13.9		17		13.3		11.5		15.8	
F per day	6		7.7		8		7		8.5		6.3		4.7		5.5	
F G up to 1st Ec		4.5		5		4		5.5		4.5		4		4		3
G at 1st Ec		4.5		6		5		4		5.5		4.5		4.5		4
G per day		.5		.7		.41		.5		.56		.47		.4		.35



C. morosus in the act of moulting. AA. Claws of hind pair of legs by which it is suspended. BB. Empty skins of these legs. CC. Distance to which so far the legs have receded in the skins. D. Empty apical abdominal segment falling backwards. EE. Empty skins of middle pair of legs. FF. First pair of legs not yet freed. G. Antennae not yet freed. H. Skin coming off snout. K. The shedded skin.

more or less in a straight line with the abdomen. The split skin can then almost immediately be seen as it were moving across the sides of the head, and at the same time the apical abdominal segment can be seen to have slipped down from the inside of the old and contracting integument, which commences to fall over backwards. There is now a considerable bend at the thoracic-abdominal joint as the body slowly glides down out of the skin, and the antennae are forced forward by the pressure of the skin. Then the middle-legs get loose and begin to spread sideways, quickly followed by the hind pair. Immediately afterwards the antennae and first pair of legs get free, the latter spreading out like the others and the antennae now no longer holding up the head, this moves slowly backwards and downwards in a line with the whole body into its normal position.

The nymph is now in the same outstretched pendant attitude it assumed when the ecdysis started, except that it hangs by the last two abdominal segments, kept there by the contraction of the discarded exoskeleton, instead of by its hind-legs, the old skin being still suspended by its now empty leg skins.

As the slough is left by the body it contracts and we have thus two motions, the contracting old skin moving upwards and the body moving downwards. The latter motion is quite involuntary on the part of the nymph or insect, being due to the action of gravity after the skin over the pro- and mesonota supporting the body has split, which lets the body slide down and out.

If at the beginning of the moult the nymph falls from its support it cannot get free from the old skin, and succumbs in spite of its wriggling while on the ground; but if the ecdysis is well advanced before such a fall the nymph will generally get free.

The time taken to get to the clearance point is about 20 to 45 minutes or a little more. The nymph remains almost motionless in this position for about 30 or 40 minutes more, when it will make a sudden convulsive movement, bend its body forward, bring up its head and reverse its position, now hanging by its first pair of legs, head upwards, quite clear of the slough. The whole procedure, now complete, occupies from 55 to 70 minutes from start to finish.

In this, the final position, the nymph or insect remains quiescent from a few minutes to several hours, after which

it commences to eat up the old skin close to which it has attached itself. This meal is an almost invariable proceeding, unless through some accident the slough has fallen to the ground or the nymph has been disturbed in some way. The skin shrivels considerably, so that the head portion is not very low down, and it is here that the nymph begins its repast, *not* biting pieces off, but drawing in the skin by means of the palpi. When it has devoured the skin of all but one hind-leg it looks for this, generally detached in the course of the feed, eats it up also, and then searches the twig for more. If the skin has fallen the nymph or insect will look for it where it should be, and occasionally hours afterwards it may devour it when it finds it. If otherwise disturbed at this meal it may eat part only or none at all. The proportion of uneaten sloughs is greater when there are a large number of nymphs or insects in a jar than when a nymph has a jar to itself, for they disturb one another very considerably. I once saw a nymph start to eat up a newly discarded skin before its proper owner was ready to begin on it. Occasionally, too, in the course of the shedding the nymph is disturbed by another crawling over it, whereupon it gives its body a jerk which does not always get rid of the troubler. Preparatory to the change the nymph is not very particular as to what it attaches itself to, and will even adhere to another nymph, and as this species has a common habit of hanging five or six close together in the day-time, like a bunch of asparagus, the quiet progress of the moult does not in any way cause a disturbance, and proceeds as in the ordinary course.*

On one occasion I observed a clot of green liquid develop at the proto-mesonotum joint similar to that mentioned on p. 357. It was about 1.5 mm. in diameter, did not seem to inconvenience the nymph at all, and gradually disappeared, apparently by absorption. This clot appeared after the discarded skin had passed clear of the head.

After the ecdysis the body is much attenuated and generally lighter and brighter in colour; in the course of 3 to 4 days it has filled out again, and if the full number of moults has not been passed the swelling slowly recommences until the next ecdysis occurs.

* With the Walking-Stick, *Diaperomera femorata*, Say, H. H. P. and H. C. Severin observed a peristaltic-like movement in the course of the moult (*loc. cit.*, 1911, p. 313).

TABLE VIII.—INCREASE IN LENGTH OF NYMPHS AT EVERY SUCCESSIVE ECDYSIS.

Specimen's Number.	Length on Hatching.	From Hatching to		Increase up to		From First Ecd. to		Increase at		From Second Ecd. to		Increase at		From Third Ecd. to		Increase at		From Fourth Ecd. to		Increase at		From Fifth Ecd. to		Increase at		From Sixth Ecd. to		Increase at	
		First Ecd.		Second Ecd.		Third Ecd.		Fourth Ecd.		Fifth Ecd.		Sixth Ecd.		Days.		Mm.		Days.		Mm.		Days.		Mm.		Days.		Mm.	
		Days.	Mm.	Days.	Mm.	Days.	Mm.	Days.	Mm.	Days.	Mm.	Days.	Mm.	Days.	Mm.	Days.	Mm.	Days.	Mm.	Days.	Mm.	Days.	Mm.	Days.	Mm.	Days.	Mm.	Days.	Mm.
98	9	24	6.5	5.5	7	17	9	20	12	19	9	20	12	19	15	24	19	15	24	19	15	24	19	15	24	19	15		
99	11	21	5	5	8	17	10	19	11	19	10	19	11	19	13	23	16	13	23	16	13	23	16	13	23	16	13		
101	10	21	6	5	9	17	8	19	8	19	8	19	8	19	8	23	18	8	23	18	8	23	18	8	23	18	8		
68a	12	29	5	4	4	21	9	22	8	23	8	22	8	22	11	27	14	11	27	14	11	27	14	11	27	14	11		
68b	12	25	4	4	5	21	8	22	7.5	21	9.5	20	13	20	14	24	17	14	24	17	14	24	17	14	24	17	14		
68c	11.5	28	5.5	5	7	22	9	22	9	22	9	20	11	21	13	27	18	13	27	18	13	27	18	13	27	18	13		
68d	12	28	5	5	7	23	7	22	7	22	9	19	12	19	15	27	18	15	27	18	15	27	18	15	27	18	15		
68e	12	28	4	4	4	18	8	23	9	23	9	21	13	20	14	27	16	14	27	16	14	27	16	14	27	16	14		
68f	11.5	23	4.5	5.5	6.5	21	6.5	22	10	22	10	22	11	20	15	26	17	15	26	17	15	26	17	15	26	17	15		
68g	11.5	29	5	4	7.5	22	7.5	21	10	21	10	21	11	20	13	29	19	13	29	19	13	29	19	13	29	19	13		
69	12	29	4.5	5	5	21	7.5	17	9	22	11	22	11	20	16	28	15	16	28	15	16	28	15	16	28	15	16		
72	11	27	5	5	8	19	8	16	9	16	9	19	10	20	14	26	15	10	20	14	26	15	10	20	14	26	15		
73	11	26	5	5	9	19	9	19	7.5	17	7.5	17	11.5	22	15	27	17	11.5	22	15	27	17	11.5	22	15	27	17		
75	12	25	4.5	5.5	7	18	7	15	10	19	10	19	12	21	12	24	19	12	21	12	24	19	12	21	12	24	19		
77	12	27	4.5	5.5	7	21	7	18	10	20	10	19	13	27	14	24	15	13	27	14	24	15	13	27	14	24	15		
78	11	28	5	5	7.5	18	7.5	20	9.5	20	9.5	18	12	19	13	25	17	12	19	13	25	17	12	19	13	25	17		
83	11	28	5	4	6	24	6	20	8	24	8	24	11	21	13	27	17	11	21	13	27	17	11	21	13	27	17		
84	9	24	6	6	7	18	7	17	9	19	9	19	11	23	14	26	15	11	23	14	26	15	11	23	14	26	15		
88	12	25	4	6	8	17	8	16	7.5	16	7.5	19	13.5	24	13	24	15	13.5	24	13	24	15	13.5	24	13	24	15		
89	8.5	34	6.5	2	7	16	7	19	10	21	10	21	11	20	13	23	16	11	20	13	23	16	11	20	13	23	16		
90	8.25	22	7.75	5	8	16	8	18	10	18	10	26	11	22	15	26	15	11	22	15	26	15	11	22	15	26	15		
91	8.25	22	7.75	5	7	16	7	16	10	22	10	22	12	20	14	27	20	12	20	14	27	20	14	27	20	14	27	20	
92	7.25	24	6.75	4	7	19	7	19	9	24	9	24	12	19	13	25	17	9	19	13	25	17	9	19	13	25	17		
94	8	28	7	3	6	20	6	17	8	23	8	23	10	20	14	25	14	8	23	10	20	14	25	14	25	14	25	14	
95	10.5	25	5.5	3.5	8.5	19	8.5	21	9	15	9	15	11	19	14	24	17	11	19	14	24	17	11	19	14	24	17		
97	8.5	22	6.5	5	6	17	6	19	10	19	10	20	11	18	14	23	14	10	18	14	23	14	10	18	14	23	14		
Max.	12	34	7.75	6	9	24	9	23	10	26	10	26	13.5	27	18	29	20	13.5	27	18	29	20	13.5	27	18	29	20		
Mm.	7.25	21	4	2	6	16	6	15	7.5	15	7.5	15	10	18	12	23	14	10	18	12	23	14	10	18	12	23	14		
Aver.	10.5	25.8	5.4	4.7	7.5	19.1	7.5	19.1	9.1	20.4	9.1	20.4	11.5	20.4	14.1	25.4	16.5	11.5	20.4	14.1	25.4	16.5	11.5	20.4	14.1	25.4	16.5		

TABLE IX.—LENGTH OF NYMPHS AT EVERY SUCCESSIVE ECDYSIS.

Specimen's Number.	Hatching.		First Ecd.		Second Ecd.		Third Ecd.		Fourth Ecd.		Fifth Ecd.		Sixth Ecd.			
	Length on Hatching.	From Hatching to	Length at	Mm.	Length after	From Hatching to	Mm.	Length after	From Hatching to	Mm.	Length after	From Hatching to	Mm.	Length after	From Hatching to	Mm.
98	9	24	15.5	21	28	60	37	80	49	99	64	123	83			
99	11	21	16	21	29	57	39	76	50	95	63	118	79			
101	10	21	16	21	30	57	38	76	50	94	68	117	83			
68a	12	29	17	21	30	73	38	95	49	117	65	144	79			
68b	12	25	16	21	29	68	38	88	51	108	65	132	82			
68c	11.5	28	17	21	28.5	71	38	91	49	112	62	139	81			
68d	12	28	17	22	29	73	38	92	50	111	65	138	83			
68e	12	28	16	20	28	69	37	90	50	110	64	137	80			
68f	11.5	23	16	21.5	28	66	38	88	49	108	64	134	81			
68g	11.5	29	16.5	20.5	28	72	38	93	49	113	62	142	81			
69	12	29	16.5	21.5	29	67	38	89	49	109	65	137	80			
72	11	27	16	21	29	62	38	81	48	101	62	127	77			
73	11	26	16	21	30	64	37.5	81	49	103	64	130	81			
75	12	25	16.5	22	29	58	39	77	51	98	63	122	82			
77	12	27	16.5	22	29	66	39	85	52	112	66	136	81			
78	11	28	16	21	28.5	66	38	84	50	103	63	128	80			
83	11	28	16	20	26	72	34	96	45	117	58	144	75			
84	9	24	15	21	28	59	37	78	48	101	62	127	79			
88	12	25	16	22	30	58	37.5	77	51	101	64	125	79			
89	8.5	34	14	16	23	69	33	90	44	110	57	133	73			
90	8.25	22	16	21	29	56	39	82	50	104	65	130	80			
91	8.25	22	16	21	28	55	38	77	50	97	64	124	84			
92	7.25	24	14	18	25	62	34	86	46	105	59	130	76			
94	8	28	15	18	24	65	32	88	42	108	56	133	70			
95	10.5	25	16	19.5	28	65	37	80	48	99	62	123	79			
97	8.5	22	15	20	26	58	36	78	47	96	61	119	75			
Max.	12	34	17	22	30	73	39	96	52	117	68	144	84			
Min.	7.25	21	14	16	23	55	32	76	42	94	56	117	70			
Aver.	10.5	25.8	16	20.6	28	64	37	84.5	48.7	105	62.8	130	79			

There are six ecdyses in all, and none after full growth is attained. With regard to the number of moults MacBride and Jackson (*op. cit.* p. 109) state they had observed seven moults, and that Meissner was mistaken as to the actual number of ecdyses. My own observations, however, based on two separate series of specimens, proved definitely that six ecdyses actually occurred. The discrepancy in the number of ecdyses may possibly be due to the insect producing one or more races which differ as to the number of ecdyses.

With regard to the number of ecdyses, it is interesting to note that Sinéty ("Recherches sur la biologie et l'anatomie des Phasmes," 1901, p. 18) records five ecdyses in the case of one individual of *C. (Dixippus) morosus* and six ecdyses in another.

GROWTHS AFTER THE FIRST 24 HOURS FROM HATCHING
OUT UP TO AND INCLUDING THE LAST ECDYSIS.

The growth, as ascertained by measurements taken on hatching out and at each successive ecdysis, of which there are six in all, is shown in the two summarised Tables Nos. VIII and IX. There is a consistent increase in the rate of growth from first to last, although this does not appear to be the case in the growth from hatching out to the first ecdysis. If, however, for the length on emergence from the egg averaging 10.5 mm., we take the corrected hatching-out length to be 13.3 mm. as already explained, the growth to the first ecdysis will be 2.6 mm. instead of 5.4 mm., and the average increase will then be as follows—

TABLE X.—CORRECTED AVERAGE INCREASE.

To I Ec. 2.6	At I Ec. 4.7	At II Ec. 7.5	At III Ec. 9.1	At IV. Ec. 11.5	At V Ec. 14.1	At VI Ec. 16.5 mm. per Ec.
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Similarly the diurnal rate of growth is an augmenting one with each successive ecdysis except the last one, thus—

TABLE XI.—DIURNAL RATE OF GROWTH.

To I Ec. 0.28	To II Ec. 0.39	To III Ec. 0.48	To IV Ec. 0.56	To V Ec. 0.69	To VI Ec. 0.65 mm. growth per day
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Generally speaking, if at any time it is desired to ascertain the stadium of a stick insect, one has only to measure

it, thus : a stick insect measuring, say, 33 mm. will have passed its second moult, and so on.

THE INSECT'S LENGTH.

The length of the individual full-grown insects varies very considerably, as the following Table of the summary of the measurements of 354 mature insects shows. These insects were the whole of the surviving progeny of one parent, measured as soon as they themselves began to drop eggs.

TABLE XII.—LENGTHS OF FULL-GROWN INSECTS—BRED FROM
“ ORIGINAL ” FEMALE.

Specimens' Numbers.	Dates of the Dropping of the Eggs from which these Insects hatched out.	Quantity of Specimens Measured.	Length in mm.		
			Max.	Min.	Aver.
1-5	19 June-19 July	53	81.5	74	77
6-11	20 July-7 Sept.	61	81	72	77.7
12-15	8 Sept.-3 Nov.	54	83	77	79.4
16-17	4 Nov.-25 Dec.	57	86	75	82
18-20	26 Dec.-16 Mar.	61	86	76	82.2
21-23	17 Mar.-13 May	68	84	75	81.8
		354	86	72	80.1

The range in the length of the adult insects is therefore 14 mm. from a minimum of 72 mm. to a maximum of 86 mm. I have no other records which exceed the above maximum of 86 mm., but I have two records which do not come up to the above minimum of 72 mm., viz. No. 42, an almost black insect and a very good egg-producer, which measured only 69 mm., and No. 159, a runt, which both ate and produced little and was only 62 mm. in length.

THE GROWTH OF THE ANTENNAE.

In connection with the body growth, as illustrated by the successive ecdyses, it is interesting to note the growth of the antennae. When hatched out the nymph's antennae consist of ten segments, the joints of which can nearly all be distinguished by the naked eye. Under the microscope on segments IV, V and VI, counting from the base, are to be seen indications of further segmentation, which develops with successive ecdyses. The three basal segments increase in size, but do not subdivide. Segment IV gets broken up into as many as 10 very distinct divisions by the

time the last ecdysis has taken place. Segment V breaks up into 4 to 7 divisions; segments VI and VII break up into 4 to 6 divisions, rarely into 7 divisions; segment VIII into 4 divisions and occasionally 6 divisions; segment IX into 3 divisions; segment X into 2 or rarely into 3 divisions. In fact, the nearer we get to the apex the less the number of sub-segments to the original or pre-ecdysical segments.

At the same time the original segments increase in length, but not all to the same extent. Their increase is shown in the following table. The number of segments on the right and left antennae of one and the same insect are not always the same.

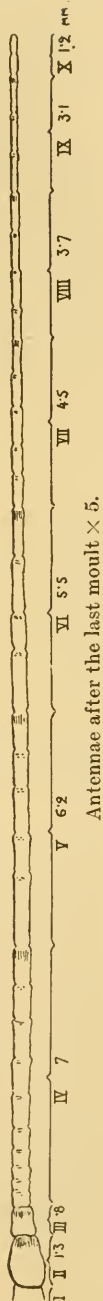
III
I I IV Y VI VII VIII IX X
05 75 75 72 72 6 6 mm
45 35

Antennae on emergence $\times 5$.

Coincident with the growth of the antennae the body (including head, thorax and abdomen) increases from 10 or 11 mm. to 80 mm. (Tables III and IV), or seven- or eight-fold. But if we accept a length of 13.3 mm. as the starting-point for growth after hatching out, then the increase of the whole body in length is six-fold, the growth

TABLE XIII.—GROWTH OF THE ANTENNAE.

Segment No. (from Base).	Length.		Rate of Growth.
	At Hatching.	After Sixth Ecdysis.	
I	—	—	—
II	.45	1.3	3 fold
III	.05	.8	16 „
IV	.35	7	20 „
V	.75	6.2	8.3 „
VI	.75	5.5	7.5 „
VII	.72	4.5	6 „
VIII	.72	3.7	5 „
IX	.6	3.1	5 „
X	.6	1.2	2 „
Total	5	33	6.6 fold



of the antennae being practically the same as that of the rest of body.

FOOD CONSUMPTION.

It follows from the form of the feeding organs that the stick insects are edge feeders and not surface feeders, cutting off strip after strip of leaf and swallowing them down whole. When decay approaches they often have difficulty in making the final bite to release the strip, and then when they move the head backwards the whole strip reappears out of their mouth still attached to the leaf. When young the bite is clean; as age increases it becomes jagged and rough (see illustration).



A partly consumed leaf showing the clean-cut edges when the nymph or insect is in good health.



A partly consumed leaf, showing the jagged edges where the insect has been feeding when decay has already set in.

They show considerable difference in their choice of food. Sometimes they will eat of one leaf, daily returning to it till it is all or nearly wholly consumed, and in the meanwhile not touch any other; at other times they will eat a small portion out of several leaves. Occasionally they will continue eating a sere or flaccid leaf instead of consuming an adjacent fresh one. They are irregular feeders, eating much one day and little the next, and so on, but always more immediately after a moult than later on in the same stadium. Except at the moults, already referred to, they feed daily and only abstain through accident, sickness or the approach of decay. Their feeding generally takes place in the evening and in the morning.

I understand that most people who keep stick insects

provide them with privet to feed on. The late Mr. Meade-Waldo informed me that "in greenhouses where they have been raised from the eggs they have started feeding on privet, and when by some accident they get separated from it they feed equally well on *Coleus*, *Fuchsia* or many other plants, at least that is my experience." My objection to privet is that, in my garden at least, if the weather is at all severe the leaves get nipped by the frost and drop off before new ones appear; in other words, they are not sufficiently persistent for food-observation purposes. Ivy is a good substitute.* The smoke with us blackens the leaves, which, except in late spring when the new leaves have not yet attracted the smuts, necessitates their being washed before being given as food to the insects. All the observations with regard to food consumption were made with ivy leaves as food. In connection with these observations it may be remarked that towards the middle of May there is usually a little difficulty in getting suitable ivy leaves, for the old leaves are then almost past service and the young ones are still too flabby, either continuing to grow after being cut, or shrivelling up quickly and so tending to vitiate the correctness of the records. As the calculations are based on the superficial area and not on the cubical contents of the portion of the leaf consumed, it was essential to supply leaves of uniform thickness in so far as this could be done.

In order to ascertain the amount of food consumed, outlines of the leaves were drawn by placing the leaves on sheets ruled in mm. squares and running a pencil round

* As regards some Stick Insects reared in India (paper by Ramakrishna Aiyer in Jour. Bombay Nat. Hist. Soc., xxii, pp. 641-3), to which my attention has been kindly called by F. H. Graveley of the Indian Museum, Calcutta), it seems that many food plants were tried, and eventually, after many deaths had occurred, some insects took to *Hibiscus esculentus* and were successfully reared on it. The name of the insect is not given. Rowland Turner informs me that in Queensland the stick insects ate gum leaves (*Eucalyptus*); these were large Phasmids (*Cyphocrania goliath*); smaller species he found devouring guava. Otto Meissner gives a list of plants, with the leaves of which he has supplied stick insects (and nymphs), and has tabulated the plants according to the preference shown for them; he found radish leaves and hazel nut leaves most in demand ("Biol. Beobach. a. d. Ind. Strohheuschrecke *Dixippus morosus*," Z. f. wiss. Insektenbiologie, v, 1909, pp. 20 and 56). Schleip fed his nymphs on rose leaves and his imagines on ivy (*op. cit.*, p. 48).

TABLE XIV.—FOOD CONSUMPTION BY, AND GROWTH OF, NYMPHS DURING THE FIRST PERIOD, *i. e.* FROM HATCHING OUT UP TO AND INCLUDING THE SIXTH (LAST) ECDYSIS.

	No. 181.						No. 183.						No. 184.						No. 187.							
	No. of Days' Fast previous to Ecd.	Lineal Increase in mm.	Food Consumption in sq. mm. since previous Ecd.	Food Consumption in sq. mm. per lineal mm. Increase.	No. of Days since previous Ecd.	Food Consumption per Day since previous Ecd.	No. of Days' Fast previous to Ecd.	Lineal Increase in mm.	Food Consumption in sq. mm. since previous Ecd.	Food Consumption in sq. mm. per lineal mm. Increase.	No. of Days since previous Ecd.	Food Consumption per Day since previous Ecd.	No. of Days' Fast previous to Ecd.	Lineal Increase in mm.	Food Consumption in sq. mm. since previous Ecd.	Food Consumption in sq. mm. per lineal mm. Increase.	No. of Days since previous Ecd.	Food Consumption per Day since previous Ecd.	No. of Days' Fast previous to Ecd.	Lineal Increase in mm.	Food Consumption in sq. mm. since previous Ecd.	Food Consumption in sq. mm. per lineal mm. Increase.	No. of Days since previous Ecd.	Food Consumption per Day since previous Ecd.		
I	2	10	142	14.2	18	8	2	167	16.7	21	8	3	10	89	8.9	17	5	120	13.3	4	9	120	13.3	20	6	
II	5	10	397	52.9	23	17	3	274	30.4	14	20	4	7	280	40	16	17	286	38.1	3	7.5	286	38.1	14	20	
III	3	9.5	573	61	17	34	3	547	64	15	36	4	9	553	66	16	34	590	65	3	9	590	65	15	39	
IV	3	12	1,449	121	17	85	2	1,219	102	17	72	3	12	1,165	97	16	73	1,275	98	3	13	1,275	98	18	71	
V	4	12	2,831	256	19	149	4	2,589	138	18	144	4	16	3,452	215	18	192	4	2,361	197	4	12	2,361	197	17	133
VI	5	17	6,485	381	22	295	4	5,711	334	23	248	5	14	6,852	489	24	285	4	6,564	410	4	16	6,564	410	21	313
Total	22	68	11,883	175	116	102	18	10,507	153	108	97	23	68	12,391	182	107	116	21	11,196	168	21	66.5	11,196	168	105	107
No. 188.																										
I	3	11	131	11.9	17	8	1	176	19.5	22	18	3	9.5	132	13.9	19	7	153	17	3	9	153	17	18	9	
II	4	7.5	267	36	14	19	2	282	35.2	15	19	3	7.5	332	44.4	16	21	241	32.1	3	7.5	241	32.1	16	15	
III	4	9	709	79	17	42	3	756	94	16	47	4	9	452	50	15	30	569	63	3	9	569	63	15	38	
IV	5	11	1,382	122	17	81	3	1,433	110	16	90	3	12	1,561	130	15	104	1,230	107	3	11.5	1,230	107	16	77	
V	4	14	2,931	209	18	163	4	2,399	165	19	126	4	14	2,521	180	18	140	3	2,092	150	3	14	2,092	150	19	110
VI	5	18	8,164	453	22	371	5	6,056	418	21	288	5	16	6,444	403	21	307	4	6,130	323	4	19	6,130	323	22	279
Total	25	70.5	13,584	193	105	129	18	11,102	166	109	102	22	68	11,443	168	104	110	21	10,415	149	21	70	10,415	149	106	98
No. 192.																										
Averages.																										
I	2	8.5	113	13.3	18	6	4	98	11.5	21	5	2	7	111	15.8	20	5.5	130	14.2	2.6	9.2	130	14.2	19	7	
II	3	7.5	212	28.3	14	15	3	263	32.8	16	16	3	7.5	235	31.3	17	14	279	36.5	3.2	7.7	279	36.5	16	17.5	
III	3	9	460	51	17	27	3	605	76	17	36	4	8.5	550	65	16	34	579	66	3.4	8.7	579	66	16	36	
IV	4	12.5	1,361	109	16	85	4	1,413	109	19	74	4	11	1,084	98	16	68	1,121	110	3.5	12.1	1,121	110	17	79.6	
V	4	14	2,578	184	19	136	3	2,652	189	20	133	4	14	2,457	175	20	123	2,611	186	3.8	14.1	2,611	186	19	140	
VI	4	18.5	6,853	370	21	326	5	6,474	405	24	270	5	17	6,185	364	23	269	4	6,538	398	4.6	16.4	6,538	398	22	295
Total	19	70	11,577	165	105	110	22	11,505	168	117	98	22	65	10,622	163	112	95	21	11,475	168	21	68.2	11,475	168	109	106

their edges; these leaves were then put at the disposal of the insect. At the end of twenty-four hours (the next morning) the leaves were fitted into their respective outlines on the sheets, and the portion missing, *i. e.* consumed, was outlined and the leaves replaced with the insect. The number of square mm. in the missing portion was then counted, and recorded day by day as the amount of leaf consumed.

As shown in Table XIV, the food consumption doubles with each successive stadium and not merely in actual quantity, for the quantity consumed increases per mm. length of the insect at the same time, thus: in the 1st stadium the consumption per mm. length of the insect is 7 sq. mm., in the 2nd 17.5 sq. mm, in the 3rd 36, in the 4th 79.6, in the 5th 140, in the 6th 295, and after the 6th 597 (see Table XV), and these figures are as near as possible 9, 18, 36, 72, 144, 288, and 576, respectively.

For the two or three weeks immediately following the last ecdysis the insects eat enormously (as can be seen from Diagram III), afterwards, generally speaking, they gradually eat less and less. As the same diagram indicates, there is considerable correspondence between the food consumed and the eggs produced.

As with the egg-dropping, so too with the food consumption, the size of the insect appears to have nothing to do with the results, and according to Table XV a shorter insect may eat more than a longer one.

TABLE XV.—FOOD CONSUMPTION BY FULL-GROWN INSECTS.

Specimen's Number.	Length of Insect. mm.	Total sq. mm. of Leaf consumed.	No. of Days lived (Ind Period).	Total No. of Eggs dropped.	Averages.			
					No. of Eggs dropped per Day.	Sq. mm. of Leaf consumed per Day.	Sq. mm. of Leaf consumed per mm. Length of Insect.	Sq. mm. of Leaf consumed per Egg dropped.
69	80	111,438	187	471	2.52	596	1392	238
88	79	138,341	211	591	2.8	656	1751	234
97	75	118,835	200	554	2.77	594	1584	214
99	79	113,979	210	536	2.55	543	1443	213
94	70	56,049	142	253	1.78	395	800	221
Aver.	78.2	120,648	202	538	2.66	597	1541	225

III DIAGRAM TO ILLUSTRATE CORRESPONDENCE BETWEEN FOOD CONSUMPTION AND NO OF EGGS PRODUCED IN 15 DAY PERIODS

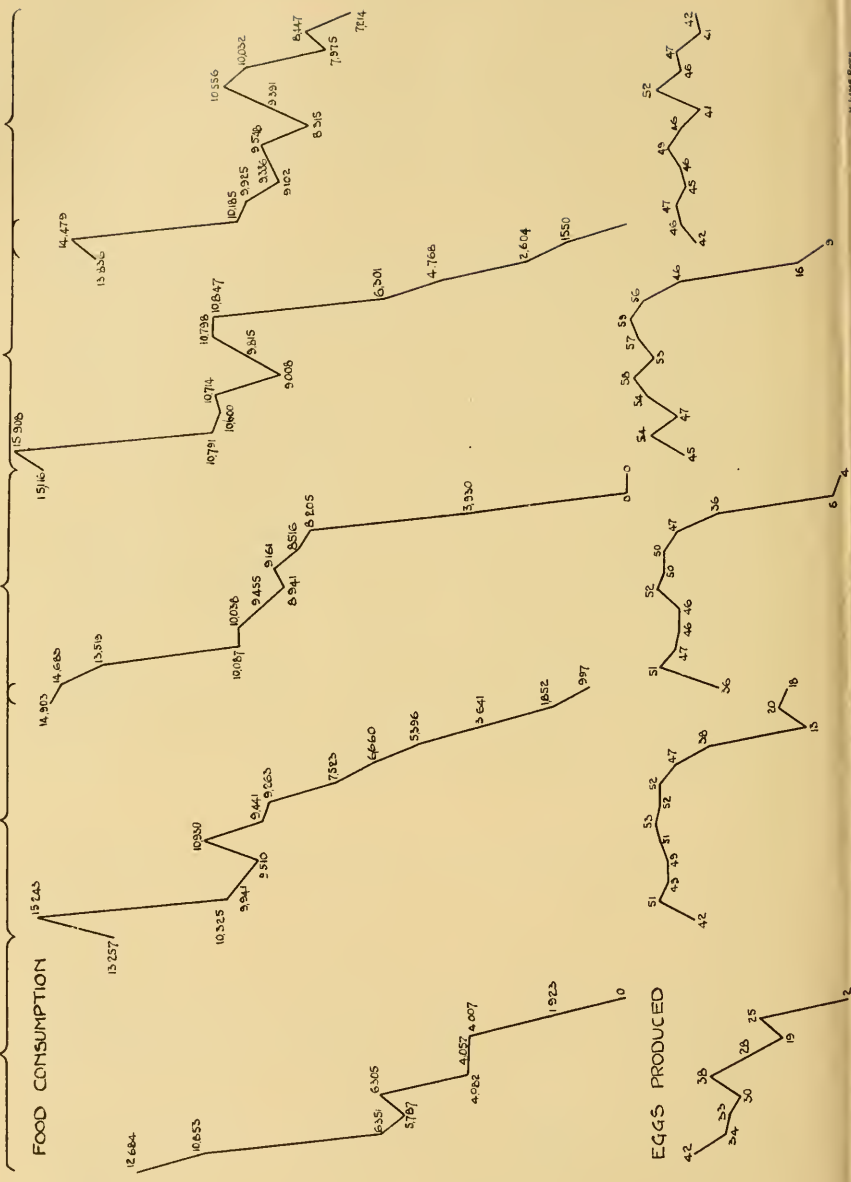
NO 94
 L. 70 MM Total E = 536
 TOTAL F = 56049 Sq MM
 F : E = 221 : 1

NO 99
 L. 79 MM Total E = 536
 TOTAL F = 113979 Sq MM
 F : E = 215 : 1

NO 69
 L. 80 MM Total E = 471
 TOTAL F = 111438 Sq MM
 F : E = 238 : 1

NO 97
 L. 75 MM Total E = 554
 TOTAL F = 116835 Sq MM
 F : E = 214 : 1

NO 82
 L. 75 MM Total E = 591
 TOTAL F = 138341 Sq MM
 F : E = 234 : 1



WATER-DRINKING.

It has been mentioned that on hatching out water is frequently imbibed with avidity. Afterwards, unless improperly fed or neglected, the nymphs and insects avoid water. Towards the end of life, when for days together they are unable to eat and therefore to take in moisture with their food, they will search for water and remain with their mouths immersed for many minutes.

CANNIBALISM.

They will bite off one another's appendages if not sufficiently supplied with food. At the Manchester Museum once during vacation some stick insects were left for about 7 to 10 days without being fed. At the end of that period out of 24 specimens only 5 remained perfect, all the others having their appendages more or less mutilated, small portions of which were found lying on the floor of the jar. There were no body mutilations.

I have had two cases in which one full-grown insect was mutilated by one or more full-grown insects, although there was plenty of food in the jar at the time. Only the appendages were bitten off, and of these in one case only one leg was left perfect, when, as it could no longer feed itself, it was taken away and destroyed; while, in the other case, all the appendages were more or less bitten off, and it died of want of food.

THE EXCRETA.

The excreta are thick and cylindrical in shape and fairly dry when ejected. The presence of eggs in the body does not in any way tend to flatten their shape, but in times of illness or approaching dissolution the excreta are flat or tape-like in appearance. This is contrary to the observations of Meissner, who states that egg ejection tended to flatten the excreta.

PROTECTIVE MEASURES.

The nymph or insect is possibly protected from enemies by its resemblance to a stick or twig, and its habit of lying flat against a stalk, especially when very small. Also by its facility for adopting the cataleptic attitude when it slips to the ground, *not* with its appendages spread out, but

all closely parallel to the body. On the other hand, it will frequently cling tenaciously to its disturber rather than avoid such.

Meissner (*op. cit.*, p. 88), in dealing with *Dixippus morosus*, considers the general lateral movement, the ejection of a brown liquid and the recurving over the back of the terminal end of the abdomen to be protective measures, but to me the lateral movement and the flow, not ejection, of the brown liquid are due to other causes and are not protective in *Carausius morosus*.

The object of the recurving of the abdomen over the back is not clear. Meissner looks upon it as a protective attitude, but Schleip does not think so. It seemed to me that, while at emergence from the egg this recurvature was very pronounced, it lessened imperceptibly, until with the egg-bearing stage it disappeared almost entirely. Schleip considers that the weight of the abdomen when full of eggs keeps it in a straight position and prevents the recurving.

DURATION OF LIFE.

Table VI, already referred to, gives the average number of days lived during the First Period as 136; but omitting the two abnormal cases of 171 and 174 days respectively, and adding the days for seven other insects under observation, viz. 127, 138, 130, 130, 123, 123, and 117, we get a normal average of 131 days with a range of 27 days (117-144), and an exceptional range of 57 days (117-174).

The average duration of life during the Second Period, according to the Table, is 207 days; but omitting the abnormal results shown by Nos. "Orig.," 18, 22, 159, 94 and 65, we obtain a normal average of 239 days with a range of 142 days (187-329).

Generally speaking, about two-fifths of the insect's lifetime is spent in the First or Preparatory Period, and three-fifths in the Second or Reproductive Period.

DEATH.

When ill or dying a sticky brown liquid occasionally issues from the mouth, and when the nymph or insect is asphyxiated (in the fumes of cyanide of potassium) the liquid almost invariably flows out. Excepting under these circumstances I have not found any traces of this discharge.

VARIATION.

Weismann, from a study of the variation of a parthenogenetic organism, *Cypris reptans*, concluded ("Germ-Plasm," 1893, p. 344) that forms reproduced in this manner varied but little. He explained this comparative constancy on the ground that the union of male and female cells in sexually produced forms provided the material for variation, and that, therefore, in the absence of the male cell, greater stability in character resulted. Warren has made observations on parthenogenetically reproduced specimens of *Daphnia magna*, and found (Proc. Roy. Soc. lxx., 1899, p. 155) that the variation shown by them was very considerable. In consequence of the divergent views on the variability of parthenogenetic forms it seems desirable to accumulate evidence on the subject, and the observations made during this study of the life-history of *Carausius morosus* are offered as a contribution towards that end.

The observations made are summarised in the following table, giving the maximum, minimum, range, average, standard deviation and co-efficient of variation for each character observed. The two latter are calculated on the method advocated by Karl Pearson ("Grammar of Science," 2nd ed., p. 387).

TABLE XVI.—SUMMARY OF VARIATIONS.

Particulars of Observations.	Min.	Max.	Range.	Average.	Standard Deviation.	Co-efficient of Variation.
Oviposition : Eggs produced per insect	253	712	459	513	95.76	18.66
Oviposition : Eggs produced per mm. length of insect	3.6	9.2	5.6	6.5	1.23	18.92
Size of Egg : Length in mm.	2.3	3.5	1.2	2.8	.16	5.68
Incubation : Number of days	137	297	160	165	21.85	13.24
Nymphs on hatching out : Length in mm.	6.5	13	6.5	10.5	1.34	12.7
Increase in length of Nymphs in mm. during first 24 hours	0	6	6	2.7	1.8	66.66
Increase in length of Nymphs in mm. up to and at 1st moult	7	12.75	5.75	9.9	1.23	12.42
Increase in length of Nymphs in mm. at 2nd moult	6	9	3	7.5	.77	10.2
Increase in length of Nymphs in mm. at 3rd moult	7.5	10	2.5	9	.75	8.3
Increase in length of Nymphs in mm. at 4th moult	10	13.5	3.5	11.7	.87	7.43
Increase in length of Nymphs in mm. at 5th moult	12	18	6	14.1	1.22	8.65
Increase in length of Nymphs in mm. at 6th moult	14	20	6	16.4	1.68	10.24
Length of full-grown insects of one parent in mm.	72	86	14	80.1	2.85	3.55
Duration of Life : Number of days	275	469	194	361	40.48	11.21

The variation in colour, which is not capable of measurement, is also very well marked. The original specimen, of which all the subsequent progeny formed the material on which my observations are based, was a not very dark green. The offspring have exhibited all variations of colour from a very pale green to a speckled fawn colour. As a discontinuous variation there appeared at intervals a few very dark speckled brown, almost black; three of these were isolated and the 1237 eggs dropped by them were kept separate. The accommodation at my disposal was only sufficient to rear to the adult state some 475 of the nymphs which hatched from these eggs. Of this number only eight were of the very dark colour of the parents, the remainder being various shades of green and fawn. The hereditary tendency to transmit the dark colour, although certainly present, is evidently weak.

The insects forming the subject of these observations have been reared under as uniform conditions as it was possible to get, so that the effect of environment is eliminated as a possible factor in the variation observed.

The amount of variation as brought out in the table is considerable; whether it is greater or less than in the sexually produced forms of the same insect, if any, can only be established when a similar series of observations on the latter have been carried out.

SUMMARY OF OBSERVATIONS.

The observations were made under a regulated temperature varying from 56° to 64° F. (13° to 18° C.).

The insects are of a lethargic disposition, feign death when disturbed, and support themselves by their claws assisted by their pads, which do not act by surface tension.

In colour they vary from a light fawn to a dark green; very dark brown almost black is rare. During life the colour barely changes.

Incubation in the boxes varied from 137 to 297 days, equal to a range of 160 days; 52·7% of nymphs hatched out in 141 to 160 days, and 32·3% in 161 to 190 days. Placed on garden mould the hatching out commenced 16 days sooner, *i. e.* in 115 days, with a somewhat similar average range.

The insects were parthenogenetic, and only one specimen, obviously an infirm female, failed to produce eggs. One

male was found and there is a possibility of its being de-generated; it had no contact with any of the females under observation.

The length over all of the egg capsules varied from 2.3 to 3.2 mm., average 2.8 mm. Under 2.6 mm. long they did not hatch out. The fertility of the eggs was found to be 81.5%.

Eggs are first dropped 12 to 24 days (average 16.5 days) after the last ecdysis; they are neither laid nor shot out, but simply dropped.

The average egg production was found to be 513 per insect, the highest total reached by one insect being 712. There appeared to be no correlation between the size (length of the insect) and the quantity of eggs produced.

The nymphs emerged by pushing off the cap of the egg and *appeared* to come out pronotum first, and not head first. The length of the nymphs on hatching out varied from 7.5 to 12.5 mm., average 10.5 mm. Almost invariably on hatching out they were eager for a drink, but not keen to eat. At the end of 24 hours their average length was 13.3 mm. From the time of hatching out the nymphs grew at the rate of .35 to .7 mm. per day, for an average of 21 days, with a total increase of 3 to 5.5 mm. This is the only period during which the nymphs grow without shedding the skin.

The nymphs fast from 2 to 6 days previous to the actual moulting. The ecdyses were performed by the nymph hanging head downwards, the skin splitting from the pronotum upwards, when gravity did the rest. There were in all the cases observed six ecdyses for each insect. The increase in length at every ecdysis was so marked that it was possible to ascertain by measurement the stadium in which the nymph or insect might happen to be.

The length of the full-grown insects varied from 72 to 86 mm. (exclusive of the antennae), average 80.1 mm., equal to a range of 14 mm. The progeny from eggs dropped late in life attained to a greater length than that from eggs dropped early in life.* The body length increased six-fold; the antennae increased in the same total ratio; but the increase in the various segments was more and less.

With the exceptions named the nymphs and insects

* It is noteworthy that Elkind states that in *D. morosus* the eggs are smaller during the earlier stages of production than later on (*op. cit.*, p. 14).

were fed on ivy leaves. Their food consumption doubled after every ecdysis. Except when hatched out the nymphs did not care for water, and only towards the end of life, when they were unable to eat, did they drink with avidity.

The average duration of life was 136 days for the First or Preparatory Period (*i. e.* from hatching out to the 6th moult), and 225 days for the Second or Reproductive Period; in other words, the insect spends two-fifths of its life in preparing for the following three-fifths.

The results here detailed demonstrate very clearly that parthenogenetically produced organisms do vary considerably, and support the observations made by Warren rather than those of Weismann.

XX. *Falkland Islands* Diptera. By C. G. LAMB, M.A.,
B.Sc., Clare College, Cambridge. Communicated
by F. W. EDWARDS, F.E.S.

[Read October 18th, 1916.]

THROUGH the kindness of Mr. F. W. Edwards, of the British Museum, I have had the opportunity of examining a small collection of flies from the Falkland Islands. In part this collection was made by Mr. R. Vallentin in the years 1901-3; the remainder was collected by Dr. M. Cameron (of H.M.S. *Cornwall*) on Dec. 7, 1914, when he paid a hurried visit ashore the day before the naval engagement off those islands.

There are four species in the collection, of which three appear to be undescribed. The known species is the Borborid *Antrops truncipennis* described by Enderlein in Zool. Anz. Bd. xxxiv, p. 226, 1909. Specimens of this species were collected both by Vallentin and Cameron. One of the new species is a Phycodromid. Enderlein gives a conspectus of the genera of that family in the "Deutsche Südpolar. Expedition" (X. Zool. ii, 1909); according to his tables the species falls within the limits of the genus *Oedoparea*, though it is sufficiently distinct from the normal form of that genus to warrant generic rank should more related forms be discovered. The other two species are almost wingless forms closely allied to *Scatella*. Becker gives a beautiful figure of his *Scatella brevipennis* in "Belgica," Zool. Ins. (1906), Plate III; one of the new species must be very similar in appearance to that species, but on comparison distinct differences are visible: in particular Becker states that the costa plainly ends at the 3rd vein, thus fixing his species as a *Scatella*. In the new species the wings and venation are more reduced, and it is quite impossible to state whether they are to be considered as members of that genus or of *Scatophila*. When further stages of wing reduction come to light, the point may be settled, and it will probably be found that the relationships of the new species are to be sought for

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in *Scatophila*; meanwhile the generic name *Synhoplos* is proposed for these two new semiapterous Ephydriids.

The description of the new species is as follows:—

***Oedoparea oblita*, n. sp.**

As mentioned above, the three specimens of a *Phycodromi* may be provisionally placed in this genus. To facilitate description, the insect is compared with the well-known *Oedoparea buccata*, which very exceptionally reaches nearly the size of the present insect. To avoid repetition of name the contrasting characters of the latter species are placed in square brackets, thus [].

♀. *Head*: top view:—frons quite flat with no ocellar tubercle, widening slightly to the overhanging forehead, all dull orange, darker in front, with a long pointed orange frontal triangle extending $\frac{2}{3}$ the distance to the forehead, and including in it a small ocellar triangle [only an ocellar triangle]; the front half of the frons is covered with tiny bristles [bristles few and scattered]; hind eye margins broad, two orbital bristles with tiny ones between [three orbitals on grey borders], divergent ocellars inserted on lines joining the ocelli, parallel inner verticals, divergent outer, and post-verticals just behind the line formed by the bases of the vertical pairs.

Front view:—the frons runs on into the cheeks, both being demarcated from the face by the lunule and by side furrows extending to the upper mouth margins; the face is orange, covered with silvery hairs and contracted below [broader in *buccata*]; the grey upper lip projects; palpi very stout, orange and covered with dark hairs [less hairy], the ridged yellow tongue is well visible. The arched side furrows of the face form two well-marked shallow antennal foveae; the antennae are separated at the base by a nose projecting below the lunula: they are all orange, 1st joint somewhat orbicular, with tiny black bristles; 2nd joint calyciform, bristled, especially below inside, 3rd joint flattened orbicular, darker, but covered with silvery pollen; arista practically bare, a little longer than whole antennal length, awn-like, the basal joints stout, the second coneing into the flagellum.

Side view:—profile rather like *buccata*, but while the latter has a median nose, broad and slightly convex in profile, the present species has a distinctly concave profile, and hence the forehead appears more prominent. Eyes bare, rather oval, the long axis sloping from vertex to cheek, with the sharpest curvature at the upper end of this axis [eyes much more nearly round]; jowl as deep

as the eye, yellow-orange in colour, as is the side of the face, and both covered with bristly hairs [fewer hairs, hind jowls bare]; the hind head runs into the jowls smoothly and continuously [hind head cut off from hind jowls by a furrow]; post-orbital row present above.

Thorax:—the dorsum is dull grey, pollinated, and covered with fine bristles; humeri greyish orange; the bristles are, humeral (with accessory hairs) in a line with the two notopleurals, presutural, one supra-alar, a row of 8 bordering the hind margin of thorax, of which one is on the post-alar callus, two are the true prescutellars (small and close together), and between the post-alar and prescutellar is another bristle; this is possibly the last of a true dorso-



FIG. 1.—*Oedoparea oblita*.

central row of which (1 + 2) others can just be seen projecting somewhat among the scattered bristles [has a similar chaetotaxy, but the dorso-central row is more developed, and the general clothing bristles are very much longer]; scutellum as thorax, rounded, pale edged with a few scattered bristles except on the centre of the disc, a pair of stout upright terminal bristles and smaller convergent basal pair [no small discal bristles]. The pleura is grey with fine orange pollen, mesopleura bare, a bristle below the stigma, sternopleura with 3 bristles close to upper suture and covered with very long curly hairs which are dark basally but otherwise orange [less hairy on sternopleura]. The wings have a similar form to *buccata* in venation, structure, relative size and form, but are stouter in texture, they are somewhat milky with pale veins except for a slight suffusion on the cross veins. Calypters pale yellow with short pale hairs. Halteres pale yellow, same in form as in *buccata*.

Legs principally orange. *Front*: coxa greyish with bristles in front; femur rather swollen in the middle with long orange hairs, no bristles; tibia swollen for its distal half, also covered with long soft hairs, a long front preapical bristle; tarsus with 1st joint about as long as the next three, the last joint larger, all bristly, the bristles getting longer towards the end, claws stout and black, pads pale, a long black bristle for empodium. *Middle*: similar to front pair, but the tibia has a very strong crown of spines, and the tarsal bristles are stouter. *Hind*: similar, but the femur and tibia are but little swollen and are longer, a crown to tibia, and a large long hind preapical; tarsi with usual golden pads [clothing bristles shorter and more bristly, without the long soft hairs].

Abdomen, grey with fine whitish pollen, covered with small hairs, except for the penultimate segment which has long hairs.

Length about $7\frac{1}{2}$ mm.

Wing about 6 mm.

Collected by R. Vallentin, 1902-3. Types in British Museum.

SYNHOPLUS, gen. nov. (*Ephydridae*).

This genus is related to *Scatella* and *Scatophila*, having a very similar facies, but it is almost wingless in both sexes. The face has a very pronounced median ridge carrying a knob, and this ridge forms deep-set side furrows which receive the antennae. These latter have a very bristly second joint, and the arista is distinctly, though shortly, pectinate; eyes irregularly oval; jowls deep; the lower lip is rather short, and does not close the oral aperture completely; the chaetotaxy is somewhat like that of *Scatella*, but the dorso-central and acrostichal bristles are irregular; the scutellum has four bristles, the end two being long, upright and crossed. A rather noticeable feature is that the notopleura turns somewhat into the dorsal plane, and is comparatively feebly developed, owing to the feeble wing musculation.

Synhoplos sturdeeanus, n. sp.

♂. *Head*: top view:—broader than the thorax and about $\frac{1}{2}$ as deep as broad, the forehead margin almost straight; the frons is very broad, roughly square, the front ocellus is nearly in the middle of the frons, all three ocelli are extremely minute and lie nearly in an equilateral triangle. The frons is dark grey, with

broad pale silvery eye margins, and with an ill-defined leaf-shaped darker area enclosing the ocelli, whose point nearly reaches the forehead. Surrounding this leaf the frons is broadly paler than the remainder of its surface (and shows ochraceous in a side light), so that a darker triangle is left each side bounded by the eye margin, the forehead, and a line from forward vertical bristle to



FIG. 2.—*Synhoplos sturdeeanaus*.

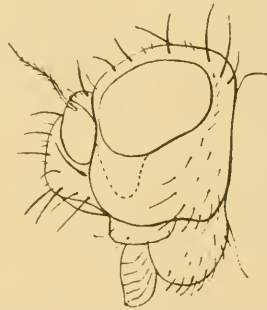


FIG. 3.—*Synhoplos sturdeeanaus*.

nearly the centre of the forehead. The chaetotaxy is as follows:—ocellar bristles divergent, inserted just outside middle of line joining ocelli; forward vertical bristles on middle of wide eye margins converging to centre, long hind verticals somewhat divergent but straight; two large orbital bristles each side overhanging eyes, with a preceding, intermediate and following smaller bristle. Other smaller bristles are as follows: a row of some six bristles on sloping boundary of black triangle mentioned above, the front ones longest and strongly converging to centre; a clump of fine bristles exists between the hind ocelli and the vertex; the upper bristles of the

rather irregular post-orbital row are visible, and are continued by 2 or 3 small bristles behind the hind verticals.

Front view :—vertex arched with no sign of any hump; eyes slightly prominent; mouth edge straight with about 5 long stout fringing bristles each side; the nose starts with a silver base level with second antennal joints, and suddenly becomes prominent at that point, it then widens, and sweeps each side into the mouth margin; it is mainly orange but grades into the grey mouth margin; the nose bears a diverging row of 4 bristles each side and has much smaller scattered ones on its surface; the lines of main bristles curve round so that the very large bristles on the cheeks below the antenna form their terminations. The whole face is distinctly pollinated. The antennae being turned rather sideways beside the nose are best seen in this view, the first joint forms a small elongate knob embracing the base of the second joint; this is oval, smooth, with a few small bristles on the surface and a long dorsal one; the visible part of the third joint is also oval, densely but obscurely pilose and darkened at tip; otherwise the whole antenna is orange. The arista is thick at base, then tapered, with about 7 feathers; its whole length is a little greater than the whole antennal length.

Side view :—the greatly protuberant nose is very evident, as is the deep antennal groove, and a deep furrow in front of the eye, with a long facial bristle forward of it. The eyes are oval, with the longer axis oblique and sloping downwards from behind to front: the boundary is regularly curved, the upper margin with a shorter radius than the lower: the ends of the longer axis also smoothly curved, the upper having larger radius than the lower. The whole of the side of the face is grey with some silvery pollen. The hind jowls towards the back of the head carry many palish decumbent bristles, longer below. The post-orbital bristle-row extends halfway down, and there are a few accessory bristles behind it. It can be seen that the second antennal joint is rather swollen and is practically smooth behind. The lower lip is grey, swollen and hairy, and the ridged orange tongue protrudes from it: the palpi are orange, stout, rather flattened in the vertical plane and bristled. On looking into the mouth, the true lip is seen to be cut off from the outer mouth margin by a deep encircling furrow.

Thorax :—the general colour is silvery grey, due to very minute dense pollen, with very faint bluish and bronzy reflections; there are rather irregular rows of small bristles, some of which form the irregular double acrostichal rows, others the dorso-centrals; in the latter the presutural and precutellar dorso-centrals are true macrochaetae. There are two or three small humerals, a bristle (pre-

sutural) just before the V-shaped cross furrow at the side, two notopleurals on the much-abbreviated notopleura, and one supra-alar; between all are the small bristles. The scutellum is slightly rounded with a shallow furrow in front, the terminal bristles are large, upright and crossed at tip, each side is a smaller rather depressed bristle. The pleura is silvery grey, more orange below; it is covered with small scattered bristles and has a large mesopleural bristle, and there is a large sternopleural one.

The *wings* are reduced to small pointed orange flaps with short stout bristles, the thoracic squama is present, though minute. The halteres are reduced to stout orange rods.

The *legs* are bright orange, stout, and profusely covered with bristles, all the femora and coxae are rather pollinated with silver; the only stout bristles are inferior crowns to mid and hind tibiae, and a pair beneath each tarsal joint. The 1st tarsal joints of all the feet are rather shorter than the rest of the feet, and have inferiorly a dense pile of stout orange bristles. The last joints are rather flattened and have long dorsal hairs, very stout curved claws, delicately feathered pads, and a long empodium of several fine hairs.

Abdomen:—long—oval with rounded end: in colour it is silvery-grey like the rest of the insect, but has rather ill-defined brown marks as follows: smallish side spots on 2 and 3, a large median oval spot on 1, a central V on 2 extended almost across segment, a similar rather larger and more slender V on 3. The segments 1, 2, 3 are about equal, but 4 is about $1\frac{1}{2}$ times as long. The whole surface is covered with bristles which are reddish in certain lights, the marginals are black and longer. In side view the end is cut off obliquely, the 5th segment has a very large terminal pit which hides the complex genitalia.

Length about $2\frac{1}{4}$ mm.

Wings about .3 mm.

♀. Very like the male except that the abdomen is longer and the segments are all equal, the brown marks are reduced to very indistinct central spots: the lower part of last abdominal segment carries a pair of very stout curved claws.

3 ♂♂ and 1 ♀.

Collected by Dr. M. Cameron, R.N., in 1914. Co-types in the British Museum.

Synhoplos neglectus, n. sp.

This species is somewhat larger than the last, and is very much more bristly and robust in appearance.

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Head: top view:—shape and general character like the last species, but the whole is dark blackish brown, the eye margin being somewhat more brown: the central area is scarcely differentiated from the rest. The chaetotaxy is the same, though stouter.

Head: front view:—same as last, but the colour is altogether darkened grey, much less orange. The antennae are similar, but ochreous grey in colour, the 3rd joint being quite grey.

Side view:—much as last, but there is no very evident furrow behind the cheek-bristle: the sides are grey and silvery, and the hind jowls bear short black bristles. The remainder of the side is much like the last species, but the orange colour is far less distinct. The eyes slope similarly, but they are somewhat different in outline, being rather pointed below in front, the radius of curvature of the boundary being very small.

Thorax:—the general colour is dull brown-black, the upturned notopleurae are orange, so that they form two irregular orange side stripes. The small dorsal bristles are arranged somewhat like the last, but much longer and more evident. The dorso-central rows are more marked, as there is a mid-bristle pair as well as the front and hind pairs: the other bristles are the same, but longer and stouter. The scutellum is similar, and bears two very long upright crossed bristles and the usual two small accessory side ones. The pleura is darkened orange, bristled as last.

The *wings* are reduced to hairy strips, they are proportionately a little longer than in the last species, being about equal in length to two-thirds the distance from the root to the humerus.

The *legs* are similar to the last, darkened orange and a little more stoutly haired.

The *abdomen*: this shows a striking difference in colour, etc.: it is all very dull dark black-brown, almost black; it is uniformly and densely covered with tiny adpressed bristly hairs. In outline the shape is similar to the last, being widest at the end of the 2nd segment. The 1st, 2nd and 3rd segment have their axial length the same; the 4th is about twice as long. The last is only just visible dorsally, but on side view it is seen to be long and rather narrow, its axis being about 60° to the body axis. This segment ends in a papilla bearing a bunch of orange hairs, at the base of the 4th segment are two strong chitinous hooks. If the 5th segment be viewed from behind, it is seen to bear a rounded triangular patch which is paler haired, and is well marked off from the rest by a definite sunk boundary: it looks like a little segment glued on to the 5th. In the first species these structures cannot be seen as the whole apparatus is withdrawn in all three specimens.

The female differs from the female of the last species in the

same way as the males differ, the abdomen being dull brown-black. The terminal hooks are not visible.

Length $3\frac{1}{2}$ mm.

Wing a little more than $\frac{1}{2}$ mm.

5 ♂♂, 8 ♀♀.

Collected by Vallentin in 1902-3. Types in British Museum.

XXI. *Parthenogenesis amongst the Workers of the Cape Honey-Bee: Mr. G. W. Onions' Experiments.* By RUPERT W. JACK, F.E.S., Govt. Entomologist, S. Rhodesia.

[Read October 7th, 1914.]

PLATES CV, CVI.

FOR some years past Mr. G. W. Onions, until recently a resident in the Cape Peninsula, has been engaged in following up a line of research, suggested by observations tending to show that the variety of the honey-bee mainly kept at the Cape exhibits a remarkable divergence from the European varieties, in that a far greater portion of the workers are apt to develop the habit of laying eggs, and that these eggs may produce either workers, queens or drones, but do, as a matter of fact, mainly produce workers.

As is well known, Dzierzon, Von Siebold and others held, and their views have been generally accepted, that the eggs of the "laying workers" and unfertilised queens of the honey-bee invariably produce drones, and founded on these and other observations we have the "Dzierzon theory" to the effect that the ova of the honey-bee are predominantly male whilst unfertilised, but that the female elements invariably predominate after the union of the ovum and spermatozoon. The production of a certain proportion of males by a fertilised queen was accounted for by supposing that the queen could control the egress of spermatozoa from the spermatheca when impelled by instinct to add a certain number of drones to the colony.

Of the merits or demerits of Dzierzon's explanation the writer is not qualified to judge, but the following paragraph is to be found on page 499 of the volume entitled "Peripatus, Myriapods, and Insects, Pt. I," by Sedgwick, Sinclair and Sharp, Cambridge Natural History: "The facts we have stated as to the sexes resulting from parthenogenetic reproduction in Hymenoptera generally, are extremely opposed to the Dzierzon theory, in so far as this relates to the production of sex. There have always been entomologists who have considered this view unsatis-

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factory, and the observations of several recent French naturalists are unfavourable to the idea that the sex of an egg is determined by its fertilisation." Could it be shown, therefore, that in a variety of *Apis mellifica*, closely related to the variety with which Dzierzon and Von Siebold conducted their experiments, unfertilised eggs may and do produce female adults, the arguments of those opposed to Dzierzon's explanation would be very greatly strengthened, as few could credit the statement that the fact of the egg being fertilised or not determines its sex in respect to one variety of a species and not to all. An examination of Mr. Onions' claim to have proved the production of female offspring from Cape "laying workers," with a view to giving his remarkable discoveries wider publicity, is the object of this paper.

Concerning the actual variety with which Mr. Onions' experiments were conducted, Dr. Peringuey, Curator of the S.A. Museum at Cape Town, who kindly examined specimens for the writer, states that some authors consider the variety identical with the typical European *Apis mellifica*, L., but he himself is inclined to retain the varietal name *kaffra*, as given by Lepelletier. Specimens submitted to the British Museum were, however, judged to belong to the race *unicolor* var. *intermissa*, Latr. The identification of the exact variety, therefore, appears to be a somewhat difficult matter, and the writer is not in a position to express any opinion on the subject. The important fact is that this bee is very closely allied to the typical *Apis mellifica*, L.

As far back as November 1909 a notice appeared in the *Agricultural Journal of the Cape of Good Hope* stating that Mr. Onions had deposited with the Government Entomologist "an account of observations and experiments conducted by himself, which tend to show that laying workers of the native black honey-bee are far more common than is generally supposed, and that their eggs generally produce workers and not infrequently queens." A full account of these and other observations of a similar nature was published in the *Agricultural Journal of the S.A. Union* for May 1912. Since that time Mr. Onions has become a resident in S. Rhodesia, and has been able to repeat some of his experiments with bees imported from the Cape. Conditions in this territory are more favourable for such observations than those at the Cape, for the

reason that very few bees of the Cape variety are kept, whilst the native honey-bee of Rhodesia (*Apis mellifica unicolor* var. *adansoni*, B.R.) is easily distinguishable from that of the Cape. On account of this, any possibility of error through eggs having been stolen from other hives was entirely removed. It may be mentioned that although "laying workers" are, under certain circumstances, common enough in hives of the Rhodesian bee kept under domestication, their eggs have not been observed to produce anything but drones.

The account of Mr. Onions' observations, published as above, attracted but little attention, although a certain amount of adverse criticism appeared from the pens of one or two bee-keepers in the Union, and, anxious that his discoveries should be brought to the notice of scientists interested in parthenogenesis generally, the help of the Division of Entomology at Salisbury was sought, with the offer of experiments to be conducted under the supervision of an officer of the division.

Before proceeding to an account of these experiments it is desirable to call attention to one anatomical peculiarity in the Cape worker bee. In the typical *Apis mellifica* the spermatheca in the workers is, of course, vestigial, consisting merely of a slight projection from the common oviduct. This is also the case in the Rhodesian variety. In the Cape worker, however, the spermatheca is nearly spherical in shape, an average specimen measuring .54 mm. \times .45 mm. The writer has dissected upwards of sixty workers of this variety, and has found the spermatheca as above in every case. This observation is also due to Mr. Onions.

The development of the spermatheca naturally suggested the possibility of the Cape worker being adapted for fertilisation by a drone, possibly the diminutive form produced by fertile worker eggs—a condition of affairs which, though remarkable enough in itself, would have explained the production of female bees from worker eggs without subverting the fundamental nature of accepted principles in regard to parthenogenesis in bees. Careful examination, however, shows the laying workers to contain no spermatozoa, and the development of the sperm sac must apparently be regarded as merely in some way correlated to the reproductive potentialities of the insect, the organ itself being functionless.

The first experiment was commenced on December 24th, 1913, when Mr. Onions brought a bar-frame hive to the Experiment Station at Salisbury. This hive contained a strong nucleus of bees, one pure Cape and some crossed Rhodesian-Italian, introduced the day before, with seven frames of comb containing some honey and a very few eggs laid since the enclosure of the bees. All the comb was stated to have been taken from store and introduced into the hive the previous day. There was no queen present in the hive and no brood. The whole hive and colony was subjected to a searching inspection by the writer. On the 27th the hive was opened and thoroughly inspected again. More eggs had been deposited since the 24th, many being in the drone cells bordering certain of the frames. The writer again satisfied himself that no queen was present. The egg-laying appeared to be more systematic than is usually the case with the laying workers of European honey-bees, but more than one egg was frequently present in a cell, and on the whole the work might be described as intermediate between that of a normal queen and normal laying workers (see Plates CV, CVI). In two old queen cells a number of eggs were deposited.

On the 29th a considerable number of eggs had been laid in the two frames, and in one a number of young larvae were present, sometimes two in a cell. Some enlarged cells contained up to a dozen eggs, and the queen cells contained a great number which showed no sign of hatching. On January 3rd egg-laying was still confined to the two frames, and a number of the cells were now capped. Both old queen cells contained unhatched eggs.

Observations were continued until January 27th, by which time a number of young had emerged, all of which were of the black Cape variety and *workers*. Workers apparently emerged from the eggs laid in the *drone* cells, as no drones were present in the hive. On the 27th a frame of brood from the hive was taken into the laboratory and a number of workers were seen to emerge. All these were Cape bees. A few of the cells were now found to be capped in the well-known manner of worker cells destined to produce drones. These cells subsequently emitted small drones. The hive was next opened on February 5th, and the drone cappings were by this time more numerous, and a few small drones were present in the hive. Cape workers continued to emerge, however. This hive was

kept under observation until February 21st, in the hope that the bees would set up a queen cell, but although they hatched an egg in an old queen cell and fed the larva until nearly full grown, they subsequently allowed it to starve. In the meantime, another experiment was decided upon.

On February 21st, therefore, Mr. Onions installed a small colony of pure Rhodesian bees (var. *adansoni*) in a second hive, and in the writer's presence removed the queen. Two frames of honey only were carefully inspected and then placed in the hive, and two frames of Cape worker brood from the queenless hive used in the first experiment. The bees were brought in a swarm box, with the queen already caged. The two frames of honey were stated to have been in store for some time previously, and were certainly free from any eggs or brood at the time of insertion. The Rhodesian workers at once set up seven queen cells *on the introduced brood comb*, which were all sealed over by the 28th. On this day five of the queen cells were covered over with gauze cages, one was accidentally injured in manipulation, and one was left to hatch out normally. In the meantime, two other events had occurred. One of them was the appearance of mature Cape "laying workers," apart from young bees hatched from the introduced frame. These had evidently entered from the other hive, and Mr. Onions stated that in his apiary experience he had found that the Cape "laying workers" were accepted in almost any hive, and were, of course, an unmitigated nuisance on this account. The other event was the development of a number of Rhodesian "laying workers," which had scattered their eggs in great abundance through the drone cells on the two frames that had contained only honey. There were a dozen or more eggs in each drone cell, and an examination of several Rhodesian workers showed that they contained eggs in abundance.

The hive was not opened again until March 9th, when all the queens had hatched except two, which were dead in their cells. Two were alive in their cages and three dead outside. *All proved to be of the Cape variety.*

By this time it was impossible to deny that the Cape laying workers produced workers in abundance, and perfect females, if necessary. There was no possible source of error, because practically no Cape bees are kept in S. Rhodesia, and certainly there were none within miles of

the experimental hives, and yet in the queenless colony an abundant production of workers of the Cape variety continued, and only a small proportion of undersized drones appeared. Even had Cape bees been abundant near by it is impossible to imagine that some hundreds of eggs were stolen.

The question now remained as to whether these Cape workers could possibly have been fertilised. During the course of the experiment the writer had dissected a small number only of the Cape laying workers, examining the spermathecae under the microscope. The examination was checked by the dissection of a fertile and an unfertilised Rhodesian queen. The spermatheca was placed in saline solution on a slide and crushed under the cover glass. In the case of the fertilised queen, of course, myriads of spermatozoa were at once apparent. The spermathecae of the Cape workers, however, contained nothing but a jelly-like substance, which agreed on a smaller scale with the contents of the sperm sac in an unfertilised queen.

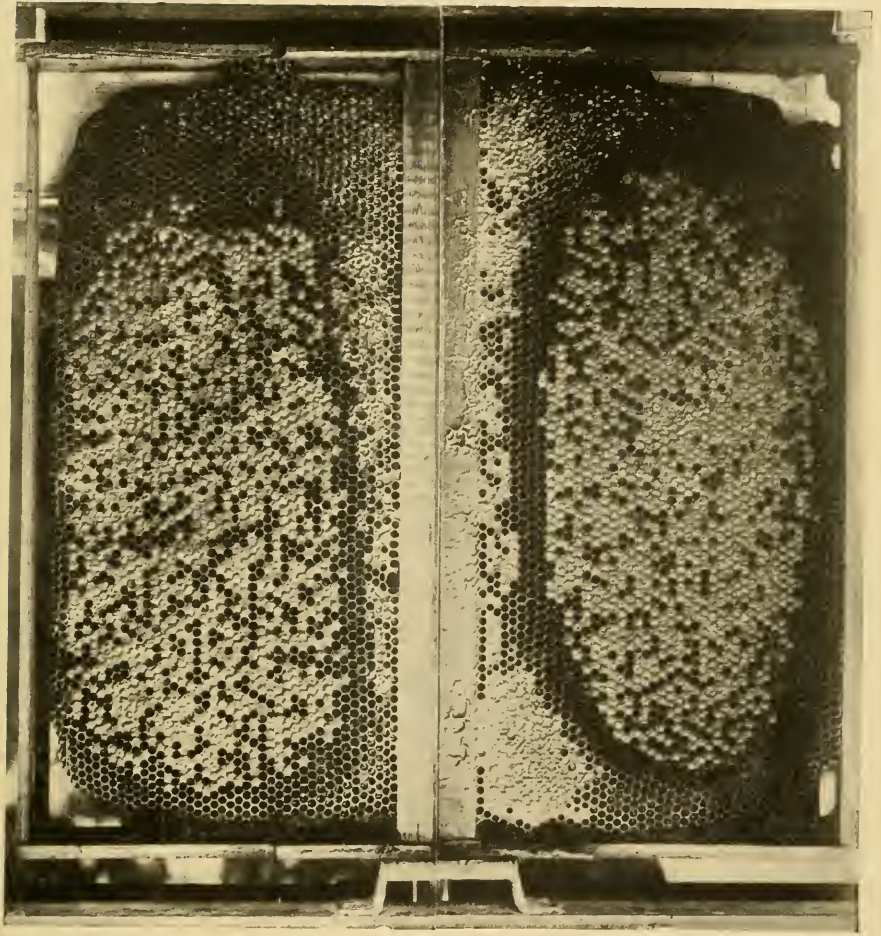
On request, Mr. Onions supplied a number of Cape workers from his apiary, which were found to contain eggs but no spermatozoa, but it was obvious that there was no certainty that these eggs were destined to produce workers, so that the dissections were of comparatively little value. A third experiment was therefore undertaken, and this served not only to prove that the Cape laying workers contained no spermatozoa, whilst producing worker bees, but also furnished a corroboration of both the other experiments.

On March 23rd Mr. Onions set up a new hive at the Experiment Station, giving its history as follows:—

On February 24th a hive of Rhodesian bees was “de-queened” and given a frame of Cape brood (from a queen). Two queen cells were matured—one of these was removed and one allowed to hatch. This hatched in due course, but on March 22nd the queen was found to be missing and Cape fertile workers strongly in evidence. The hive was examined by the writer and found to contain no queen. Three or four normal-sized Italian drones were present and many eggs, and some brood were present in the brood comb. These, of course, might possibly have been laid by the Cape queen, but this, as will be seen, did not affect the experiment in any way. A large number of black

Cape workers were present, and thirty of these were collected, and on dissection fourteen were found to contain eggs. There were no spermatozoa present. Other fertile workers were dissected on March 27th and on April 2nd with the same result. In the meantime, egg-laying continued and worker cappings appeared on the bulk of the brood in the combs, but about half a dozen drone cappings were in evidence amongst the worker brood. On opening, the latter were found to contain undersized drones. By April 2nd no drone cappings were present at all, and Cape workers were emerging freely. Five or six undersized drones were present amongst the bees.

Again, on April 8th nothing but worker cappings were seen, young bees were numerous and all of the Cape variety. Several were seen to emerge during the inspection. No drones at all were seen. On April 18th all the cappings were of the worker kind, Cape workers were emerging from the cells and numerous young Cape workers were present in the hive. The bees had constructed and sealed a queen cell in the meantime. One diminutive drone was seen. On the 27th the queen had emerged and was found in the hive. She had all the appearance of a pure Cape variety. Nothing but worker cappings were visible on the combs, and a long search was needed to find even one small Cape drone in the hive. By this date the queenless hive had been under the writer's observation for thirty-five days, during the last twenty-five of which no drone cappings had appeared and large numbers of Cape workers had emerged. This experiment, therefore, proved a clear corroboration of the first. The fortunate appearance of a queen served as a corroboration of the second experiment, whilst the fact that none of the fertile workers examined on March 23rd and 27th and on April 2nd contained spermatozoa, and that no drones emerged at any time that could possibly have been the progeny of eggs laid by these workers shortly before dissection (the period of development from egg to adult in the Cape variety agrees with that of European varieties), eliminated the exceedingly small possibility of an accident by which all the fertile workers taken for dissection might have been destined to produce drones. It is obvious that the eggs they were laying at the time they were caught produced workers only, and as no spermatozoa were present there can be no doubt that the eggs were parthenogenetically produced.

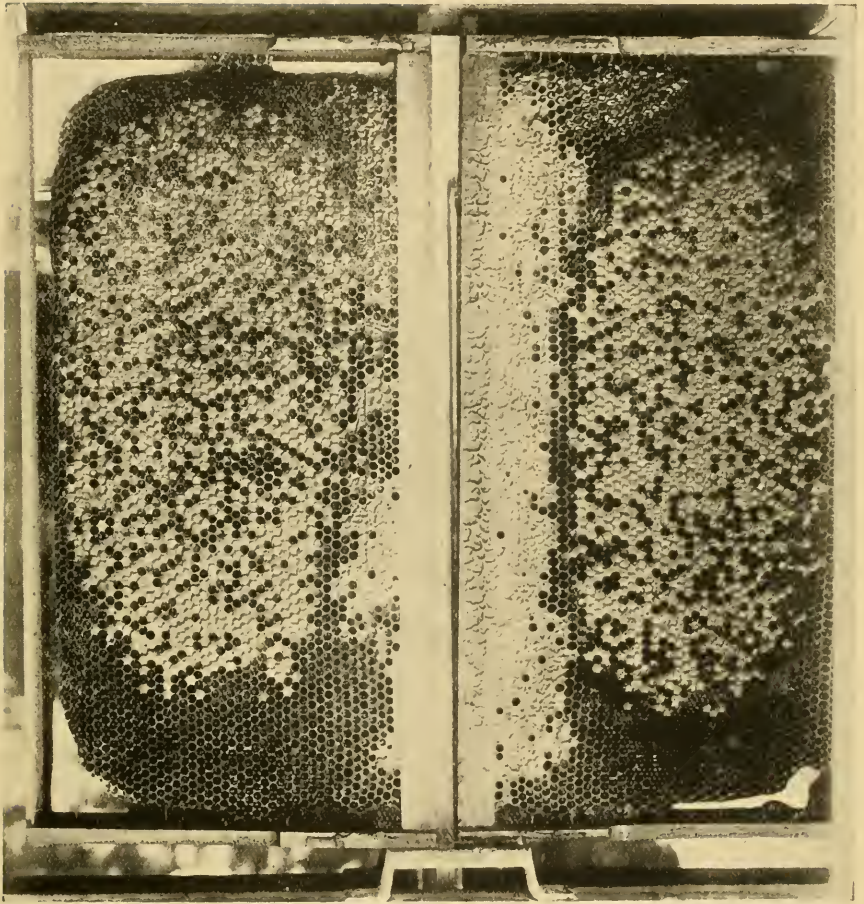


Photo, R. Jack.

André, Sleigh & Anglo, Ltd.

PARTHENOGENESIS IN CAPE HONEY-BEES.





Photo, R. Jack.

André, Sleight & Anglo, Ltd.

PARTHENOGENESIS IN CAPE HONEY-BEES.



Owing to the straightforward nature of the foregoing experiments and the absence of any conceivable source of error, the writer has no hesitation in stating that Mr. Onions has proved his case—namely, that the unfertilised eggs of laying workers of the Cape variety of the honey-bee produce mainly workers under the conditions obtaining during the experiments, and that their eggs also develop into queens as readily as the fertilised eggs of ordinary queen bees. A few small drones are produced at times.

Mr. Onions' discovery suggests further lines of investigation, and it is a source of regret to the writer that his official position as a purely economic entomologist prevents his following the matter further. The next important step is to ascertain whether the Cape queens share the capabilities of the workers in producing females from unfertilised eggs. It appears inconceivable that they should fail to do so, but the fact has never, as far as is known, been demonstrated. It is also to be noted that the Cape bee, in spite of its peculiarities, crosses very readily with such bees as *Apis ligustica* and the Rhodesian race. The parthenogenetic potentialities of the hybrid or mongrel offspring would be an interesting subject for study, and other lines of work are suggested.

It is to be hoped, therefore, that others who have the means and opportunity will be sufficiently interested to experiment with this variety of bees, not only to corroborate the results made public in this paper and in Mr. Onions' previous publications, but also to follow the matter up with a view to obtaining the utmost biological value from the study of this marked divergence between insects so closely related as the Cape honey-bee and other domesticated varieties.

EXPLANATION OF PLATES CV, CVI.

The plates represent both sides of two frames of brood comb from one queenless hive, the brood present being all that of Cape "laying worker" bees. It is to be noted that a number of bees have already emerged and that a few days previous the capped cells would have presented a still more uniform appearance. About half a dozen Cape workers emerged during the few minutes occupied in taking the photographs.

XXII. *On the Factors which determine the Cocoon Colour of *Plusia moneta* and other Lepidoptera.* By Mrs. ONÈRA A. MERRITT HAWKES, B.Sc. (Lond.), M.Sc. (B'ham). Communicated by Dr. A. D. IMMS, M.A.

[Read November 15th, 1916.]

1. THE COCOON COLOUR OF *Plusia moneta*.

THE cocoons of *Plusia moneta* are normally bright yellow, but a white one is occasionally found. It is supposed by many entomologists that when such a phenomenon occurs, under natural conditions, in this or other species, that the whiteness is due to "weakness" of the larva. I have shown (Hawkes, 1916) that this is not the case in one Indo-Chinese hybrid moth (*Philosamia ricini* × *P. cynthia*), and it may be that further experiment will demonstrate that the lack of colour is usually due to well-defined environmental or physiological causes, rather than to any such indefinite condition as "weakness." Tutt in his "British Noctuae" only mentions yellow cocoons in *P. moneta*, but Barrett notes the variation from deep yellow to white.

In June 1916 two larvae of *Plusia moneta* were found feeding on Monkshood (*Delphinium*) in Edgbaston, Birmingham. They were reared in two glass-lidded boxes. When about to spin-up, all the leaves were removed from one box; thus, one box was dry, whilst the other was damp from the water evaporated from and transpired by the leaves. As a result, cocoons of two colours were spun—a yellow one in the damp box, and a white one in the dry box.

A piece of the white cocoon was then cut off and placed in the damp box, where, after twelve hours, it had become a deeper yellow than the complete yellow cocoon.

The larva in the yellow cocoon did not pupate, but, owing to some unknown cause, left its cocoon and died. The larva in the white cocoon pupated and produced a perfect imago. The white cocoon was kept in a dark dry box, the box being opened daily to admit fresh air. Towards the

end of the pupal stage one end of the white cocoon had become yellowish, but it did not have even a vestige of the yellow lining described by Winsler.

The experiment with the cut-off piece of silk makes it clear that an environmental cause, and not any excretion or secretion of the larva, was the *ultimate* producer of the yellow colour; the conditions under which the two larvae spun-up, and their subsequent history (it was the larva in the white cocoon which became an imago), indicates that environmental moisture and not "weakness" produced the difference in the cocoon colour. This conclusion is supported by the following independent observations.

1. J. H. Bird writes that empty white cocoons of *P. moneta* became yellow when immersed in water. R. S. Smallman, in discussing the remarks of Bird, also states that he believes moisture hastens the change from white to yellow, but in that case he would expect to find a larger proportion of white cocoons in the second brood, as that is produced in the late summer, when presumably there is less moisture than in the late spring; but, unfortunately, Smallman makes no statement concerning the relative numbers of the two colours in the two broods.

2. H. E. Winsler states that most of his cocoons were white, but gives no indication as to whether the atmosphere in his breeding-cage was dry or damp; if the former, the white colour is accounted for.

3. Nicholson remarks that some have thought that light had an effect upon the colour.

It may here be stated that the two larvae under consideration in this paper were bred and spun-up in exactly the same conditions of light and heat, both breeding-boxes having been placed on a shelf in a large light room. The white cocoon which subsequently became yellowish at one end, did so at the same temperature, but in the dark.

4. Mr. W. H. Edwards of the Natural History Museum, Birmingham, was given, also in June 1916, two white cocoons of *P. moneta* which had been spun out of doors; these he put into his greenhouse, where in a couple of days they became yellow. The cocoons were spun during a period of drought, hence the white colour, and they became yellow when placed in the comparatively damp conservatory.

5. Sydney Webb and H. W. Andrews mention the variety of colour, and like Nicholson believe it is due to the amount

of light. H. W. Andrews found that cocoons on Larkspur were yellow, whilst those on Monkshood were white.

6. Bowles mentions that the cocoon, if spun indoors, is white, if out of doors, bright yellow.

The impression that white cocoons, such as the above, produce poor imagines, may be due to the deterioration of the pupa, if there is a continuance of the dry conditions under which such cocoons were spun. It is known by all breeders that the environmental condition during the pupal stage is a factor of great importance, and that very subtle differences in warmth and moisture may cause non-emergence or cripples. It is frequently more difficult to get the right environment for the pupa than for the larva. Crampton states, in reference to *Philosamia cynthia* (*advena*): "The perfect imagines constituted only 16·6% of the whole number of individuals which entered the cocoons, from which we may gain an idea of the severity of the conditions under which the quiescent pupa exists."

2. EXPERIMENTS BY VARIOUS OBSERVERS UPON WHITE COCOONS OF OTHER SPECIES.

Prof. E. B. Poulton has made extensive experiments with larvae which produce cocoons of various colours, and believes that in the majority of experiments white or pale cocoons were produced as a protective device by the larvae. If the white surroundings to which he refers (A) means white paper, which is dry when compared with green leaves, the whiteness may have been due to dryness.

One of his own experiments confirms my observations concerning the importance of a damp environment. On p. 450 (C) he relates that he put two larvae of *Halias prasinana* in two chip boxes (presumably dry), and both spun white cocoons. The first specimen, after having spun-up, was removed from its cocoon—in the process, it was cut and also found to be attacked by an ichneumon. It was then placed among oak leaves (comparatively damp), and there spun a brown cocoon. The second specimen was also removed from its cocoon, and placed in rolls of black net (presumably dry), where it began a second white cocoon. The second part of this experiment should be repeated, the black or any other coloured net being slightly damped.

Bateson in criticising the work of Poulton says, p. 205 :

“The evidence which I brought forward went to show that the statement that there is any relation between the colour of these cocoons (*E. lanestris*) and that of the substance to which they are attached, was founded on a mistake”; and “it was to be concluded, that the cause determining the production of light cocoons was removal from the food, or the state of annoyance incidental to such removal, and that in fact the light-coloured cocoon was an abnormal product resulting from unhealthy conditions.” This may well be the case in *Eriogaster*, but it is not the case in one *Philosamia* hybrid (loc. cit. p. 54), in *P. moneta*, and in the above two specimens of *Halias*.

Again, Bateson experimented with *Saturnia carpini*, and concluded (p. 207), “that there is no relation between the colour of the cocoons of *S. carpini* and that of the substances to which they are attached”; and (p. 209) “it may be safely concluded that the brown colour of the cocoons is derived from the alimentary canal.” When Bateson placed pieces of white silk in the fluid ejected from the mouth of the larvae, the silk became brown; but Dewitz, who has also done experiments on *S. carpini* (= *S. pavonia*), found that when a piece of white silk was put in water it became brown.

May makes a report of two broods of larvae of *Saturnia carpini*. In brood 1, reared by Bell, the larvae were badly fed and kept in a practically air-tight cage with a damp atmosphere, the resulting sixteen cocoons being all dark. Brood 2 was reared by May, the larvae being well fed and kept in a dry, well-lighted cage; nineteen cocoons were produced—eighteen pale, one dark. When six of the pale ones came in contact with damp, they turned dark almost immediately. May says: “With regard to the one dark cocoon, it may have been splashed on pulling old stalks out of the water-bottle.”

Dewitz believes that there is a “chromogene” in the silk of *S. carpini*, which under the influence of the oxygen of the air and an alkaline fluid becomes brown.

Comparing these results with my experiments on the *Philosamia* hybrid (p. 56), I am inclined to think that water *per se* can produce the change of colour in the completed silk.

Dewitz states that some hours after the last drop of frass has been expelled, a second, colourless intestinal excretion takes place in *S. carpini*, and that it is this that produces

the brown colour. Dewitz and Bateson are in agreement as to an intestinal liquid producing the brown colour, but Bateson does not state that he distinguished between a first and a second ejection. Péligré, in one of the earliest papers on *Bombyx mori*, writes that the frass is first deposited, and sometime later a drop of clear alkaline liquid containing bicarbonate of potassium, and then "it (the larva) moves away and finds a place in which to spin." The second deposit in *Bombyx* differed from that of *S. carpini* in that it is deposited before the cocoon is spun, in which case it is difficult to see how it can have any subsequent influence on the silk.

Dewitz repudiates the statement of Levrat and Conte, that an intestinal fluid colours white silk by means of a foreign matter added to the outside of the silk fibres.

Dr. A. D. Imms kindly sent me two white cocoons of *Clisiocampa neustria*, which became yellow when placed in a damp box.

3. RESULTS OF THE ABOVE EXPERIMENTS.

So few attempts have been made to discover the ultimate cause of changes in cocoon colour, that the subject is almost untouched ground. The causes suggested for producing white cocoons may, *pro temp.*, be tabulated as follows. Each division is followed by the names of the moths of which we have any knowledge and the name of the observer.

- I. The absence of an intestinal fluid (*i. e.* either an excretion from the intestine, or the secretion of the Malpighian tubules).

Saturnia carpini, Dewitz.

Poecilocampa populi, Tutt.

Hemaris fuciformis, Tutt.

Leucoma salicis, Tutt.

Eriogaster lanestris, Bateson.

- II. A comparatively dry environment.

Plusia moneta, Merritt Hawkes.

Halias prasinana, Poulton (see p. 406 above).

Clisiocampa neustria, Merritt Hawkes.

- III. A lack of foreign particles which are normally woven into the cocoon.

Hemerophila abruptaria, Poulton.

Chelonia caia, Tutt.

IV. A reduction of a yellow colour which is at first present.

Clisiocampa castrensis, Tutt.

C. neustria, Tutt.

This list by no means includes all the British moths which produce occasional white cocoons.

4. MENDELISM AND COCOON COLOUR.

Kellogg in America and Toyama and his students in Japan have made a great number of breeding experiments with *Bombyx mori*, in order to study the inheritance of cocoon colour, but their results are not uniform, apparently because they dealt with different races. No such experiments have yet been undertaken with any British moths.

It is clear from the above observations that in the future all work done on cocoon colour, whether in studying heredity or environment, must take cognisance of the possible effect of moisture. In order to obtain reliable results, all cocoons must have *strictly* the same environment, not only as regards heat and light, but also as regards moisture. The lack of recognition of the response of cocoon colour to very small differences in moisture, has materially reduced the value of much work already done.

5. CONCLUSIONS.

1. Except as regards the addition of foreign particles, our knowledge of the causes of the change from white to brown or yellow silk is very superficial, and can only be made complete by a biological and chemical study of silk, both as a dead and a living product.

2. Even this superficial knowledge has yet to be extended to a considerable number of British species, and some experiments should be repeated, viz. those on *Saturnia carpini*.

3. Further investigation will probably co-ordinate the effect upon white silk of intestinal fluids and atmospheric moisture.

I wish to thank Dr. A. D. Imms, of the Department of Agricultural Entomology of Manchester University, for giving me the opportunity of consulting the scattered literature cited in this paper.

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XXIII. *On a collection of Heliconine forms from French Guiana.* By J. J. JOICEY, F.E.S., and W. J. KAYE, F.E.S.

[Read November 1st, 1916.]

PLATES CVII, CVIII.

THE following account is concerning a collection made during the months July, August and September, 1915, between the places St. Jean and St. Laurent on the Maroni river in French Guiana. The distance between the two places is about twelve miles or rather less, and the distance of St. Laurent (the nearer place) from the coast is about twenty miles. The collection, which contained numbers of specimens of other families, was, however, chiefly remarkable for the vast number and variety of forms of *Heliconius melpomene* and *Heliconius erato*. A few other species of *Heliconius* were obtained, but only a very few specimens of each. The other species were *Heliconius egeria*, *H. numata*, *H. silvana*, *H. xanthocles*, *H. antiochus*, *H. burneyi*, *H. doris*, *H. aede*, *H. sara*, and *H. wallacei*. The whole collection was not undertaken for a special scientific diagnosis, and in classifying the material of *Heliconius melpomene* it is necessary to state that a number of typical *melpomene** were rejected by the collectors. It has been estimated that something like a further 25 † typical *melpomene* could have been taken during the three months. As it is, there are 731 specimens, which show a most wonderful range of variation. Many forms are new, and others graduate completely into these as well as to all the other known forms that have ever come from French Guiana. The following described forms are all contained in the series—*melpomene*, Linn., *atrosecta*, Riff., *lucia*, Cram., *lucinda*, Riff., *melpomenides*, Riff., *funebri*, Moesch., *cybele*, Cram., *hippolyte*, Bates, *tyche*, Bates, *thelxiope*, Hübn., *thelxiopeia*, Stgr., *faustina*, Stgr., *eulalia*, Riff., *deinia*, Moesch., *melanippe*, Riff.

* Including some identically coloured forms of the companion species *erato*.

† Very uncertain, but probably not more.

In order to arrive at some scheme for classifying this large amount of material, we have primarily divided up the forms into those with a black hind-wing, or the true *melpomene* type (125 specimens); those with a red basal streak to the hind-wing, or the *cybele* type (420 specimens); and those with the basal streak and cross streaks, or the *thelxiope* type (186 specimens).

As there are already so many named forms of *Heliconius melpomene*, it may be questioned by some as to the value of naming still more forms. But this can be decided satisfactorily if one applies the question: Are the forms recurrent, well marked, and perhaps of subspecific rank? If so, we maintain they should be named. Of the forms which we figure on Plate CVII, numbers 1, 4, 5, 6 are certainly terminal developments and well worthy of names. If one accepts the three principal divisions or subspecies based on the colouring of the hind-wing, viz. black hind-wing, *melpomene melpomene*; black basal streak, *melpomene cybele*; and black basal streak with flame streaks, *melpomene thelxiope*, it follows that for each named form (by fore-wing) of one, there are probably parallel forms in the other two hind-wing divisions. Thus *melpomenides*, with a black hind-wing, has its parallel in *dianides*, with the hind-wing red basal streak, and in *hippolyte* with the fully streaked hind-wing. Although, perhaps, every parallel form to other aberrations has not yet been described or detected, it is more or less certain to occur, and should, therefore, be described when found. The form *eltringhami*, which we have described later, is treated as a new subspecies, and while of extraordinary interest as having occurred in the Guiana region, it is no doubt extremely rare in that country and little more than a rare chance aberration. But in some locality further south it is likely that the type is more fixed, as in East Bolivia and South Brazil a yellow-banded hind-wing form of *melpomene* is the usual type.

Appended are descriptions of three new forms in the section, with black hind-wing.

***Heliconius melpomene melpomene* ab. *collis*, nov.**

(Plate CVII, fig. 3.)

Fore-wing black with a red band of half the width of typical *melpomene* and similar to *melpomenides*. It is edged on its inner

edge as far as vein 4 with yellow. A yellow spot is also on the inner edge of the band between veins 2 and 3. A large conspicuous squarish yellow patch within the cell just beyond the middle. Hind-wing black as in typical *melpomene*.

Habitat. FRENCH GUIANA, Nouveau Chantier.

Type in coll. Joicey.

This form is figured in Seitz under the name of *lucia*, Cram., but Cramer's figure shows a different form with a broader red band, and without yellow on the inner edge except for a little spot near costa. There is also a curious small yellow mark at the base of the fore-wing in Cramer's figure, which is a characteristic of true *lucia*. This short yellow streak is doubtless the residuum of the red basal streak present in all *cybele* forms. Seitz probably copied the error of identification of *lucia* from Riffarth, who was evidently unacquainted with Cramer's figures on Pl. 350.

***Heliconius melpomene melpomene* ab. *primus*, nov.**

(Plate CVII, fig. 1.)

Fore-wing like *melpomene*, except for a conspicuous trapezoidal yellow blotch in the cell slightly beyond the middle, and contiguous with the inner margin of the red transverse band, which is almost the same as in typical *melpomene*.

Habitat. FRENCH GUIANA, St. Jean de Maroni.

Type in coll. Joicey.

This fine form is reminiscent of the Bolivian aberrational form *aphrodyte*, except that *primus* has the red and yellow sharply defined, while in *aphrodyte* the colours coalesce. In *primus* also the red band is considerably wider.

***Heliconius melpomene melpomene* ab. *melpina*, nov.**

Fore-wing black, with a group of yellow spots arranged as in *thelxiope*, edged externally with a narrow red band from costa to vein 3. Hind-wing black.

Habitat. FRENCH GUIANA, St. Laurent.

Type in coll. Joicey.

This form is the equivalent of *faustina*, but with a black hind-wing.

Of the 125 specimens with a totally black hind-wing there is a complete transition between *melpomene* and

melanippe, the latter a rare form in which only the yellow *thelxiope* group of spots remains on the fore-wing. It is figured by Oberthür (Études d'Ent., xxi, Pl. 5, fig. 58). Of *melpomenides* (figured by Oberthür, loc. cit., Pl. 4, fig. 46 and Pl. 5, fig. 50) there are eighteen specimens, and barely half the number of true *melpomene*, viz. eight. Of *primus* which we figure (Pl. CVII, fig. 1) there are only two specimens, with some seven intermediates graduating to typical *melpomene*. Of *lucinda* there are also only two specimens that are typical, but there are some eighteen intermediate forms to *lucia*. Of *collis* which we figure (Pl. CVII, fig. 3) there are but three typical forms with the intermediate specimens to *melanippe*. The whole can be grasped better in tabulated form.

SECTION A (*specimens of melpomene with a wholly black hind-wing*—125):—

<i>melpomene</i> , Linn.	8
intermediates	7
<i>primus</i> , J. and K.	2
intermediates	—
<i>atrosecta</i> , Riff.	5
intermediates	—
<i>melpomenides</i> , Riff.	18
intermediates	37
<i>lucinda</i> , Riff.	2
intermediates	18
<i>lucia</i> , Cram.	3
intermediates	11
<i>collis</i> , J. and K.	3
intermediates	9
<i>melpina</i> , J. and K.	1
<i>melanippe</i> , Riff.	1
	—
Total of forms with a wholly black hind-wing	125

SECTION B (*hind-wing with red basal streak*).—Of the forms with a short red basal streak to the hind-wing there are 420 specimens. These have the streak of variable size, some showing a suffusion over the lower and outer half with black scaling. But the hind-wing red markings are discussed later. The 420 specimens in this section divide up mainly into three principal groups—(1) The *diana*, *dianides* group; (2) the *deinia*, *faustina* group; (3) the *cybele* group. These contain the following numbers of examples each—(1) 89, (2) 79, (3) 51. Both *diana*

and *cybele* are the most fixed and definite races of this section, the former giving fifty-five nearly typical examples, and the latter fifty-one examples. Of *funebria*, of which there are only four completely typical examples without any trace of markings beyond the red basal area to the fore- and hind-wing, there are interesting examples showing that *funebria* is an extreme development of both *cybele* and *diana*. Of the new forms *negroida*, *maris*, *elegantula*, *faustalia* and *dianides*, the last is doubtless well known but hitherto undescribed, but the remaining four, we think, have probably never been seen before. *Elegantula* is at once a development out of *lucinda*, and *faustalia* a development of *eulalia*. *Negroida* is a striking aberration, and quite unlike any already described form. It must be looked upon as a parallel development to *deinia*, but suffused heavily with black. *Maris* is a perfectly natural advance on *lucia* as figured by Cramer (vol. iv, Pl. 350, fig. E), being simply the addition of the red base to fore- and hind-wing. We are surprised that no intermediate forms are available, showing either a red fore-wing base only or a red hind-wing base only. The two red areas are always present together, and this is the only phase of variation where connecting forms are not to be found.

Unquestionably the most interesting form is the one we name *eltringhami* in honour of Dr. Eltringham, who has recently advanced our knowledge of the genus *Heliconius* by his researches. This form, of which we have but one specimen, is connected by two other forms to a more or less typical *deinia*. One of these specimens is a *deinia* form, but with the hind-wing basal stripe half red and half yellow, the outer half being yellow. In the other specimen, which is of the *cybele* type with the yellow spotting very much reduced, only just the tip of the transverse red streak is yellow.

The aberrations which we herein describe appear to be terminal developments in different directions, and as such should be named, because it is possible and quite likely that in certain localities these may have become races of at least subspecific rank. In every instance except *eltringhami* there are two or more identical specimens, thus proving that these forms are recurrent, and there are series of graduating specimens leading up to these types.

***Heliconius melpomene cybele* ab. *elegantula*, nov.**

Fore-wing black with the base red, and extending nearly half-way across the cell. A broad red band from costa to near tornus, edged broadly internally with yellow as far as vein 2. Some suffused yellowish scales extending inwards across the cell. Hind-wing black with a red basal streak.

Habitat. FRENCH GUIANA, St. Jean de Maroni.

Type in coll. Joicey.

This form is analogous to *lucinda*, and may be described as a *lucinda* with a red basal area to both fore-wing and hind-wing.

***Heliconius melpomene cybele* ab. *faustalia*, nov.**

Fore-wing black with the base red, extending half-way across the cell. A large yellow patch surrounding the crescent-shaped black discoidal spot, similar to *H. melpomene penelope*. On the outer margin of the patch between the costa and vein 3 is a broad edging of red. Hind-wing black with a red basal streak.

Habitat. FRENCH GUIANA, St. Jean de Maroni.

Type in coll. Joicey.

This rare form, of which there is but a single* specimen, is a red-edged *eulalia*, Riff., also a rare form. The solid yellow fore-wing patch, such as is found in the common Bolivian form *penelope*, appears to be very rare in French Guiana, but with the intermediates it is clearly only a closing up of the open patch of *cybele*.

***Heliconius melpomene cybele* ab. *dianides*, nov.**

(Plate CVII, fig. 7.)

Fore-wing black, with a very narrow red transverse band wholly outside the cell. The base red. A small yellow mark on the inner edge of the red band just below costa. Hind-wing black with red basal streak.

Habitat. FRENCH GUIANA, St. Jean de Maroni.

Type in coll. Joicey.

This form is equal to a *melpomenides*, with the addition of red base to fore- and hind-wing.

Every gradation occurs between *diana* and *dianides*.

* A second specimen of this form was already in the Hill Museum.

Of the fifty-five forms placed under the former, some thirteen show a slight reduction of the band, but still classed as *diana*, while a further seventeen are wholly intermediate between *dianides* and *diana*.

***Heliconius melpomene cybele* ab. *maris*, nov.**

(Plate CVII, fig. 4.)

Fore-wing like *diana*, Riff., with a broad transverse band like *melpomene* and a red basal patch. Within the cell is a well-defined yellow squarish spot. Hind-wing black with red basal streak.

Habitat. FRENCH GUIANA, St. Jean de Maroni.

Type in coll. Joicey.

Except for the red base to fore- and hind-wing, this form is similar to *primus*.

Four specimens have a clear yellow spot of varying size, without any dark suffusion. Fourteen show more or less black suffusion, and nine have only a rudimentary yellowish mark within the cell.

***Heliconius melpomene cybele* ab. *negroida*, nov.**

(Plate CVII, fig. 2.)

Fore-wing red at base, with a prominent wedge of black pointing to base and occupying more than half the cell. Beyond the cell is a half band of long yellow spots heavily suffused with black from costa to vein 4; externally this half band is edged with red of the same colour as the base. Between veins 3 and 4 is patch of yellowish scales mixed with black and edged with a small mark of red. Hind-wing black, with a red streak at base considerably suffused with black scaling.

Habitat. FRENCH GUIANA, St. Jean de Maroni.

Type in coll. Joicey.

***Heliconius melpomene eltringhami*, nov.**

(Plate CVII, fig. 6.)

Fore-wing with the basal area black, but with a very short inconspicuous yellowish streak. A red transverse band almost as wide and of similar pattern as in typical *melpomene*. Lying wholly within the cell is a large squarish yellow blotch, which is contiguous with the red transverse band only at vein 2; above it is separated by the dark ground-colour; on the costa is a small yellow mark on edge of transverse red band. Hind-wing black, with the base

black except for a few stray yellow scales as far as vein 2; beyond as far as vein 7 is a yellow band considerably suffused with black scaling on the portion within the cell, and with the veins showing plainly black scaled.

Habitat. FRENCH GUIANA, St. Laurent de Maroni.

Type in coll. Joicey.

This specimen, apart from its strange colouring, has a peculiar aspect in the apical third of the wing. It there has a whitish appearance, caused by a regular and symmetrical loss of scales. We have not had this shown in the figure, for it is most probable that when the insect was fresh, no such loss of scales was to be detected. The specimen is far from fresh, and we have thought it best to figure it as normally scaled.

TABLE OF FORMS WITH A RED BASAL STREAK TO
HIND-WING.

(Numbers in brackets are intermediate forms, and their positions show the types which they unite.)

	ab. <i>diana</i> , Riff.	55
	(17)	
	ab. <i>dianides</i> , J. and K.	17
	(23)	
	ab. <i>negroida</i> , J. and K.	5
	(27)	
	ab. <i>funebri</i> s, Moesch.	1
	(23)	
	ab. <i>maris</i> , J. and K.	3
	(8)	
	ab. <i>funebri</i> s, Moesch.	1
	(12)	
ab. <i>elegantula</i> , J. and K. 2	(13) ab. <i>deinia</i> , Moesch.	24
	(24)	
	ab. <i>faustina</i> , Stgr.	31
	(33)	
ab. <i>faustalia</i> , J. and K. } ₁	ab. <i>eulalia</i> , Riff. 2	51
	(45)	
	ab. <i>funebri</i> s, Moesch.	2

1 + 4 + 13 + 212 + 190

420

VARIATION OF THE HIND-WING.

It has already been shown how the forms divide up primarily into three sections: (1) A black hind-wing, 125 examples; (2) a red streak at base, 420 examples; (3) a completely streaked hind-wing, 186 examples; thus

the intermediate forms with only a red streak at base far outnumber the forms in (1) and (3) together. Whether the fully streaked form or whether the plain black hind-wing was the earlier it is difficult to say. But from the greater general distribution of non-streaked forms to streaked forms, it would appear that the totally streaked form was the later development.

The first step in the development of colour to the hind-wing is a small red spot at the base, below the median vein. This is only present in a single example, a specimen (of the *melpomenides* type), Pl. CVIII, fig. 1. The next stage of development is curious, and suggests that progressive development might be working in an opposite direction, and that the red basal area might be tending to becoming reduced. The red basal spot is surrounded with black, and red appears again below it as a narrow belt. This black dividing the red basal spot from the remainder of the red streak is very persistent and appears in all stages of development of the red streak, but is hardly discernible in the fully developed basal streak, and then only rarely. From the short basal streak the development is outwards into the cell, but suffused with black scaling over the outer half, the suffusion always appearing diagonally across the red in the cell. A stage later is a sharply cut diagonally red basal streak, and in the majority of *cybele* specimens we see the fullest development of the streak where it is still slightly cut diagonally, but more often has its lower edge horizontal and at right angles with the abdomen.

An interesting phenomenon is that the red basal area of the fore-wing is practically an invariable accompaniment to the short red basal streak to the hind-wing. From the evidence of those specimens that show a single red spot at the base of the hind-wing, and at the same time no red on the base of the fore-wing, it appears reasonable to suppose that the red of the base of the hind-wing was antecedent to the red basal area of the fore-wing. But from the very constant appearance of both simultaneously, it is probable that the red base of the fore-wing was a nearly contemporary development to the red base of the hind-wing. In this connection it is interesting to recall the Ecuadorean form of *melpomene* named *contiguus*, in which the flame-streaks of the hind-wing are present alone, without the red basal area of fore-wing or red basal streak

of hind-wing. This form is most likely a later development to the *thelxiope* full streaking, the red basal area of fore- and hind-wing being suppressed. This is a likely explanation, as it is to be seen that in this, as in all streaked forms, on the underside the flame-pattern is very greatly reduced; this also lending support to the theory advanced already, that the long slender streaks are a subsequent development to the wide streaks. But material from East Ecuador is not plentiful enough in collections to at present decide, and a large collection, such as we have examined from Cayenne, is much to be desired.

A quite different phase of variation of the hind-wing is a change from a red band to a yellow band. This is a very rare form of variation in French Guiana, and only three specimens show this transition. One has the red transverse band just tipped with suffused yellowish at the apex. The second specimen is nearly half red and half yellow, the outer yellowish half being suffused with blackish, while the inner red half shows a trace of yellow. The last specimen has a wholly yellow band, but still suffused with some dark scaling about the middle. At the base the band is completely obliterated with the ground-colour.

SUMMARY OF FORMS TOWARDS A RED HIND-WING BASAL STREAK.

Single red spot.	Small broken red basal area.	Short basal streak.	Longer streak suffused outwardly.	Entire streak.
1	4	75	64	271

420

SECTION C (*forms with basal streak and flame streaks*).—

The next stage of development from the red basal streak is the appearance of either long, very narrow streaks, or of a row of suffused spots. It is possible that the very narrow, almost linear streaking, is a subsequent phase to the full nail-headed streaking. It is clear that development from a row of spots is the more usual, but perhaps not the only method. Specimens show every gradation, from a faint indication of spots to larger and better-defined spots, then to short tapering streaks, and finally to the full-length streaking as is seen in *thelxiope*.

There are no examples showing very short linear streaks, or specimens showing linear spots. As is usually the case with Guiana forms of *thelxiope*, a large percentage show an imperfectly developed and modified streaking to the hind-wing, the streaks not being heavily nail-headed but slender. No less than 107 specimens (of various fore-wing types) show less than the full-width streaking of *thelxiope*. Of fully streaked examples, as in typical *thelxiope*, there are no more than twenty-one specimens, and these are to be found chiefly among the actual specimens of *thelxiope*, though two of the *tyche* type are about as heavily marked.

TABLE OF FORMS TOWARDS FULL *thelxiope* HIND-WING STREAKING IRRESPECTIVE OF FORE-WING PATTERN.

A row of spots.	Spots wedge-shaped.	Spots become short streaks.	Streaks heavy but not full length.	Full streaks like <i>thelxiope</i> .
7	13	9	29	21

79

TABLE OF FORMS TOWARDS A REDUCED (LINEAR) STREAKING.
See Pl. CVIII, figs. 1a, 2a, 3a.

Short linear streaks.	Long linear streaks.
6	101

107

Total 79 + 107 = 186

Appended are descriptions of four new forms with "*thelxiope*" hind-wing streaking.

***Heliconius melpomene thelxiope* ab. *punctarius*, J. and K., nov.**
(Plate CVII, fig. 5.)

Fore-wing like *maris*, with the base red, and with a rather narrow transverse red band. Within the cell, just beyond the middle, is a large triangular clear yellow blotch having its base attached to the costal vein; the outer side just touching the transverse band, and the inner edge is bordered with heavy black. Hind-

wing like *thelxiope*, with a red basal streak and six large radiating streaks.

Habitat. FRENCH GUIANA, St. Jean de Maroni.

Type in coll. Joicey.

There are three specimens more or less approaching this type, showing the yellow spot considerably suffused.

A further three specimens show both the yellow spot and the transverse red band much suffused and reduced in size.

***Heliconius melpomene thelxiope* ab. *lucindella*, J. and K., nov.**

Fore-wing black, with the base red, deeply divided with black within the cell and just above inner margin. A transverse curved narrow red band beyond the cell from costa, similar to *melpomenides* and deeply edged with yellow from vein 6 to vein 2. Hind-wing like *thelxiope*, with fine pointed streaks and a basal streak.

Habitat. FRENCH GUIANA, St. Jean de Maroni.

Type in coll. Joicey.

This form is like a *lucia*, Cram., but with a *thelxiope* hind-wing.

***Heliconius melpomene thelxiope* ab. *majestica*, J. and K., nov.**

Fore-wing black, with a narrow red post-median band like *melpomenides*, internally edged from vein 4 to costa with yellow, and a large yellow spot between veins 2 and 3 on the inside of the red band. A large irregular squarish yellow spot within the cell. Hind-wing with a basal red streak and five heavy flame streaks. The fore-wing is like *melpomene collis*, and the hind-wing like *thelxiope*.

Habitat. FRENCH GUIANA, Nouvean Chantier.

Type in coll. Joicey.

***Heliconius melpomene thelxiope* ab. *stygianus*, J. and K., nov.**

Fore-wing entirely black except for red basal area. Hind-wing black with red basal streak and slender flame streaks.

Habitat. FRENCH GUIANA, St. Jean.

Type in coll. Joicey.

This form is analogous to *funnebris*, Moesch, in which there is only the red base to fore- and hind-wing.

TABLE OF FORMS WITH BASAL STREAK AND VARIABLE
FLAME STREAKS TO HIND-WING.

(Numbers in brackets are intermediate forms, and their position show the types which they unite.)

ab. <i>punctarius</i> , J. and K.	1	ab. <i>tyche</i> , Bates	1
		(18)	
ab. <i>lucindella</i> , J. and K.	1	ab. <i>hippolyte</i> , Bates	2
		(19)	
		ab. <i>majestica</i> , J. and K.	3
		(25)	
ab. <i>vicinus</i> , } Ménéti }	1	ab. <i>rufolimbata</i> Butl.	1
		ab. <i>augusta</i> , Riff.	16
		(7)	
		ab. <i>thelxiope</i> , Hüb.	7
		(23)	
		ab. <i>thelxiopeia</i> , Stgr.	23
		(16)	
		ab. <i>aglaopeia</i> , Stgr.	6
		(15)	
		ab. <i>stygianus</i> , J. and K.	2
1	+	3	+
		122	+
			60
Total 186			

KEY SHOWING THE SAME VARIATION OF FORE-WING IN THE
THREE PHASES OF THE HIND-WING.

Black hind-wing.	Hind-wing with basal streak.	Hind-wing with red basal and flame streaks.
<i>melpomene</i>	<i>diana</i>	<i>tyche</i>
<i>primus</i>	<i>maris</i>	<i>punctarius</i>
<i>melpomenides</i>	<i>dianides</i>	<i>hippolyte</i>
<i>lucinda</i>	<i>elegantula</i>	<i>lucindella</i>
<i>lucia</i> }	<i>deinia</i>	<i>majestica</i>
<i>collis</i> }	<i>negroida</i>	<i>negroidens</i> *
—	<i>faustina</i> }	<i>augusta</i>
<i>melpina</i>	<i>karschi</i> }	<i>thelxiope</i> }
<i>melpanippe</i>	<i>cybele</i>	<i>thelxiopeia</i> }
—	<i>eulalia</i>	<i>vicinus</i>
—	<i>faustalia</i>	<i>rufolimbata</i>
—	—	<i>aglaopeia</i>
—	<i>funnebris</i>	<i>stygianus</i>

* ab. *negroidens*, nov. J. and K., forewing as in *negroida*, hind-wing as in *thelxiope*.



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NEW EUEIDES AND FORMS OF HEL. MELPOMENE.

EXPLANATION OF PLATE CVII.

Hind-wings of *Heliconius melpomene* forms.

Development of *thelxiope* hind-wing pattern from a black *melpomene* hind-wing (1-12).

Development of *thelxiope* hind-wing to *thelxiopeia*-pattern hind-wing (1a-1c).

- | | |
|-----|---|
| 1a. | Hind-wing of <i>H. thelxiope</i> , ♂. |
| 1b. | <i>majestica</i> , ♀, near. |
| 1c. | <i>augusta</i> , ♀. |
| 12. | <i>majestica</i> , ♂. |
| 11. | <i>agaopeia</i> , ♂. |
| 10. | <i>thelxiope</i> , ♂, near. |
| 9. | ab., ♂, <i>cybele-funebris</i> , fore-wing. |
| 8. | <i>augusta</i> , ♂, near. |
| 7. | <i>augusta</i> , ♂, near. |
| 6. | <i>cybele</i> , ♀, near. |
| 5. | <i>cybele</i> , ♂. |
| 4. | <i>faustina</i> , ♀. |
| 3. | <i>faustina</i> , ♂. |
| 2. | <i>diana</i> , ♂. |
| 1. | <i>melpomenides</i> , ♂. |

EXPLANATION OF PLATE CVIII.

1. *Heliconius melpomene melpomene*, ab. *primus*.
2. " " *cybele*, ab. *negroïda*.
3. " " *melpomene*, ab. *collis*.
4. " " *cybele*, ab. *maris*.
5. " " *thelxiope*, ab. *punctarius*.
6. " " *eltringhami*.
7. " " *cybele*, ab. *dianides*.
8. *Eueides egeriformis*.
9. " " hind-wing underside.



1a.



2a.



3a.



12.



11.



10.



9.



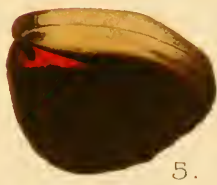
8.



7.



6.



5.



4.



3.



2.



1.

Adlard & Son and West, Newman chr

HIND WING DEVELOPMENT OF HEL. MELPOMENE.



H. silvana; there are a pair of this species, rather heavily marked with black, but otherwise typical.

H. numata, Cram.; the material in this species is curiously limited to six specimens, but they are of great interest. One is nearly typical *numata*; two are ab. *melanops*, Riff.; one is ab. *mavors*, and two are of an undescribed unicolorous form, analogous to *mavors* but with a heavy undivided black hind-wing like *melanops*. For this interesting form we propose the name *melanopors*, nov. The occurrence of these unicolorous forms in Cayenne is exceedingly interesting, and makes one wonder if there is any possibility of the Peruvian *aristiona*, in its varying phases, being a form only of *numata*.

HELICONINE SPECIES IN THE COLLECTION OF GROUP II.

Of the remainder of the *Heliconius* in the collection there are the following:—

Heliconius egeria egeria, Cram., five fine perfectly typical examples.

H. xanthocles vala, Stgr.; six specimens, all ♀, as is so frequently the case in all the races of this species. One of these specimens is remarkable on the underside. It has all the red streaks greatly widened, and almost touching the veins alone separating them. At the margins of the rays there is a considerable amount of black suffusion, giving the streaks the appearance of feathers. Above, the specimen is normal, except for a pale whitish area just below the median within the red area.

H. antiochus alba, Riff.; nine specimens, all somewhat intermediate between *alba* and typical *antiochus*, but certainly nearer *alba*.

H. doris; nine specimens. Six of the *delila* form; one a *delila* but heavily suffused with black, and two of the *amathusia* type, being really of the *metharmina* type with three in one case, or four red streaks running through.

H. aoede aoede; one small male specimen with rather slender hind-wing streaking. In view of the large number of *melpomene* forms with slender hind-wing streaking, it must be presumed that the influence extends to *H. aoede*, which is very much scarcer, and that it is, therefore, a mimic of *H. melpomene thelxiopeia*.

In comparison with the very large number of *melpomene* specimens the number of *erato* forms is small, being only
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155 against 731 *melpomene*. Usually individuals of *erato* outnumber the individuals of *melpomene*; and even in British Guiana Melpomeniformes are much rarer than Eratoformes, while in some districts, such as in the Potaro district in Central British Guiana, Melpomeniformes hardly exist at all, while numbers of Eratoformes are to be found. It is possible that where typical *melpomene* occurs, such as in British Guiana, it is always in a minority; while where it varies enormously it becomes commoner.

Of *erato magnifica*, Riff., there is but one specimen, thus closely following the paucity of typical *melpomene* specimens, of which there are eight specimens only.

Of *erato callista*, Riff., there are two rather undersized specimens.

Of *erato callycopis* there is a single pair as figured by Cramer in the two forms Pl. 190, figs. E, F. Fig. F is quoted and re-figured by Seitz, Pl. 78c, and thus fig. E should be re-named, because it is a constantly recurring aberration. We therefore propose the name *belticopsis* for the form E (on Cramer's Plate 190, Pap. Ex. ii).

One other form with a black hind-wing is represented by a single specimen. It is a form close to *elimaea*, Erichs., but has the transverse band less broken up into spots than in typical *elimaea*. It is more like the above *belticopsis*, with a red basal area.

There are very few forms connecting the streaked hind-wing to the plain black hind-wing. The most intermediate forms are—(1) an *andremona*; and (2) an *udalrica* form with very slight streaking. As with the *melpomene* a large percentage of the Eratoformes show a slender streaking, less in width than is found on the lower Amazon about Santaren and Obydos.

There are no less than forty-four specimens of the *andremona* form; these all have the typical open arrangement of red spotting, and more than half (twenty-six) show a rudimentary superimposed pattern of yellow on these spots. Six show yellow scaling all over the "*thelxiopae*" yellow-spotted area, while the remaining twenty graduate down to the typical *andremona*. It is noticeable that those specimens showing only a portion of the "*thelxiopae*" over-spotting have scales which are usually white. The commencement of the spotting seems to take place first in the cell. Eight specimens show more or less a white super-

imposed spot within the cell. Four specimens show white scaling in the subapical patch, as well as in the cell. Fourteen show a yellowish or whitish yellow overscaling, but complete transition between the *andremona* colour and the *erato* (= *vesta*) colour is only found in one specimen. In this the whole of the red colouring of the fore-wing is orange-red instead of rosy-red, while the *andremona* discoidal group of spots is heavily overlaid with the *erato* yellow colour. This form we propose to name *protea*, nov. ab.

From *protea* to *erato* there is still a somewhat large jump, but two specimens exhibit a curious retention of a large red spot obliquely lying within the yellow blotch at the end of the cell. In one of these specimens there is in addition a curious red streak lying immediately under the median vein between veins 2 and 3. There are fifty-one thoroughly typical *erato* (= *vesta*); two specimens have a slight suffusion over the yellow spotting, and three show a transition to the form *leda*, Stgr. Of this latter form there are twenty specimens showing very little variation *inter se*. The next stage is to *oberthüri*, and of this striking form there are four specimens, one of which shows traces of a red patch just inside the cell, as was remarked on with a specimen of *erato*. There are six specimens of an undescribed form, which might be called the opposite of *oberthüri*. This form retains the outer subapical portion of the group of yellow spots, while the inner portion is suppressed. This form we call *hemicycla*, ab. nov. As a collateral development out of *erato* there is a form which is somewhat parallel to *eulalia*, Stgr., of *melpomene*. In this new form the yellow spots of the fore-wing are much more closed up than in typical *erato*, so that there are only comparatively narrow bars of black separating the yellow spots between veins 2-3, 3-4, and 4-5. This form we call *constricta*, ab. nov. The specimen we make the type is unique, but five other examples approach the type, and can easily be separated from typical *erato* by an obvious closing up of the spots.

In concluding our notes on *erato* it seems curious that the form *amalfreda* (an *erato* without hind-wing streaks) or other similar forms, should not have occurred, neither any intermediate half-streaked forms of *erato*, seeing that *erato* forms including *oberthüri*, *hemicycla* and *constricta* are collectively so numerous. The home of such forms as

amalfreda, *cybelellus*, *tellus*, etc., seems to be exclusively the Lower Amazon. But among the *andremona* forms are to be seen some interesting intermediate hind-wing forms, thus tending to show that progressive development in both fore- and hind-wing took place at the same time, for *andremona* must be looked upon as wholly intermediate between *elimaea* and *erato* (= *vesta*). In the streaking of the hind-wing there are no specimens so half-streaked as that figured by Oberthür (Et. Ent., xxi, Pl. 1, fig. 9), in which only the three basal streaks are present, and these are even blackish suffused. Several specimens in the present collection show four instead of five streaks; the fifth streak, that between vein 4 and 5, clearly being the latest to be developed. A specimen with fore-wings like *elimaea* and hind-wing with four slender streaks has the basal streak very weak, and in two other instances the basal streak is seen to be also very weak. It is tolerably clear that it was the two sub-basal streaks that were earliest developed, for one can see by referring to Oberthür's plate (loc. cit., figs. 4, 7) that where the first rudiments of streaks are to be seen, it is at the roots of the two sub-basal streaks, but not the basal streak.

In the specimens of *andremona* with an apparent overlaying of white marks, it is to be seen under a powerful lens that the white scales are in reality red scales that have lost their colour and become semitransparent. If such a specimen be held up to the light, the whole of the group of markings round the discoidal cell is seen to be semitransparent. It is clear that the red scales lose their red pigment prior to developing the yellow pigment, and it may be taken probably as a general rule in Heliconines, that where red is found replaced with yellow, the transition stage is a white, or, as it appears when highly magnified, a semi-transparent stage.

The mimetic resemblance of the series of *erato* to that of *melpomene* is remarkable, and shows wonderfully close parallelism. What is most striking is the similar darkening of the fore-wing in both species. In *erato* the number of darkened specimens is ten, and includes such forms or transitional forms as *oberthüri* and *hemicycla*. Four of these, viz. three *oberthüri* and one *hemicycla*, are extreme, but still showing a good deal of suffused yellow. No form is so completely darkened as is to be found among the *melpomene* forms *funebri* or *stygianus*.

Tabulated the forms compared show fore-wing darkening as follows—

Species.	Numbers.	Percentage of total.
<i>melpomene</i>	* 35 + 27 †	8.48
<i>erato</i>	10	6.45

With the hind-wing the preponderance of dark (all black) forms is still greater with *melpomene*. In *erato* there are only six such forms, while in *melpomene* there are no less than 125 forms. Tabulated they appear thus—

Species.	Numbers with black hind-wing.	Percentage of total.
<i>melpomene</i>	125	17.53
<i>erato</i>	6	3.87

As is well known, *erato* never shows a short red basal hind-wing streak, but in Cayenne the streaking is very persistent, and it is interesting to compare the numbers and percentages with "*thelxiope*" streaked *melpomene*.

Species.	Numbers with streaked hind-wing.	Percentage of total.
<i>melpomene</i>	186	25.44
<i>erato</i>	149	96.1

It is thus seen that with a streaked hind-wing the influence exerted by *erato* is very great, and instead of *melpomene* acting as model it is very decidedly in this respect the mimic. *Erato* is even reinforced with sundry other species of Group II Heliconines, such as *H. xanthocles vala* (6), *H. egeria egeria* (5), *H. doris* (6), *H. aoede aoede* (1), all of which have a streaked hind-wing.

* *cybele* hind-wing } in all cases no suffused particoloured
 † *thelxiope* hind-wing } forms included.

TABLE OF FORMS OF *ERATO*.

(Numbers in brackets indicate intermediate forms, and their position show the forms they unite.)

ab. <i>magnifica</i> , Riff.	1		
ab. <i>callista</i> , Riff.	2		
ab. <i>bellicopis</i> , J. and K.	1		
ab. <i>callycopis</i> , Cram.	1		
ab. <i>elimaea</i> , Erichs.	1		
ab. <i>udalrica</i> , Cram.	3		
(5)			
ab. <i>erythraea</i> , Cram.	1		
ab. <i>andremona</i> , Cram.	18		
(25)			
ab. <i>protea</i> , J. and K.	1		
(2)			
typ. <i>erato</i> , Linn.	54	(1) ab. <i>constricta</i> , J. and K.	5
(4)			
ab. <i>leda</i> , Stgr.	10		
(11)			
ab. <i>oberthüri</i> , Stgr.	3		
(2)			
ab. <i>hemicycla</i> , J. and K.	4		
<hr/>			
49	+	100 + 1	+
<hr/>			
155			

* *Eueides egeriformis*, nov. sp.

(Plate CVII, fig. 8.)

Fore-wing with basal third red, outer two-thirds black with group of yellow blotches, consisting of three or four joined into a band and running transversely across the wing beyond the cell; a large blotch within the cell touching the subcostal and the median veins. A single more or less egg-shaped blotch lying wholly apart from the other yellow blotches, between veins 2 and 3.

Hind-wing with the basal half red, the outer half black. From the red basal area are emitted a variable number of slender red rays running between the veins.

Fore-wing below with a broad area of smooth glistening scales extending up to the median.

Hind-wing below streaked with red like *Heliconius estrella* costa streaked with yellow. Outer margin with a well-defined series of white spots.

Head black with white points behind and below antennae. Eyes

* Figured and described by Ch. Oberthür, Lep. Comp. XII, Pl. CDVI, fig. 3487, p. 37, while going through press.

with conspicuous white streaks behind. Palpi with 1st and 2nd joints conspicuously white. Third joint black.

Exp. 64-76 mm.

Habitat. FRENCH GUIANA, St. Jean.

This remarkable species is more *Heliconiform* than any other known species. The antennae are decidedly longer than is usual in *Eueides* species. The brand on the inner margin of the fore-wing on the underside is shiny and smooth-scaled as in Group I of *Heliconius*. But the streaking on the underside of the hind-wing is like Group II. The neuration of *Heliconius* and *Eueides* varies on parallel lines, and no one character seems to be constant. In *Heliconius* vein 5 is usually nearer 6 than 4, while in *Eueides* it is usually nearer 4 than 6. In *E. egeriformis* it is nearer 6 than 4, and thus like *Heliconius*. But the general appearance is certainly *Eueides*, while the mix up of *Heliconius* characters of sections I and II makes it certain that it is not a *Heliconius*.

EXPLANATION OF PLATES CVII, CVIII.

[See *Explanations facing the PLATES.*]

XXIV. *Further notes on the "Jurinean" Genera of Hymenoptera, correcting errors and omissions in a paper on that subject published in Trans. Ent. Soc. Lond. 1914, pp. 339-436.* By the Rev. F. D. MORICE, M.A., and JNO. HARTLEY DURRANT.

[Read November 1st, 1916.]

The Chronology of Panzer's Faunae Insectorum Germaniae.

On page 2 of Saunders's valuable Index to Panzer's Fauna Ins. Germ. he tabulates the "Dates of Publication as given on the Index of each Jahrgang." From this it might perhaps be supposed—and we at first supposed ourselves—that the actual date on which any particular Figure in Panzer's work first appeared would be that printed on the Index of the "Jahrgang" in which it was included. But this is not so. The year mentioned on the Title-page of each Index is that in which the Index itself was published, and this was not issued until the close of each completed "Jahrgang" (*i. e.* annual series of 12 "Heften"); whereas the "Heften," and the Plates contained in them, were issued at intervals in the course of the Jahrgang. For instance, the date given on the Index of Jahrgang 8 (= Heften 85-96) is "1805." But we know that even the last of these Heften (*viz.* 96) had already appeared by "October 1st, 1804," because on that day Panzer published a Notice of his forthcoming work, the "Kritische Revision," and stated in it that "8 complete Jahrgängen of the Fauna containing Heften 1 to 96" had then been issued. Accordingly the true "date" of any Heft in the Jahrgang dated 1805 cannot be later than September 1804, and the earlier Heften in it (*e. g.* Heft 85) may have appeared earlier yet, in 1803, or even 1802!—in fact, at any date not prior to that given on the Index of the previous Jahrgang, *viz.* September 3rd, 1801. It seems probable that the successive Heften of each Jahrgang were at first issued regularly, month by month, but that subsequently, from one cause or another, interruptions occurred to delay the issue of particular

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Heften, and that at last Panzer practically abandoned the attempt to conduct his work as a regular Serial, and simply published now and again a batch of Plates and descriptions whenever he happened to have one ready. In fact, during the last twenty years of his life (he died in 1829) he seems to have only published two "Heften" = one-sixth of a single "Jahrgang"!

Through not realising these facts properly until the greater part of our paper had been written and even set up in type, we fell into several errors in calculating the publication-dates of Figures in the *Fauna Ins. Germ.* Some of these we were just able to correct in time, *i. e.* before our paper actually appeared, but others escaped us, and these we hope to correct in the notes here following.

On page 341 of our paper we were guilty of another mistake in the same connection. We stated there that the coloured wrapper of each Heft bore "the date of its publication, and a list of the insects figured therein." It is true that such a list of insects is printed on each of the coloured sheets which we supposed to be parts of the wrapper. But apparently no dates were printed—at least, we can find none—on any of these sheets, until 1829, when Herrich-Schäffer succeeded Panzer as editor. In speaking of these "dates," we were confounding the (monthly?) wrappers of the Heften with the (yearly) title-pages and indices of the "Jahrgang." The following re-statement of the facts is, we believe, correct. Twelve times in each year (or nominal year) of publication, a batch of plates and corresponding descriptions was issued in a coloured wrapper, on which was printed a list of the insects dealt with. When, by the appearance of these 12 Heften, the Jahrgang was considered to be completed, the names already given on the wrappers were given afresh, but so rearranged as to form a classified Index to the whole issue of the completed Year; and this reorganised Index, with an accompanying Title-page (giving the name of the entire work, the publisher's name, the year and place of publication and so forth) was no doubt intended to be ultimately bound up into a Volume along with the Plates and Descriptions indexed in it, these having been already received at intervals in the past year by the subscribers. A similar practice has often been adopted by the Editors of scientific periodicals—subscribers receiving, say, in January 1916 an index to

the Volume whose last number appeared on or about December 1st, 1915.

The citations of page-numbers in the notes which follow refer to the pages in the Trans. Ent. Soc. Lond. for 1914.

Pages 346 and 347. The chronology on these pages requires some slight emendations:—

Page 346, par. (b). According to Mr. C. D. Sherborn's notes it would appear that Panzer did publish certain Heften of the Fauna in 1800—viz. 73–80 (73 is the first Heft quoted as 1800; 80 was out by 1800; 81 is the last quoted by Walckenaer—Aug. 1802; 82 is the first Heft which quotes the year 1800).

Page 347, line 7. After "Ins. Germ." insert "viz. Heften 81 to 85."

Page 347, par. (d), line 4. For "(1805)" read "in the same year, viz. 1804."

Page 347, par. (e), line 1. For "Next year (1806)" read "In 1806."

Page 374 (7 lines from bottom of page). The Type of *Tenthredo rosae* L. The insect ticketed "*rosae*" in Linné's handwriting in his cabinet at Burlington House is not, as we stated in error, the *Athalia rosae* of Authors, but *Athalia colibri* Christ (= *spinarum* F., = *centifoliae* Pz.), i. e. the well-known "Turnip Sawfly" of popular Entomological literature. How this mistake crept into our paper we do not know.

[My original note, written with the specimen before me gives the name *colibri* correctly! F. D. M.]

Page 375, line 19. For "see Lamarck" read "*sec.*" (i. e. *secundum*) "Lamarck."

Page 376, line 17. For "in September" read "probably in July" (Heft 82 was the tenth of the twelve comprised in the Jahrgang which is dated 1801, and which seems to have been completed shortly before October in that year).

Page 376, line 36. For "July–Sept." read "July (probably, *v. supra*)," and in the preceding line for "has precedence over" read "was probably an older name than."

Page 379 (9 lines from bottom of page). After "remark" insert "in *Fauna Succica*."

Page 384, lines 25–29. The statement that *E. troglodyta*,

or—as Mocsáry (1886) and later authors call the species—"niger" is "almost certainly not British" must be withdrawn. In the British collection at South Kensington most of the specimens called *niger* or *troglydyta* are *satyrus*. But among them are a ♂ and two ♀♀ from Coll. Stephens which are really *troglydyta*; and, if Stephens's statements in his *Illustrations* can be trusted, they are British insects, taken not far from London, perhaps at Hertford. We cannot, however, recognise in any of them the characters of the true *niger* as figured and described by Harris, and we still see no reason for identifying *troglydyta* F. with that mysterious species!

Page 403 (14 lines from bottom of page). The name **CEROPALES* Ltr. 1804 (Type: *maculata* F.) is clearly invalid, being a homonym of *CEROPALES* Ltr. 1802 (Type: *quinquecinctus* F.). Not on that ground, but to satisfy a supposed requirement of philology, Schulz has proposed emending it to "*Ceratopales*." As to this it should be remarked—(1) That the name being a homonym, should not be merely "*emended*," but sunk altogether and another name substituted for it. We have therefore proposed *HYPsicERAEUS* (*Υψικεραῖος*) in allusion to the peculiar situation of the antennae in this genus. (2) That in point of fact Schulz is mistaken in thinking the formation "*Ceratopales*" more correct philologically than *Ceropales*.

As we have noticed several attempts to "emend" other old names on exactly similar grounds, viz. the supposed necessity that the same form should be used in *inflecting* or "declining" a noun and in *compounding* it, it may be worth while to examine in some detail the actual practice of Greek writers in this matter. The stem used in "declining" *κέρας* is no doubt "*κερατ-*," and this form of the stem *may* be used in forming a compound, e. g. Aristotle has *κερατοφόρος*, *κερατώδης*, etc. But we also find *κεροβάτης* in Aristophanes, *κερό-δετος* and *κερο-φόρος* in Euripides, *κερονλίκος*, (i. e. *κερο-ελκος*) in Sophocles, and several other forms exactly analogous to "*Cero-pales*" used by the best writers of antiquity! Yet another possible compound from the same stem would be "*Ceraopales*" (cf. *κεροο-ξός* in Homer). And again the analogy of *κερασφόρος*, which is used by Euripides and Plato (!), would justify "*Ceraspales*." The fact, which seems to be very generally unknown, is, that real Greek "compound-" (or "so-called compound-") words were not made as a

rule by putting two words together according to some pre-existing canon of philologists, but by prefixing or affixing to a stem one out of several possible modifications of another stem, the choice of the particular modification to be employed being guided, not by rules of grammarians, but by the influence of some apparent analogy,* or by a sense which made the speaker or writer choose instinctively out of several possible combinations that which first occurred to him, or which he felt to be most euphonious.

A few more examples may be given to illustrate the gratuitous nature of many modern "emendations." Because the inflexion-stem of *νήμα* (*nēma*) "thread" is *νηματ-* certain authors have thought it necessary to change such names as "*Nemo-phora*" to "*Nemato-phora*," etc., etc. But the stem of *δέρμα* (*derma*) "skin" is *δερματ-*, that of *αἷμα* (*haema*) "blood" is *αἱματ-*;—and yet!—Aristotle calls "bats" *δερμόπτερα*, not *δερματόπτερα*! Sophocles expresses "bathed in blood" by *αἶμο-βαφής*, and Aristotle calls "blood sucking" insects *αἶμο-βόρα*, although either writer—had he chosen to do so—might have preferred the analogy of such forms as *αἱματο-πότης* "blood drinking" (Aristophanes), *αἱματ-ώδης* "blood-red" (Thucydides)—in fact, this last word, (as well as *αἶμο-βορος*) is employed by Aristotle on another occasion.

If it is rash to dogmatise as to what is, and what is not, possible in the formation of Greek compounds, it is almost more so to lay down laws of this kind in dealing with Compounds in Latin. Such Latin writers as use Compounds freely—and the best Latin writers, except certain poets, hardly form new Compounds at all!—are either mere imitators (at a distance) of Greek originals, or deliberately aim (like Plautus, etc.) at comic effects, or write on technical subjects without any attempt at literary style, so that it is impossible to found any reasonable arguments on their practice as to what is a solecism, and what a legitimate word-formation. Thus it has been held that *pallidipes*, *leucomelaena*, etc., etc., are "right" and "*pallipes*," "*leucomelana*," etc., wrong. But it may

* This is the case in all languages and at all times. A recent newspaper-article used the word "Villa-dom" to express "a region of villas." And this was not produced by compounding "Villa" with "dom," but by imitating the analogy of such words as Kingdom, Christendom, etc.

be replied with some confidence, that a Latin prose-writer of the Ciceronian or Augustan age would have been disinclined to approve any one of these formations, while analogies to each and all of them can be found abundantly in old Latin (*e. g.* Plautus) or late Latin (*e. g.* Appuleius), to say nothing of the many centuries which followed, while Latin was still a living language in the mouths and on the pens of churchmen, physicians, lawyers, and diplomatists, and, in short, the professors and expositors of every branch of literature and science. It by no means follows that a formation is to be branded as "not Latin" because it is not to be found in Smith's Smaller Latin Dictionary. It may require correction in a schoolboy's Latin Exercise, because he is supposed to be reproducing the Latin of a particular period. But it is quite another matter to assume the right of doctoring into conformity with tastes and fancies of our own the names which have come down to us from the founders of our science, such as Linné, Fabricius, Latreille, etc. Even the most unimpeachable of such emendations* are at best superfluous, contributing absolutely nothing either to the advancement of the science, or to the convenience of those occupied with it. [With similar misapplication of learning, and hardly more waste of time and energy, one might re-edit Shakespeare or the Bible, correcting their lapses from philological accuracy in the transcription of Proper names—Mark Antony, Shylock, Pharaoh, etc. It might be pointed out that, according to the Recommendations of a certain Committee, "Niobe all tears" ought to have appeared as *Nioba*, and "Patnos" as *Patmus*!] Sometimes, however, they are worse than superfluous, merely creating a difficulty in consulting Indices or Catalogues, as when *Heriades* is "corrected" to *Eriades*, or *Omalus* to *Homalus*. And sometimes, as we have tried to show, they are not, in fact, required by any such supposed Laws of Greek or Latin Word-formation as they postulate. So that on the whole we come to the conclusion which is briefly comprehended in Fabricius's remark upon the subject. *Nomina*, he says in his preface to "Systema Entomologiae," *mutata nunquam usum, saepius confusionem, praebent.*

* We do not mean to deny that some kinds of "emendation" may be sometimes necessary, as, for instance, in the case of an obvious misprint!

Two other gratuitous and undesirable "emendations" of old authors' names may here be noted for rejection!

(1) Dahlbom in introducing his generic name *Cyphononyx* derives it from "χυφων" [*sic!*] "furcifer" and ὄρνυξ *unguis*. Therefore W. A. Schulz has "corrected" it to the truly hideous form "*Chyphononyx*"! But there is not, and (philologically speaking) *ought not to be*, any such word in the Greek language as "χυφων";—the phonetically correct form is χύφων, and no other is employed by Greek authors, or recognised by lexicographers. Accordingly *Cyphononyx* (χυφων-ορνυξ) is at least a possible name; though a real Greek would probably have disliked the jingling reiteration (-on -on), and perhaps (remembering Homer's "μόνυχες ἱπποί") would have cut the word down to χυφῶνυξ (*Cyphonyx*). But, for all practical purposes, *Cyphononyx* is good enough, and there is no real reason for altering it in any way. "*Chyphononyx*," on the other hand, is an absolute monstrosity and on no account to be adopted.

(2) Because the Greek noun *πίων* has for its Inflection-stem not *πιο-* but *πιον-* (or sometimes apparently *πιων-*) v. Dalla Torre "corrects" *Priocnemis* of Schiödte to "*Prionocnemis*." But the form *Priocnemis* is completely justified by classical analogies. From ἄχιμων (stem ἄχιμον-) we get in actual Greek not ἀχιμονό-θετον but ἀχιμό-θετον; and from κίων (stem κιον-) both κιονό-κχαρον and κιό-κχαρον (the latter being, on the whole, more "classical" than the former). Neither "*Prio-cnemis*," then, nor "*Prionocnemis*" can be said to be an impossible form. Of the two, "*Priocnemis*" seems slightly better supported by actual precedents, and it is certainly more euphonious. It should therefore be restored, and there was never any reason for objecting to it.

Pages 411–412. In June 1909 (Ann.-Mag. NH. (8 s.) 3. p. 484) Mr. Rowland E. Turner, after examination of the type in Banks Coll. of *Tiphia variegata* F., announced its identity with the *Palarus flavipes* Pz., Auctt. Assuming this to be correct, the name *variegata* F. must be employed, having priority over *auriginosus* Eversm., and also over the otherwise invalid **flavipes* Pz., Auctt.

Page 417, line 16. In treating *communis* Auctt. as a synonym of *annulata* L. we were following Alfken who (in Zeitschr. für Hym. und Dipt. 1902, p. 88) accepted Förster's identification of the Linnéan species. Nylander,

however [in Not. Sällsk. Faun-Flor. Fenn. 2. (Rev. Syn. Ap. Bor.) p. 234 (1852)], points out that in Linné's description of *annulata* the bases of the ♂ antennae are said to be marked with white, which is not a character of *communis*, and also that in the Linnéan Collection (now at Burlington House) the only specimen ticketed by Linné himself as *annulata* is not a *communis*, but belongs to the species which Nylander had formerly [in Not. Sällsk. Faun-Flor. Fenn. 1. (Ådnot. Mon. Ap. Bor.) p. 188 (1848)] named in error **dilatata* K. and afterwards [in Not. Sällsk. Faun-Flor. 2. (Suppl. Ap. Bor.) p. 94 (1852)] re-named *borealis*. The latter has the scapes conspicuously marked with white; and as, accordingly, Linné's supposed "type" agrees with his original description there seems no reason to doubt its authenticity, in which case *borealis* Nyl. and not *communis* Nyl. should be sunk as synonymous with *annulata*. (*Borealis* and *communis* being both species of Nylander's own making, it is particularly unlikely that his decision on this point should be erroneous!)

Page 420, line 28. "Type 3: *Andrena bicolor* F." *Andrena bicolor* F. is identified by most recent authors except Schmiedeknecht (*e.g.* F. Smith, Thomson, E. Saunders, and v. Dalla Torre) with the summer generation of *Andrena gwynana* Kirby. But the latter has the abdomen clothed more or less with pale brown hairs, also in the ♂ the legs are pale-haired, and the scopae of the ♀ are fulvous.

Fabricius has described his species at least four times, and always in the same words:—"A. thorace villosa ferrugineo, abdomine atro immaculato"; and short though this description is, it seems clearly to indicate not the *bicolor* of recent authors, but the *Andrena* which we have been accustomed to call *thoracica* F. Rossi in Fauna Etrusca, after quoting Fabricius's diagnosis, goes on to say "*Statura fere A. mellificae. Tota atra, thorace tantum superne saturate rufovillosa. Abdomen glabrum nitidum. Alae apice fuscae, praesertim primores.*" This is a most excellent description of our "*thoracica*," and seems to make it certain that Rossi identified *bicolor* F. with that species, and not with the *bicolor* of Smith, etc. Panzer and Christ have both given coloured figures of *bicolor*, and the figure by Panzer is accepted by Fabricius in Systema Piezatorum as representing his species. Now in both these figures the pilosity of the legs is represented

as entirely black!, and this suits *thoracica*, and certainly does not suit the other species. Kirby, again, expressly asserts in Mon. Ap. Angl. 1. (p. 67) that "*Andrena bicolor* is nothing more than the male of *Apis thoracica*, and has precisely the same oral organs."

It seems clear, then, that Fabricius's contemporaries were generally agreed in their interpretation of his diagnosis; and it is not easy to understand why their view has gone so completely out of fashion. It is true that Fabricius treated *bicolor* and *thoracica* as different species; but this was a necessary consequence of his error which Kirby pointed out—namely that he supposed his *thoracica* to be not an "*Andrena*," but an "*Apis*." In Systema Piezatorum he silently gave up that notion, by listing *thoracica* as well as *bicolor* under *Andrena*. But we believe that any one comparing his descriptions of the two insects will find that the one is practically identical with the other:—

3. <i>thoracica</i>.	|	22. <i>bicolor</i> .
A. atra, thorace rufo, alis apice fuscis.	|	A. thorace villosa ferrugineo, abdomine atro immaculato.
Habitat in Daniae nemoribus.	|	Habitat in Daniae nemoribus.

Unfortunately, owing to his mistake about the genus of *thoracica*, Fabricius described *bicolor* before *thoracica*; so that, if our view of the facts is correct, the former name ought to be restored, and the latter to fall as a synonym.

Page 423. When proposing the new name *Donisthorpea*, in lieu of §*Lasius* F., we were led to suppose that *Acanthomyops* Mayr was generically distinct, and were unacquainted with the subgeneric names *Dendrolasius* Ruzsky and *Chthonolasius* Ruzsky. These may now be regarded as four subgeneric divisions of the genus *Acanthomyops* Mayr.

Forel [Rev. Suisse Zool. 24. 460 (IV. 1916)] rightly called attention to these omissions as follows:—"MM. Morrice et Durrant (Trans. Ent. Soc., London 1914, page 421 [1915]) ont institué en remplacement du Genre *Lasius* F. (1804) qu'ils disent tombé par synonymie de *Lasius* Jurine (1801, Apide), un nouveau genre *Donisthorpea*. Mais ces auteurs ne tiennent aucun compte des sous-

genres *Acanthomyops* Mayr, *Dendrolasius* Ruzsky et *Chthonolasius* Ruzsky, dont le dernier est à mon avis synonyme de *Lasius* s. str. et ne pouvait être maintenu. Donc, suivant mon opinion, la synonymie doit être la suivante, si Morrice et Durrant ont raison :—

Genre *Acanthomyops* Mayr (1862)

= *Lasius* F. 1804 (non Jurine 1801)

= *Donisthorpea* Morrice et Durrant;

Type : *claviger* Roger,

Subgen. *Chthonolasius* Ruzsky, type : *niger* L. (*flavus* ex. Ruzsky).

Subgen. *Dendrolasius* Ruzsky, type : *fuliginosus* Latr.

P.S.—M. Emery m'écrit qu'à son avis il vaudrait mieux prendre pour *Lasius* le nom nouvellement déterré par Wheeler de *Formicina* Shuck., nom en partie basé sur le *Lasius flavus*. Je n'ai rien à y opposer, pourvu qu'on en finisse une bonne fois avec ces déménagements perpétuels des anciens noms."

We do not quite understand the process by which *niger* is to be constituted the Type of *Chthonolasius* Ruzsky, in lieu of *flava* L., indicated as the Type by Ruzsky, nor do we accept the suggestion that *Formicina* Shuck. should be used in lieu of *Donisthorpea*. The following is the original reference to *Formicina* Shuckard :—"The group has been divided according to the structure of the abdomen; which in some has but one node only to its peduncle, but in others it has two. It is in the first division that we find the stingless genera, namely, *Formica* Linn., *Formicina* Shkd., *Polyergus* Latr., *Polyrachis* Shkd., and *Dolichoderus* Lund, besides several other yet uncharacterised genera, which we shall shortly publish.

(155). The *Formicina rufa*, or horse ant, forms those large nests of dry leaves and sticks we so frequently observe in the woods; and within these nests two genera of *Staphylini* appear to be parasitical—*Lomechusa* and *Pella*; and in their deepest recesses innumerable wood-lice (*Onisci*) are constantly found." . . . "Another singular *Staphylinus* (the minute *Claviger*), which is totally blind, and otherwise remarkable in structure, inhabits the nests of the *Formicina flava*, where it has once been discovered in this country." (Shuckard, Lardner's Cabinet Cycl. 10. (Hist. & Nat-Arr. Ins.) 172 (1840.))

TRANS. ENT. SOC. LOND. 1916.—PARTS III, IV. (June '17.) G G

Formicina would doubtless have been described at length by Shuckard in his Elements of British Entomology, but only one part (*Coleoptera*) was published (in 1839). It is not necessary to discuss the status of "*Formicina* Shkd." as a possibly valid genus, for Wheeler [Ann. N.Y. Ac. Sc. 21. 164 (1911)] has very properly cited as its Type **FORMICA rufa** L., and has definitely sunk it as a synonym of *Formica* L.—Emery's subsequent suggestion that *flava* L. should be regarded as the Type cannot therefore be maintained.

[It should be noted that §*Formicina* Canestrini (1868) *Arachn.* is homonymous with *Formicina* Shuck. (1840).]

The synonymy of *Acanthomyops* is as follows:—

ACANTHOMYOPS Mayr.

= §*LASIUS* (*nec* Jrn.) F. (1804); = **FORMICINA* (Shuck. p., 1840) Forel & Emery (1916)—*nec* Wheeler (1911); = **ACANTHOMYOPS** Mayr (1862); = **DENDROLASIUS** Ruzsky (1912); = **CHTHONOLASIUS** Ruzsky (1912); = **DONISTHORPEA** Morice & Drnt. (1915); = **CHTHONOLASIUS* (*nec* Ruzsky) Forel (1916).

Type 1: **Formica clavigera** Roger (Roger 1862; Wheeler 1911).

ACANTHOMYOPS Mayr Verh. ZB. Ges. Wien 12:1862. 699-700 (1862); Wheeler Ann. N.Y. Ac. Sc. 21. 157 (1911); Forel Rev. Suisse Zool. 24. 460 (1916).

Type 2: **Formica fuliginosa** Ltr. (Ruzsky 1912).

DENDROLASIUS Ruzsky Kasani Zap. Veterin. Inst. 29. 629-33 tf. 2 (1912); Forel Rev. Suisse Zool. 24. 460 (1916).

Type 3: **Formica flava** L. (Ruzsky 1912).

CHTHONOLASIUS Ruzsky Kasani Zap. Veterin. Inst. 29. 629-33 tf. 3 (1912). **FORMICINA* Shuck. (p.) Lardner's Cab. Cycl. 10. (Hist. Nat.-Arr. Ins.) 172 (1840); Forel & Emery Rev. Suisse Zool. 24. 460 (1916).

[*nec FORMICINA* Shuck. Lardner's Cab. Cycl. 10. (Hist. Nat.-Arr. Ins.) 172 (1840); Wheeler Science 33. 859, 860 (2. VI. 1911): Ann. N.Y. Ac. Sc. 21. 164 (17. XI. 1911)—Type: **rufa** L. (**FORMICA** L.)]

[*nec CHTHONOLASIUS* (Ruzsky) Forel Rev. Suisse Zool. 24. 460 (1916)—Type: **nigra** L. (**DONISTHORPEA** Morice & Drnt.)].

Type 4: **Formica nigra** L. (Morice & Drnt. 1915).

DONISTHORPEA Morice & Drnt. = §*LASIUS* (*nec* Jrn.) F. Syst. Piez. pp. xi, 415-8, no. 78 sp. 1-10, Ind. 18 (1804); Auctt. **DONISTHORPEA** Morice & Drnt., Tr. Ent. Soc. Lond. 1914. 423 (1915); **CHTHONOLASIUS* (*nec* Ruzsky) Forel Rev. Suisse Zool. 24. 460 (1916).

THE ENTOMOLOGICAL SOCIETY OF LONDON.

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Fellows resident abroad, or who are otherwise unable to attend, are reminded that any specimens, notes, or observations they may send to the Secretaries will be considered by the Council, with a view to exhibition or reading at the meetings of the Society.

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Authors proposing to illustrate their papers should communicate with the Secretaries before the drawings are executed. The Council recommend that the size of the work on plates should be limited to $6\frac{1}{4}$ ins. by 4 ins., and in no case will it be allowed to exceed $6\frac{1}{2}$ ins. by $4\frac{1}{4}$ ins.

Attention is called to the Instructions to Authors issued with Part I of each volume, which may also be obtained of the Resident Librarian. Inattention to these regulations may involve an author in considerable expense.

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MEETINGS

TO BE HELD IN THE SOCIETY'S ROOMS

11, CHANDOS STREET, CAVENDISH SQUARE, W.

SESSION 1917-1918.

Wednesday	April	...	...	...	...	...	4
"	May	...	...	...	...	...	2
"	June	...	...	...	...	...	6
"	October	...	...	...	...	...	3
"	"	...	...	...	...	...	17
"	November	...	...	...	...	...	7
"	"	...	...	...	...	...	21
"	December	...	...	...	...	...	5
1918.							
"	January (ANNUAL MEETING)	16
"	February	6

The Chair will be taken at Eight o'clock.

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PART V.

September 29, 1917.

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OF THE
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OF
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Some of the early volumes of the Society's Transactions are out of print, but those which are in stock can be obtained at reduced prices. Any single volume of the present series, 1868-1887, is sold at 10s. to Fellows. No volume can be broken to supply separate parts, but when odd parts are in stock they can be obtained at the published price, less 25% to Fellows. THE JOURNAL OF PROCEEDINGS is bound up with the TRANSACTIONS, but that for 1906 is sold separately, price 6s., to Fellows 4s. 6d. The following is a price list of recently published parts of the TRANSACTIONS—

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THE
PROCEEDINGS
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OF
LONDON

FOR THE YEAR 1916.

Wednesday, February 2nd, 1916.

The Honble. N. CHARLES ROTHSCHILD, M.A., F.L.S., F.Z.S.,
President, in the Chair.

Election of Fellows.

Messrs. FREDERICK LAING, Natural History Museum, Cromwell Road, S.W.; ROBERT LATTA, D.Phil., Prof. of Logic, University of Glasgow; ARTHUR RAYMOND PALMER, Ingleholme, Norton Way, Letchworth, Herts, and YELSETI RAMACHANDRA RAO, M.A., Assistant Govt. Entomologist, Agricultural College, Coimbatore, India, were elected Fellows of the Society.

Nomination of Vice-Presidents.

The PRESIDENT announced that he had nominated Dr. T. A. CHAPMAN, Dr. C. J. GAHAN and Commander J. J. WALKER as the Vice-Presidents for the current year.

Proposed Alteration of Bye-Laws.

The Secretary read a notice signed by the President and
PROC. ENT. SOC. LOND., I. 1916

six members of the Council, that a Special Meeting should be called to consider alterations in the Bye-laws. In accordance with Bye-law XXI, the proposed alterations were then read for the first time.

Mr. ROWLAND-BROWN suggested that as the alterations were numerous they should be typed or printed, so that they should be in the hands of Fellows at the next meeting and might then be taken as read. It was resolved that they should be printed, the question of their being read being left open.

Resolution on the Closing of the Natural History Museum.

Mr. G. T. BETHUNE-BAKER proposed the following Resolution with regard to the closing of the Natural History Museum during the war :—

“ That this Society would view with deep regret the closing of the Natural History Museum for three reasons—

“ 1. Soldiers from all parts of the Empire would be debarred from seeing the finest Geological, Zoological and Botanical collections in the world. Very many of them would thus be deprived of the only opportunity they would ever have of seeing some of the wonderful products of the earth.

“ 2. Teachers and Students in great numbers would thus be prevented from examining types and material, and so their work would be greatly hindered, if not stopped.

“ 3. The valuable scientific work that is being carried on in the Museum would be made to cease.

“ The study of Micro-Lepidoptera has enabled the Army to be supplied with wholesome biscuits and has saved the country thousands of pounds per annum. This was so apparent to the Army Council that a special vote of thanks was accorded to the head of that section.

“ The Society therefore hopes that the Government will keep this Museum open to the public.”

This was seconded by Mr. H. Rowland-Brown, and carried unanimously, the Secretary being directed to send a copy to the Prime Minister.

Exhibitions.

“MOTHS OF THE LIMBERLOST.”—Mr. E. B. ASHBY exhibited a beautifully illustrated book entitled “Moths of the Limberlost,” by Mrs. Gene Stratton Porter. The illustrations were from photographs and water-colours. The book contained much carefully-detailed life-history of the species dealt with.

Comm. WALKER suggested that a corresponding book on the Rhopalocera of the same district was a desideratum.

MECHANICAL STAGE FOR MICROSCOPIC EXAMINATION OF PINNED INSECTS.—Dr. H. ELTRINGHAM exhibited a new mechanical stage for examining pinned insects. He remarked that in his previous design the revolution of the pin on its own axis had to be performed by turning the carrier with the fingers. The present design obviated this difficulty by having two milled heads working concentrically. One of these turned the pin so that the latter was radial to the circle described, whilst the other by means of small grooved pulleys revolved the pin on its own axis. The combination of these movements enabled the pinned insect to be turned in any direction without removing it from the focal plane.

CIDARIA SUFFUMATA FROM SOUTH-WEST YORKSHIRE.—Mr. G. T. PORRITT exhibited the three forms of *Cidaria suffumata* as it occurs in South-west Yorkshire. Curiously in the area of melanism in so many species, *C. suffumata* tends to become much paler than the type, culminating in the black and white form, var. *porritii*. This is the more remarkable as the melanic form of the species, var. *piceata*, is not known to occur in South-west Yorkshire at all.

ANTS FROM THE FRONT.—Mr. DONISTHORPE exhibited two ants taken at the front—*Myrmica rugulosa*, Nyl., ♂, taken by Mons. Bondroit at Ramscapelle (Yser), Dec. 14, and *Messor barbara* var., winged ♀ taken in the fire trenches at Gallipoli on Dec. 21, 1915, by Lieutenant Noel S. Sennett, F.E.S., who had kindly forwarded it in a revolver cartridge case. Mr. Donisthorpe read some interesting extracts from Lieutenant Sennett's letter which he had received with the ant.

He also showed specimens of the "Argentine Ant," *Iridomyrmex humilis*, taken at Enfield and Eastbourne, and remarked that in the latter locality it had been established for nearly twenty years as he was told, and had become a great pest in many houses; he also pointed out how it had spread in America.

MIGRATION OF *LIBYTHEA LABDACA* AT FREETOWN, SIERRA LEONE, MAY 6, 1915.—Mr. A. W. BACOT exhibited specimens of the butterfly *Libythea labdaca* and read the following notes:—

"The passage of these insects in large numbers attracted general attention at 9.30 a.m., the flight continuing until 10.50 or 11 a.m. The steady stream of butterflies across the hospital compound, when my attention was drawn to the migration at 10.15 a.m., seemed to average about one per square yard of area. The nature of the ground, bushes, buildings, etc., tended, however, to give the stream a much greater concentration at certain points, so that it was possible to catch several at a single sweep of the net. By 10.45 their numbers had gradually dwindled to a few scattered individuals in view at the same moment.

"The migration was in an E.N.E. direction following the trend of the shores of the estuary, up river, against a steady but not very strong N.E. breeze. In width the stream appears to have been at least one-third of a mile, as the insects were observed throughout the town from the beach up to the Governor's house. The flight across the hospital compound was about 4 or 5 feet from the ground, and the speed would not be less than 6 to 8 miles per hour. The insects rose at walls and buildings, just sufficiently to clear the obstruction, falling immediately on the further side to the old level, and rising again in the same manner at the next obstacle. My impression was that this close approximation to contour was deliberate, in order to avoid the full force of the wind at higher levels. In the late afternoon I observed occasional stragglers taking the same direction with the sea breeze, which had then set in, *behind them*, but all these individuals flew high and wild without the same apparent regard for contour.

“ A few stragglers belonging to other species were seen with the main stream, but the only one I was able to recognise was *Danaïs chrysippus*, while, beyond the fact that those other species were flying in the same direction when I saw them, there is no evidence that they were migrants.

“ I do not know if migrations of this species are of common occurrence in Africa, but I am told that migratory swarms of butterflies are rare at Freetown, though my boy, a native from further south (Lagos), told me that in his country butterfly migrations are of annual occurrence. The Creole population of Sierra Leone, I was informed, considered the phenomenon a portent boding ill to the colony.

“ Subsequent to the first migration, several small flights of the same insect were seen in the adjacent country. They passed without notice or comment by the general population. It would appear, therefore, that the numbers alone were the remarkable feature of the first migration.

“ During the previous September there was an immigration of a Vanessid closely allied to *Pyrameis cardui*, possibly only a local variety, into Freetown and the surrounding district. These insects I first saw in large numbers in the centre of the town, on Tower Hill, flying in the dusk like swift moths. They haunted Tower Hill alone for a few days, and then became generally dispersed through the town and district, although always most numerous on the hill where I first saw them. As the days passed they seemed to lose the marked habit of flying in the dusk. I saw numbers paired and at rest about dusk. They died out completely in about five or six weeks, and no breeding occurred, presumably owing to the lack of a suitable food-plant.”

Commander WALKER, Mr. J. C. F. FRYER and Dr. COCKAYNE commented on the migration of butterflies.

CROSS BREEDING OF *PEDICULUS CAPITIS* AND *P. HUMANUS*.—Mr. BACOT also exhibited a box containing recently hatched lice resulting from a pairing between *Pediculus capitis*, ♂, and *P. humanus (vestimenti)*, ♀, and remarked that there was no difficulty in obtaining pairings between the two insects, in either direction; a state of affairs which was unusual in his experience of cross-pairing different species. It seemed

possible, in spite of the difference in size, shape and egg-laying habits, that the insects were only races and not yet specifically distinct.

He further remarked that experiments showed that both eggs and active lice (*P. humanus*) were killed by exposing them to a dry air or water temperature of 52° C. (125·6° F.) for thirty minutes.

Paper.

The following Paper was read :—

“ On the Pairing of the Plebeiid Blue Butterflies,” by T. A. CHAPMAN, M.D., F.Z.S., F.E.S.

Wednesday, March 1st, 1916.

Commander J. J. WALKER, M.A., R.N., F.L.S., Vice-President, in the Chair.

Proposed Alteration of Bye-laws.

The proposed alterations in the Bye-laws, having been printed and distributed to all Fellows present at the Meeting, were taken as read for the second time.

Date and Hour of the Special Meeting.

In accordance with the decision of the Council, it was announced that the Special Meeting for consideration of the proposed alterations in the Bye-laws would take place on April 5th before the Ordinary Meeting, and the Fellows present were requested to decide whether the hour should be 7.30. or 8.

Mr. JONES proposed that the hour should be 8 p.m. This was seconded by Mr. R. W. LLOYD, with a view to avoiding the necessity of sending out notices. The Secretary pointed out that in case of a Special Meeting notices had always to be sent out in accordance with the Bye-laws. Mr. BETHUNE-BAKER proposed as an Amendment that the hour be 7.30,

this was seconded by Mr. STANLEY EDWARDS, and being put to the Meeting was carried with three dissentients.

Exhibitions.

ABERRATION OF *ARCTIA CAJA*, AND A BRITISH *LAVERNA NODICOLELLA*.—Mr. J. H. DURRANT exhibited a fine variety of *Arctia caja*, L., ♂, with dark fuscous hind-wings, similar to the specimen figured in Barrett's "Lepidoptera of the British Islands," vol. ii, Pl. 721e. This specimen was taken at Brighton, in August 1915, by Miss Kathleen G. Sherrin, and will be presented to the national collection.

Mr. Durrant also exhibited a specimen of *Laverna nodicolella*, Fuchs, "Stett. Ent. Ztg.," 63, 328-9 (1902), taken at Westerham, Kent, June 24, 1915, by Mr. P. A. Buxton. This species has not been recorded as a British species. There is a British specimen in the Walsingham Collection, and a third in the Bankes Collection—both without localities. *Laverna nodicolella* was originally taken by Herr K. T. Schütze, at Rachlau, where he found the larvae feeding in swellings on the roots of *Epilobium*. It is intermediate between *subbistrigella*, Hw., and *decorella*, Stph. Mr. Buxton is kindly presenting his specimen to the Museum.

BUTTERFLIES FROM WAIGEU.—Mr. G. TALBOT exhibited, on behalf of Mr. J. J. JOICEY, several species of Rhopalocera from Waigeu, and contributed the following notes:—

Papilio (Troides) goliath, Ob., ♂. The only authentic ♂ specimen of this species. *P. goliath* was described by Oberthür in 1888 from a ♀ specimen. The locality of this specimen was for some time doubtful, until it was discovered that the collection in which the specimen came contained an example of the Waigeu form of *P. tithonus*. Oberthür considered that this ♀ was either a large form of *paradisea* or else a distinct species, and Rothschild formerly referred it to *priamus* var. *poseidon*. In Seitz' "Macrolepidoptera" Dr. Jordan gives it specific rank, and associates *atlas*, *supremus*, and *titan* with it. He places provisionally as the ♂ of *goliath* a specimen of doubtful locality, which differs from others of the group. This specimen does not agree with the one here exhibited, and may be a new race.

- Papilio aegaeus* var. *ormenus*, ♂, f. *pandion*, Wall.
 " " " " ♀, f. *inornatus*, Roths. Not
 previously known from Waigeu.
P. ormenus, ♀, f. *leporina*, Jord.
 " " ♀, f. *onesimus*, Hew.
Delias emmiana, Ob., ♂ ♀.
 ,, *dice* f. *dorothea*, Mitis, ♂ ♀.
 ,, *ennia*, Wall., ♂ ♀.
 ,, *ladas*, Gr.-Sm., ♀. Differs from the typical form and
 not known before from Waigeu.

A HAWK-MOTH FOUND IN THE STOMACH OF A FISH IN SUVA HARBOUR, FIJI.—Prof. POULTON exhibited a specimen of *Chromis erotus*, Cr. (*eras*, Boisd.), kindly sent to him by Lieut. L. H. Mosse-Robinson with the following account:—

“I am enclosing the large Sphingid from Fiji. The fish was captured by a sailor fishing from the side of H.M.S. *Australia* in Suva harbour, October, 1914, and the moth discovered inside it, in, as you see, comparatively good condition, considering the extraordinary circumstances. The insect always comes in great quantities to light on board any of the ships in Suva harbour.”

Lieut. Mosse-Robinson informed Prof. Poulton that the fish was about 1 ft. long, that he saw the moth directly after it had been taken from the stomach, and that convincing evidence was afforded by its wet and sodden appearance.

A SERIES OF *DANAIDA CHRYSIPPUS*, L., FROM FERNANDO PO.—Prof. POULTON exhibited eighteen *D. chrysippus* captured between Nov. 3, 1914, and Feb. 15, 1915, at or near Sa. Isabel, on the N. coast of Fernando Po, by his friend Mr. G. H. Bullock, H.M. Vice-Consul in the island. The series was very interesting in the numbers and proportions of the different forms, and in the comparison between them and those of the mainland opposite the island. The white-hind-winged *alcippus*, Klug, was apparently the only form on the tropical west coast from some point in Gambia, where it replaces the type, as far south as the Cameroons where the type form begins again to appear, although, on the testimony of Prof. Yngve Sjöstedt, it is excessively rare (Poulton, “Essays on

Evolution," 1908, p. 321, n. 1). But on the island of Fernando Po, the type form, *D. chrysippus*, L., appeared to be far commoner, for Mr. Bullock's series included three male examples, viz. one-sixth of the whole series. The basal section of veins 2, 3, and 4 of the hind-wing in two specimens was narrowly outlined with white, but this is a common feature in the type form. Fourteen examples, including the single female, were *alcippus*, forming a gradually transitional series from specimens with the maximum of white to those in which it was reduced more and more, although never greatly, by the increasing area occupied by the tawny ground-colour. This increase was effected by a broadening of the submarginal border and especially by an advance from the costa and the base of the cell. In a single male, not included in the series of fourteen, the invasion had been carried so far that the specimen was nearly intermediate between *alcippus* and *chrysippus*.

The tint of the ground-colour also varied in an interesting manner. In two of the type forms, seven *alcippus* and the intermediate example, the ground-colour was sienna brown, the tint most commonly found in African examples of these forms: in one type form (with hind-wing veins outlined with white) and one *alcippus* (with full development of white) the tint was brownish orange, closely resembling that of Oriental examples: in six *alcippus*, scattered indiscriminately along the transitional series, the brighter tint was pronounced in the submarginal border of the hind-wing, and recognisable, to a varying extent in different individuals, in the inner marginal section of the fore-wing.

These two very distinct tints were also found in mainland examples of *chrysippus*, and it would be an extremely interesting piece of work to inquire into their development and proportions in various parts of Africa and over the whole range of the species.

Comm. WALKER commented on the first of these exhibits.

A BEE BEARING POLLINIA ON ALL ITS LEGS.—Mr. G. MEADE-WALDO exhibited a South African Carpenter bee (*Xylocopa hottentota*, Smith), the tarsi of all three pairs of legs bearing the pollinia of some Asclepiad flower. The specimen, which

was collected by Dr. G. A. K. Marshall, at Salisbury, Mashonaland, in 1903, had a very curious aspect.

A CURIOUS OLD ENTOMOLOGICAL BOOK.—Mr. HAMILTON DRUCE exhibited a book he had lately come across entitled "The indigenous insects of the region of Petersburg," by John Cederhielm, published at Leipzig in 1798, and made remarks upon it.

Mr. A. H. JONES and Mr. W. G. SHELDON commented on Mr. Druce's observations with regard to the occurrence of *Papilio machaon* in various parts of Russia.

A BRITISH (?) SIREX JUVENCUS.—The Rev. F. D. MORICE exhibited a specimen of true *Sirex juvenicus*, ♀, F., from Wakefield in Yorkshire, given to him by Mr. J. W. Saunt of Coventry, who received it with several others from Mr. W. Fletcher of Wakefield. Mr. Morice made the following remarks on this exhibit:—

A joiner employed by Mr. Fletcher found in the course of his work a piece of timber infested by these insects and brought it to his employer. Unfortunately, Mr. Fletcher has not been able to ascertain whether this particular piece of timber was of British or foreign origin. If the latter, it must have come from Riga, and perhaps this is the most likely explanation of the matter; but as I know of one and only one other reliable record of *juvenicus* as a British-born insect, and in that case also the locality was a Yorkshire one—viz. Doncaster (where it was taken by Mr. Bayford in, I believe, 1904)—it seems worth while to exhibit it.

Nearly all British records of *juvenicus* really refer to another species, viz. *noctilio*, which differs from it in having entirely black antennae, and seems to be, if not actually indigenous, at least thoroughly established in many British localities. But yet another species (viz. *cyaneus*, F.) also figures as *juvenicus* in some collections. This, however, is certainly not a Palaearctic but an American insect, and all occurrences of it here must be accounted for by the accidental importation from Canada or the States of timber containing its larvae.

CELLS OF VARIOUS HYMENOPTERA.—Mr. NEVINSON exhibited—

(a) The tubes at the entrance of the burrows of *Odynerus reniformis* and *O. spinipes* to show their close similarity.

(b) The cells of *Odynerus herrichi*.

(c) The cells of *Eumenes coarctata*.

(d) The cells of *Osmia rufa* found in an old hive showing how the hexagonal cells had been enlarged and adapted by the *Osmia*.

(e) The cells of *Osmia xanthomelana*.

(f) The cells of *Osmia leucamelana* in a bramble stem with *Stelis octomaculata*, and an imprisoned male at bottom of the burrow.

He also exhibited examples of *Cimbex* and its allies, in illustration of Mr. MORICE'S succeeding exhibit.

THE SAWS OF VARIOUS CIMBICIDS.—The Rev. F. D. MORICE exhibited, with the Epidiascope, a series of photo-micrographs to illustrate specific characters in the ♀ ovipositors or "saws" of various Cimbicids, especially of the genus *Trichiosoma*, Leach, but also of *Cimbex*, *Pseudoclavellaria*, *Abia*, and *Corynis* (= *Amasis*).

PUPAL PADDLES OF MOSQUITOES.—Mr. A. BACOT exhibited a series of lantern slides showing outline camera drawings of preparations of the anal fins or paddles of mosquito pupae (see list below). He called attention to the possibilities afforded by these characters for the separation and identification of species closely resembling each other in the adult stage. Although it did not seem probable at present that the pupae could be made the basis of a scheme of classification, still, when a large number had been examined, this might follow, as had happened with the genitalia of the Lepidoptera, which were at first used as a means of separation in difficult cases.

The extremes of variation as shown between the paddles of *Eretmopodites quinquevittatus* and *E. chrysogaster*, species in which it was difficult to distinguish between the females (although the males of *chrysogaster* were easily separated by the tuft of scales on the third pair of legs), had led him to examine the pupae of as many species as possible, with the result that a new species, *Eretmopodites dracaenae*, Edwards,

associated with collections of water in the axils and central whorl of leaves in certain plants was discovered.

A slide was also exhibited, showing outlines of eggs of *Eretmopodites quinquevittatus* illustrating the remarkable range of size, which experimental breeding had proved to have no relation to sex.

The following were the species the pupal paddles of which were exhibited :—

Stegomyia fasciata, *S. luteocephala*, *S. sugens*, *S. simpsoni*, *Ochlerotatus apicoannulatus*, *O. minutus*, *O. simulans*, *Eretmopodites quinquevittatus*, *E. chrysogaster*, *E. dracaenae*, *E.* an undetermined species, possibly *inornatus*, *Culex tigripes*, *Culiciomyia nebulosa*, *Uranotaenia ornatus*, *Toxorhynchites brevipalpis*, *Anopheles costalis*, *A. funestus*.

Papers.

The following papers were read :—

“ On Specific and Mimetic Relationships in the Genus *Heliconius*, L.,” by H. ELTRINGHAM, M.A., D.Sc., F.E.S.

“ Gynandromorphous *Agriades coridon*, Poda,” by E. A. COCKAYNE, M.A., M.D., F.E.S.

The latter was profusely illustrated by means of the Epidiascope, and Dr. Eltringham observed that he proposed to illustrate his paper also in the same way on a future occasion.

Wednesday, March 15th, 1916.

The Honble. N. CHARLES ROTHSCHILD, M.A., F.L.S., F.Z.S., President, in the Chair.

Death of a Member of the Council.

The death was announced of Mr. G. MEADE-WALDO, a Member of the Council, at which he was a constant attendant, having been present at the last Council Meeting on March 1. A vote of sympathy with his father was unanimously passed by the Fellows present.

Election of Fellows.

MR. RALPH HEADLEY MOORE, B.A., Heathfield, Plymstock, Devon, and Lieut. F. W. SOWERBY, R.N.D., Cleethorpes, Lincolnshire, were elected Fellows of the Society.

Proposed Alteration of Bye-laws.

The proposed alterations in the Bye-laws, being in the hands of all Fellows present, were taken as read for the third time.

Exhibitions.

LEPIDOPTERA FROM GALLIPOLI.—MR. D. A. J. BUXTON, who was present as a Visitor, exhibited a small collection, mostly butterflies, taken on the Gallipoli Peninsula, where he was stationed from April to October, 1915. He remarked on the fact that most butterflies kept to the shade, even of a small bush, and that even *Pieris brassicae* was seen to rest under a bush during a long flight through hot sun. *Colias edusa*, and the Vanessids, however, appeared indifferent to heat.

He also said that he had observed and pursued a young shrike (*Lanius* sp.), which was seen to fly down from a bush and capture a small hawk moth (? *Hyles euphorbiae*) which was hovering at the time, but was unable to make it drop its prey.

Dr. G. B. LONGSTAFF said he was especially interested in Mr. Buxton's remarks as to the heat being too great for butterflies. The *Satyridae* as a family were well known to be shade-lovers; this was especially true of the genus *Mycalesis*, and even more so of *Melanitis*, which flew at dusk. He was surprised to hear of *Pieris* avoiding the sun; was it not resting after a long flight?

PINK-TINTED *PIERIS BRASSICAE*.—MR. L. W. NEWMAN exhibited on behalf of Mr. Arthur Horne, of Aberdeen, two pairs (a part of a series) of *Pieris brassicae* bred by himself from wild Aberdeenshire larvae, the ♂♂ especially showing a decided pink coloration all over the wings. He also showed typical specimens for comparison.

AFRICAN RHOPALOCERA.—Mr. G. TALBOT, on behalf of Mr. J. J. JOICEY, exhibited the following African Rhopalocera :—

Papilio cariéi, Le Cerf, from the Ivory Coast. This very interesting *Papilio* was first described from Mauritius. It is allied to *P. demodocus*, Esp.

Papilio demodocus, Esp. A dwarf ♀ with the cell-spots of fore-wing confluent, from the Ivory Coast.

Charaxes acraeoides, Druce. The specimen exhibited is the only individual at present known, and was taken in the Cameroons by Mr. Rosenberg's collector. The species is quite unlike any other known *Charaxes*. It appears to exist in mimetic association with the following species, also exhibited, which occur in the same district :—

Papilio ridleyanus, White; *Pseudacraea clarki*, Butl., and *Acraea egina*, Cram.

Pinacopteryx venata, Butl., from the South Soudan.

Pemba jordani sp. nov., from French Congo.

SECOND GENERATION OF HYBRID PEDICULUS HUMANUS AND *P. CAPITIS*.—Mr. A. BACOT exhibited specimens of *Pediculus humanus (vestimenti)*, *P. capitis*, and the 2nd generation of hybrids resulting from a pairing between *P. capitis* male and *P. humanus* female. Referring to a previous communication on the subject, he stated that the female *P. humanus*, after pairing with a *P. capitis* male, laid about the average number of eggs for the species. Few if any of them were unfertilized, but there was a considerable mortality among the eggs, which died in various stages of development, chiefly at, or when approaching, the hatching period. As a consequence of, or apart from, this mortality, the offspring of the cross showed an abnormal percentage of males (64 ♂♂ to 24 ♀♀ to date). These facts inclined him to modify his previously expressed opinion that *P. capitis* and *P. humanus* were only races, and now to consider them as sub-species, even if they were not entitled to full specific rank.

The reverse cross between *P. humanus* male and *P. capitis* female resulted in a considerable mortality to the females, possibly attributable to the too persistent vigour in pairing of the larger and more powerful male. The eggs resulting from successful pairings of the cross were, however, fertile,

and no disparity in the proportion of the sexes of the hybrids had been observed up to the present. Pairings between hybrid individuals of this cross had been obtained, and fertile eggs resulted.

Wednesday, April 5th, 1916.

Special Meeting.

Dr. C. J. GAHAN, M.A., D.Sc., Vice-President, in the Chair.

The Chairman having read the notice summoning the meeting, the following alterations in the Bye-laws were submitted to the Fellows present.

CHAP. III. *Management.*

. . . No Fellow shall be eligible as an ordinary Member of the Council for more than three years successively.

Proposal :—

After “ successively,” add “ or until he shall have been a Fellow for three consecutive years.”

Mr. DURRANT proposed as an amendment that the alteration should read as follows :—

“ No Fellow shall be eligible as an ordinary Member of the Council until he shall have been a Fellow for three consecutive years, nor shall he serve for more than three years successively.”

This was seconded by Mr. Tomlin and carried.

CHAP. V. *Removal or Resignation of Officers.*

1. For any cause which shall appear sufficient to a majority thereof, the Council shall have power to suspend any Officer, etc.

Proposal :—

Before “ majority ” insert “ two-thirds.”

There was a slight discussion on this alteration, but it was carried without a division.

CHAP. VIII. *Treasurer.*

3. . . . the date of payment and name of the Fellow paying being written both on the Receipt and on the part of the Cheque which is left in the book.

Proposal :—

For “ part of the Cheque which is left in the book ” read “ counterfoil.” Carried.

CHAP. IX. *Secretaries.*

2. In the absence from any Meeting of the Society, or the Council, of both the Secretaries, Minutes of the Proceedings shall be taken by a Fellow whom the President shall appoint for the occasion.

Proposal :—

After “ both the Secretaries ” read “ or in the absence of one Secretary, and the other Secretary being in the Chair as Vice-President, then the Chairman of such Meeting shall appoint a Fellow to take the Minutes of the Proceedings.” Carried.

CHAP. XI. *Library Regulations.*

3. The Librarian shall call in all books borrowed from the Library on the 5th day of January and 5th day of July in each year.

Proposal :—

Read “ The Librarian shall, on the 1st day of May in each year, call in all books borrowed from the Library.” Carried.

4. . . . the Library shall be open to the Fellows between the hours of one and six p.m. on every weekday, except Saturday, and on that day between one and three p.m.

Proposal :—

For “ one ” read “ nine a.m.” (twice), for “ three ” read

“two,” and add “except during the month of September, when the Library will be closed.” Carried.

CHAP. XIII. *Admission Fee and Annual Contribution.*

4. . . . any Fellow elected after September will not be called upon for his Contribution for that year.

Proposal :—

Add “unless he desires to receive the Transactions of the Society for the year in which he is elected.” Carried.

CHAP. XIV. *Withdrawing and Removal of Fellows.*

2. . . . if a majority of the Fellows balloting shall vote that such Fellow be removed, he shall be removed from the Society.

Proposal :—

Before “majority” insert “two-thirds.” Carried.

Proposed new Chap. XVII. *Special Life Fellows.*

1. Fellows, being British Subjects, who have paid subscriptions as Ordinary Fellows for not less than fifteen years, and who in the opinion of the Council have rendered distinguished service to Entomological Science, may be elected Special Life Fellows, in the manner provided under Chap. XVI., § 1, for the Election of Honorary Fellows, and after election they shall be exempt from the payment of fees and contributions, and shall possess all the privileges of, and shall be subject to the same rules and restrictions as Honorary Fellows.

2. The number of Special Life Fellows shall not exceed twelve.

There was some discussion with regard to this proposed Bye-law, but on a show of hands it was carried almost unanimously.

[The insertion of this new chapter will necessitate the alteration of the numbers of the chapters from the present XVII. onwards.]

CHAP. XVII. *Ordinary Meetings of the Society.*

1. The Ordinary Meetings of the Society shall be held on

the first Wednesday in each month (except January, July, August and September).

Proposal :—

Add “ and on the third Wednesday of March, October and November.” Carried.

2. At the Ordinary Meetings the order of business shall be as follows :—

Proposal :—

After “ Meetings ” add “ unless otherwise announced by the President or Chairman.” Carried.

3. The Presents made to the Society since the last Meeting shall be announced and exhibited.

Proposal :—

For “ The Presents ” substitute “ Donations ” and delete “ and exhibited.” Carried.

7. Entomological communications shall be announced and read either by the Author or by one of the Secretaries.

Proposal :—

After “ Author ” add “ or by some other Fellow deputed by him.” Carried.

CHAP. XIX. *Annual Meeting.*

3. . . . The list [prepared by the Council] shall include the names of not less than twelve Fellows recommended as ordinary members of the Council.

Proposal :—

Delete “ not less than.”

There was some discussion on the reason for this change and on the working of the present arrangement, but the proposal was carried without a division.

4. The list prepared by the Council shall be read at the Ordinary Meeting next but one before the Annual Meeting. At the Ordinary Meeting preceding the Annual Meeting, the

names of other candidates to fill any of the offices, or to serve as Members of the Council (each proposed and supported by at least four properly qualified Fellows of the Society), shall be received. Nominations by post made by four properly qualified Fellows, and received prior to this Meeting, shall also be accepted. These shall be added to the Council's list, and copies of the complete list shall, before the 20th December, be transmitted to every Fellow whose last known residence shall be in the United Kingdom, and who shall have paid his subscription for the current year.

Proposal :—

1. 2. At the end of the line add " and a copy sent, not less than seven days before the December meeting, to every Fellow whose last known residence shall be in the United Kingdom."

1. 9. For " These " read " Any such names."

1. 10. For " copies " read " a copy," and for " 20th " read " 31st."

All these proposed alterations were carried.

Proposed new sections 5 and 6 :—

5. If no more than the number of Fellows required to fill any Office or to form the Council shall have been nominated, the President shall at the Annual Meeting declare them to be appointed, and no second list shall then be issued.

There was a good deal of discussion on the wording of this section; eventually Dr. LONGSTAFF proposed that after the word " nominated " it should read :—

" . . . no second list shall be issued, but the President shall at the Annual Meeting declare the Council's nominees to be appointed."

This was seconded by Mr. KAYE and carried.

6. Where nominations shall have been received in addition to those upon the List prepared as aforesaid by the Council, then the Election shall proceed as hereafter appointed, but such Election shall only be held in respect of any Office or Position to which more than the required number of Fellows shall have been nominated; and the second List shall contain

in alphabetical order the whole of the nominations, original and supplementary, for such Office or Position only. Carried.

[Change the numbers of the remaining Sections to 7, 8, 9, 10.]

5. The election shall be by Ballot at the Annual Meeting.

Proposal :—

After " Election " insert " if any be necessary." Carried.

CHAP. XXI. *Alteration of the Bye-Laws.*

Proposal :—

Add, " 2. In the event of any such alteration being made, a copy of the altered Bye-law or Bye-laws shall be issued with the last-published Part of the Transactions for the current year." Carried.

Ordinary Meeting.

Dr. C. J. GAHAN, M.A., D.Sc., Vice-President, in the Chair.

Election of Fellow.

Mr. CHARLES HANSLOPE BOCOCK, The Elms, Ashley, Newmarket, was elected a Fellow of the Society.

New Member of Council.

The Secretary announced that the Council had, in accordance with the Bye-laws, co-opted Mr. H. WILLOUGHBY ELLIS as a member of Council, in the place of the late Mr. G. MEADE-WALDO.

A NEW OBSERVATION CAGE.—Mr. H. MAIN exhibited a new observation cage for the study of earth-boring insects, especially *Geotrupes* species. The cage contained larvae of *Geotrupes spiniger*, nearly fully grown, resulting from ova deposited last November.

The CHAIRMAN inquired whether Mr. Main could throw any light on the stridulation of the larvae. Mr. Main said he was unable to do so, but that the ♀ imago certainly stridulated to call the ♂ to work at the burrow, and that if unsuccessful

in the attempt she went to the entrance of the burrow to fetch him.

In answer to a question by Dr. DIXEY as to the effect of light on the insects, the exhibitor said that the mere presence of light had no effect on them at all, but that sudden changes of light caused them to stop working.

FURTHER RECORDS OF *HYPOLIMNAS BOLINA*, L., IN MADAGASCAR.—Prof. POULTON exhibited further examples of this species from the same locality as the fifty-one shown by him last year, and described in tabular form in our Proceedings (1915, pp. lxi–lxiii). Thirty-four males and five females collected in 1915 at Ambinanindrano, Mahanoro, east coast, and kindly sent to Oxford by Archdeacon Kestell-Cornish were shown to the meeting, together with nine males and six females from the Tring Zoological Museum, kindly lent by Lord Rothschild. These latter were collected (1911–14) in the same locality, and all except one by Archdeacon Kestell-Cornish. The exception, a female, was taken 1913–14 by the Rev. H. Gedge.

Some of the butterflies showed obvious indications of attack by enemies, the clearest being a female (March, 1912) and a male (June 10, 1915) with a part of the left hind-wing torn away along a straight line, which retained the mark of a bird's bill. The wing had evidently been seized from behind, and the female showed, at the deepest point reached by the injury, the impress of the bill-tip. The beak was thus shown to be long and narrow, and Mr. Ogilvy Grant had suggested that it may have been that of the Madagascar Roller *Uratelornis chimaera*, Rothsch. Both hind-wings of a male (Sept. 4, 1915) were marked with a number of roughly parallel scratches probably caused, as suggested by Dr. G. A. K. Marshall, by the feet of a large Asilid fly.

The specimens exhibited to the meeting are tabulated and the seasonal forms of the males described on page xxii.

Archdeacon Kestell-Cornish had kindly written, Dec. 26, 1915, giving a general account of the climate of Ambinanindrano :—

“ I do not know whether our seasons are sufficiently marked

	Females.	Males.	Seasonal form of Male.
1911: Jan.	1		
" May		1	Dry side of Intermediate.
" Sept.		1	Dry.
" Dec.	1		
1912: Mch.	2	1	Wet.
" Apr.		4	2 wet ; 2 intermediate.
" Sept.		1	Intermediate.
" ? Month		1	Wet side of intermediate.
1913: Jan. 8 to 1915: Feb. 11	12 (Also, at Tring 1—Feb. 1913; 1—1913- 14.)	39	Described in Proc. Ent. Soc. Lond., 1915, p. lxii, where exact dates are recorded.
1915: Feb. 24		1	Nearly full wet.
" " 26		1	Wet.
" " 27		1	"
" Mch. 2	2		
" " 4		2	Wet.
" " 17	1		
" " 24	1		
" Apr. 10		1	Wet.
" June 10		2	Wet—1 not quite full wet.*
" July 7	1		
" " 15		1	Intermediate.
" Aug. 13		1	"
" Sept. 4		1	Nearly full dry.
" " 13		1	Dry.
" " 18		1	Wet—probably not quite full.
" " 29		3	2 dry † ; 1 intermediate.
" Oct. 17		2	Dry. †
" " 26		1	"
" " 28		2	"
" Nov. 7		2	Wet—1 not quite full wet.
" " 12		2	1 intermediate ; 1 nearly full wet.
" " 22		2	1 dry ; 1 nearly full wet.*
" Dec. 1		2	Intermediate—1 on wet side.
" " 5		2	1 dry ; 1 dry side of intermediate.
" " 16		2	Wet.
" " 29		1	"
TOTALS	23	82	

* White bar crossing hind-wing underside narrower than in the typical wet form.

† One example with fore-wing underside as in wet form. The chief differences between wet and dry forms are, however, found on the hind-wing underside.

down here to warrant the theory of the wet and dry forms of *H. bolina*, but as soon as I got your last letter I began looking out for a rain-gauge, and have had one going for a few weeks, so in time I shall be able to give you accurate information. At present I should say that the following is a pretty fair description of our climate as regards rain. Jan., Feb., March, April—wet; May—fine; June, July—wet; August—wet, but with fine intervals; Sept., Oct., Nov.—fine; Dec.—wet, but chiefly in the evenings and nights. Rain has fallen on 17 of the 25 days of this month, and the total rainfall for these days is 5.565. At the same time the days are beautifully sunny until late in the afternoon, and there are plenty of butterflies about. Thunderstorms are fairly frequent from now till the end of February, and it is in these three months that we get the heaviest rainfalls. In June and July the rain is much more like that in England—not very heavy but continuous, sometimes for a fortnight, with intervals of not more than a few hours at a time. I thought I had answered your question as to the date when I first saw *H. bolina*. I sent the first specimens I caught to Tring, and the date was marked on the envelope. I should say it was in 1912, though it might have been a little earlier. [The first date is Jan. 1911.] For some time I took the butterflies for *H. misippus*. I think it would be fairly safe to say it was not before 1911 that they appeared at Ambinanindrano. The female is still extraordinarily shy. I don't think I have seen more than 3 or 4 specimens since I came out this time; whereas the male is always *en évidence*."

The specimens were sufficiently numerous and had been observed long enough to make it worth while to tabulate the seasonal forms of the males according to the months. Two examples out of the 82 were omitted because of insufficient data. The seasonal forms of the specimens had been determined from the patterns, especially of the under surface, before Prof. Poulton had received information upon the climate of Ambinanindrano.

In the following table W stands for "wet season form"; W— for "nearly full wet"; I for "intermediate"; I—W and

I D for "wet" and "dry side of intermediate," respectively;
D— for "nearly full dry"; D for "dry."

Month.	Climate.	1911.	1912.	1913.	1914.	1915.
Jan.	Wet			3 W		1 W 2 W—
Feb.	"			1 W		2 W 1 W—
Mch.	"		1 W	2 W		2 W
April	"		2 W 2 I			1 W
May	Dry	1 I—D				
June	Wet					1 W 1 W—
July	"				1 I—W	1 I
Aug.	Wet (Dry intervals)				1 D	1 I
Sept.	Dry	1 D	1 I		1 I 1 D	1 W— 1 I 2 D— 2 D
Oct.	"				1 W— 4 I 3 D	1 D— 4 D
Nov.	"				5 W 2 W— 1 I—W 1 I 1 D	1 W 3 W— 1 I 1 D
Dec.	Wet				5 W 2 W—	3 W 1 I—W 1 I 1 I—D 1 D
TOTALS		2	6	6	29	37

The seasonal forms of the males, as shown in the above table, were concordant with the climate of the locality, especially in the early half of the year when the full dry pattern was altogether wanting. On the other hand, wet and intermediate forms occurred mixed with the dry in the dry months, and in the last of these, November, wet forms strongly predominated. Before arriving at safe conclusions it would be necessary to compare the Indian climate and seasonal forms of *H. bolina* with the above table. Prof. Poulton wished to draw attention to a slip in the following sentence on p. lxi of the 1915 Proceedings. "A clear succession from the wet

(Aug.-Nov.) to the dry forms (Nov.-Mch.) was shown in the table on p. lxii." The words "wet" and "dry" should be transposed in this sentence.

It was interesting to compare these Madagascar specimens, so closely similar to the Indian, with examples from Fanning Island in the central Pacific. Two males, and two females, kindly presented by Mr. J. H. Watson and exhibited to the meeting, showed a considerable approach of the female towards the ancestral non-mimetic pattern of the male. The underside was "wet," but differed in the unusual predominance of chestnut brown in the ground-colour.

OBSERVATIONS ON VARIOUS INSECTS IN N. QUEENSLAND BY MR. F. P. DODD.—Prof. POULTON said that in the spring of last year Mr. Dodd had sent him a number of interesting observations together with examples of the species on which they had been made. He now brought forward some of these observations and showed the insects concerned, hoping to deal with the remainder in the near future. The following notes were written by Mr. Dodd. Prof. Poulton had only added a few determinations and the sentences enclosed in square brackets. Except where otherwise stated the species were from Kuranda, N. Queensland.

1. *Hissing sound made by a Sphingid moth*.—The Sphingid sent [*Psilogamma menephron menephron*, Cram.] is close to *Macrosila casuarinae* [a synonym of the variable *menephron*], which squeaks by rapidly moving the terminal segments of the abdomen. Is that how your Death's-head squeaks? The insect forwarded is really a champion squeaker, or hisser. We have heard it and the other species when in the net or being bottled, but one that came into the room one night made an extraordinary hissing as it dashed excitedly about, the noise being a long series of rapidly given short hisses, more than squeaks, made practically as loudly and as quickly as a man could make them. [*A. atropos* squeaks by drawing in and expelling air through the short proboscis, as may be easily proved by dipping the end in water, when all sound ceases instantaneously. If the water be held in a narrow tube its level will be seen to rise and fall as it is drawn in and expelled. It would be very interesting to test

the Australian hawkmoths in this way, dipping various parts of the body in water.]

2. *Panacra splendens*, Rothsch. (*automedon*, Misk.), trapped in a flower.—This Sphingid and *Troides cassandra* are often so trapped, and once I released *Macroglossum hirundo*. So far I have noticed only worn examples victimised. Flowers white, leaves large and glossy green, fruit much larger than a cricket ball and are rubber-producing. [Dr. O. Stapf, F.R.S., who kindly examined the flower, identifies it as belonging to the *Apocynaceae* and the genus *Rejoua* (= *Tabernaemontana*, auct. in part). He has not been able to find the species, which may be new.]

3. The Buprestid beetle *Stigmodera regia*, Blackb.—My friend, A. M. Lea, who was here, almost laughed when I stated my determination to publish the note on "A beetle that takes in ballast" (Proc. Roy. Soc. Q'land, vol. xxiv, p. 103). I challenged him to advance a better explanation than mine of the sand-absorbing habit. Though he is a splendid man on descriptions, I require the opinion of a more experienced all-round field-observer to induce me to alter my views, ever so slightly, on the subject. I would be glad to know what your opinion is.

I am sending two ♀ *Stigmodera regia*, and, if I can find it, the fine earth taken from another ♀, also a Bombylid fly [*Hyperalonia funesta*, Walk.] which I captured in the act of dragging the abdomen in a dusty path. After eviscerating this insect (to satisfy myself that earth *is* taken up by these flies) I spread the body contents, as removed, upon paper, which is sent with the fly.

[The contents of the fly, treated with hydrochloric acid, and examined under the microscope by Dr. Eltringham, showed the presence of abundant crystalline mineral fragments, probably siliceous. The abdomen of one female *Stigmodera* was examined, and, although stuffed with cotton-wool, was found to contain similar fragments at the posterior end. Dr. Eltringham, who made the dissection, prepared a photomicrograph of the fragments, which was exhibited to the meeting. The facts support the conclusions drawn by Mr. Dodd and his sons; but it is much to be hoped that speci-

mens may be sent preserved in spirit, so that careful dissections may be made and the sexes compared. Mr. Dodd states in the paper already referred to that in the Kuranda and Herberton districts he and his sons had often found females of this large Buprestid on the ground where there was dry dust or fine sand, and always on hot days. In removing the contents of the abdomen he "often noticed and removed two or three little sacs of fine sand at the extreme tip of the abdomen, but only in the females, invariably in those examples which were rather old and contained but few eggs." The movements and position of the females on the ground also suggested that they were drawing up the dust. Mr. Dodd considers that the ballast enables the beetle, when its body has become light from loss of eggs, to fly steadily in the violent gusts of the hilly country which it frequents.]

4. *Two Pentatomid bugs which stay with their ova and larvae until they have grown considerably.*—The larvae of the larger species [*Garceus fidelis*, Dist.] shelter upon the underside of the abdomen of their parent. I have not often met with this bug, but when I did come across a mother with young they were never on the leaf, though I suppose they come down to feed. The specimen of the smaller species [*Eumecopus* sp.] is from the Cairns district.

5. *The Reduviid bug Ptilocnemus lemur*, Westw.—The use of the brush-like legs has lately been made plain to me. The insect keeps under cover, but, if obliged to wander, works its hind-legs in such a way as very well to pass muster for a wasp that frequently raises and lowers its wings when running.

6. *Variation in Lucanid beetles.*—We have taken *Aegus jansoni*, Boil., from sappy clefts in trees, in company with very small and somewhat different-looking examples, which Lea has made another species of, viz. *A. subbasalis*, though we informed him that we generally took the two together. I should imagine that a Lucanid would scarcely tolerate a strange species in the same hole. Look at *Neolamprina mandibularis*, Macleay, big ♂s with normal or elongated jaws, little fellows *always* with short ones, and ♀s blue, bronze, or bronze-green, all on the same small tree. The diminutive

♂s are occasionally smaller than the average ♀. These size differences in the ♂ also occur in *Xylotrupes*. In *Phalacrognathus muelleri*, Macleay, we often get the lengthened jaws in the larger ♂s, sometimes only in the medium, and never in the small ones. Again, we get nearly black examples in the medium and large ♂s, but never in the small. Two specimens are forwarded in illustration.

NEST-BUILDING INSTINCTS OF BEES OF THE GENERA *OSMIA* AND *ANTHIDIUM*.—Prof. POULTON said that he had received from Dr. R. C. L. Perkins the following letter, dated Nov. 15, 1915, together with the specimens referred to and exhibited to the meeting:—

“ I am sending a nest of *Osmia bicolor*, Schk., and two females of the bee. You may like to exhibit it at the Entomological Society and afterwards keep it in the Hope Department. Many years ago my uncle, V. R. Perkins of Wotton-under-Edge, Gloucestershire, described how the ♀ *O. bicolor*, having stored its cells in an empty snail-shell, covers this over with pieces of ‘bents’ or dry grass-stems. I have noticed his account quoted in various works.

“ I have myself caught the bees carrying the grass-stems, and found the nests, as he describes. The nest I send was found May 20, 1915, on the edge of a beech-wood near Wotton, and the ground was nearly bare. The snail-shell was in a slight depression, and the material of the nest entirely concealed it. This material consists for the most part of the brown scales that drop from the beech-twigs in the spring-time. The bee had practically completed the nest when it was found, but was still fussing about it and tucking in a piece here or there, and now and again bringing a fresh piece. She was very old and worn and had considerable difficulty in flying with a piece of material, owing to the strong breeze, to which the nest was exposed, and her torn wings. This was in the morning. In the afternoon she had disappeared, having, no doubt, quite finished her work.

“ The two bees sent are, therefore, neither of them the maker of this nest; the one fresh example (dated) was caught on the same day, but the other with the piece of grass-stem, that it was bringing to a nest, at another time. The latter’s

nest was on a hillside and was formed of grass, as my uncle described.

“ The snail-shell contains the cells formed by the individual that made the nest sent ; from this bees may be bred next April.

“ In preserving nests of this kind, as also the brittle tubular structures formed by *Odynerus*, I use a dilute solution of the gum employed by Coleopterists for mounting beetles. For a nest like that of *Osmia* it is most easy to reach all parts with a syringe. This gum dries quickly on a hot day, and the nest can be carefully removed without breakage after this treatment. After one gets home one can apply a stronger solution of the gum at leisure. Except that the nest has settled down a little from the wetting, it is practically in the shape in which it was found. I am unable to suggest any certain use of the heaped-up material that covers the snail-shell. The nest sent would almost certainly have been blown or washed away in heavy storms. While intact, it certainly hides the shell beneath it, but it is itself more likely to attract the attention, than an old empty shell would be ! ”

Mr. A. H. Hamm had also observed *Osmia bicolor* covering snail-shells with beech-scales, and also with grass. His observations are recorded below :—

“ In the spring of 1893 I was resting on the grassy slope just outside Hardwick Wood, near Mapledurham, Oxon., when I noticed a small red and black bee carrying one of the brown scales that drop from the buds of beech. I watched it, and saw to my surprise that it added its burden to a little mound of similar brown scales. Then, sitting down within a foot or two of the mound I continued to watch the bee's movements as it kept picking up the scales and placing them with the others. Its journeys were very frequent, and were made quite close to the edge of the wood where the scales lay thick on the ground. Looking further afield I saw several other bees of the same kind doing exactly the same thing. I then lifted up one of the mounds and to my surprise found that it covered an empty shell of *Helix nemoralis*. Several other mounds were examined with the same result. At the time I did not know the name of the bee, but a year or two later ascertained that it was *Osmia bicolor*, Schk.

“ Near Oxford I have only once seen *Osmia bicolor* covering the shell (*Helix arbustorum*) that contained its nest, and that was in Bagley Wood, Berks., on June 10, 1905; but, on this occasion, small, short pieces of grass, and not beech-scales, were piled up in much the same way so as to form a mound. This bee I caught and also brought away the shell, which the following spring I sectionised and endeavoured, but without much success, to photograph.”

The double instinct of nidification in an empty snail-shell and then covering up the shell was of great interest, and it was desirable to recall Mr. V. R. Perkins' original discovery, so that its details might appear side by side with the abundant confirmation provided by Dr. R. C. L. Perkins and Mr. Hamm.

Mr. V. R. Perkins described in Ent. Monthly Mag., vol. 21, 1884, p. 38, how on May 28 on the dry slope of a hill near Wotton-under-Edge he saw a female *Osmia bicolor* which was—to continue in his own words—“ coming towards me carrying in her jaws a bit of dry bent some four inches long, holding it in the middle, just exactly as an acrobat would carry a balancing pole to steady himself.” He then saw many other bees similarly engaged. “ They would settle down momentarily on the ground, seize hold of a short bent, and start away with it in the direction of the wood below.” The same day Mr. Perkins found the bee making its nidus in the shell of *Helix nemoralis*, and he was therefore inclined to doubt whether the grass-bent-carrying instinct was connected with nidification. A little later in 1884 the observations were confirmed by the same naturalist, and recorded on pp. 67, 68 of E.M.M. vol. 21; but it was not until May 6, 1891, that he was able to solve the mystery (E.M.M., vol. 27, 1891, pp. 193, 194). Here Mr. Perkins described how he made the discovery by noticing a peculiar little pile made up of bents like those carried by the bees. He took it up in his hand and found under it a *Helix* shell full of the cells of the *Osmia*. On May 7 he returned to the spot and watched the process of building :—“ I was close enough to take it up if I wanted to, but the bee came with her load, perfectly indifferent to my presence, and deposited it in her own peculiar way and to her own satisfaction, and then went away for another; she worked hard, and brought

them in rapidly one after another; with each one she would alight on the top of the mound, then look round, walk over it, and with her jaws push one of the ends into the heap where she wanted it to remain, and so fix it; as soon as she was satisfied with its position off she went for another, brought it in, and did exactly the same, every bent was put in its proper place, and she never laid one simply down on the top while I watched her.

“These nests very much resemble those of *Formica rufa* in miniature, they are from four to six inches round the bottom, and are from two to three inches high, so that they are very easily detected when you once know what they are, and the labour spent upon them must be very great, for there are hundreds of bents in each, and each one is brought and added separately. I found some dozen or more, all within a short distance, and three so close together that I could watch the proceedings of them all at the same time.”

Up to the present time there had been no record of the manner in which the bee obtains the pieces of grass—by picking up loose stems or by cutting them off.

Mr. V. R. Perkins considered that the object of the instinct was to hide the nest “both from the sun’s rays, and from any birds, mice, insects, or other enemies that might chance to come across it.” Prof. Poulton hoped that naturalists would keep a watch on such nests together with others from which the covering had been removed. In this way it might be possible to determine the meaning of the adaptation and the enemies against which it was directed. Dr. Perkins believed that *O. bicolor* was the only British species which hides the shell it uses.

It was of great interest to bring together, so far as possible, all that is known about bees using old snail-shells; and the Rev. F. D. Morice had kindly selected from his collection nearly all the species in which he had been able to find records of the instinct. These bees, brought for exhibition to the meeting, were the species in the following alphabetical list whose names are immediately followed by the locality and date at which they were captured by the ex-President. The notes of the following Hymenopterists were indicated by their

initials—Mr. Morice (F. D. M.), Dr. Perkins (R. C. L. P.) and Mr. Hamm (A. H. H.). The numerous fine observations of Ferton were very kindly obtained by Mr. Morice from the “Actes de la Sociét. Linnéenne de Bordeaux,” 1891, 1893, 1894, 1896 and 1897, and the “Ann. Soc. Ent. France,” 1901 and 1908. Hence the date, accompanying each of Ferton’s records, gave the reference to the original publication.

Species of Osmia which are known to nidificate in empty shells.

1. *Osmia andreoides*, Spinola (Algeciras, near Gibraltar : Apr., 1905). “Very common in Central Europe and Mediterranean districts. F. D. M.” Shell-using instinct on the authority of Fabre, and also of Ferton who (1894) has found the species in a *Helix* of the group of *pisana*, and states (1908) that it utilises small species of *Cyclostoma* and *Helix*.

2. *Osmia aurulenta*, Panz. (Eleusis, near Athens : May 1, 1912). One of the commonest British species having the instinct. Recorded in 1844 by F. Smith under the synonym of *tunensis*, Kirby (“Zoologist,” vol. ii, 1844, p. 405). Smith here quotes Mr. Walcott of Clifton, Bristol, for *Osmia bicolor* and *tunensis* breeding in empty snail-shells on the downs, and also states that Mr. Curtis had captured *O. bicolor* in snail-shells. On p. 609 he adds that the shells were *Helix nemoralis* and *aspersa*, and states that *O. tunensis* also excavates burrows in old posts.

Ferton (1893) has seen this species, “so faithful to the shells of the genus *Helix*, abandon them for a fossil *Paludina* in a better situation.”

“I have only found it in snail-shells and on the Devonshire coast at Slapton in the large shells of the whelk! The shells were on the beach, and sometimes not properly clean! The whelk-shells used by *aurulenta* were fully exposed to sun and rain after the cells were completed. When I saw the bee using snail-shells, on the other hand, the shells used were at the roots of the thick vegetation forming a dense hedge-row! R. C. L. P.”

This nesting in whelk-shells is recorded in Saunders’ book on Bignell’s authority, but it was Dr. Perkins who gave

Bignell his information and led him to go to Slapton on purpose to see the bee.

“Taken freely breeding in snail-shells on the sand-hills at Wallasey in 1855, Rev. H. H. Higgins; and similarly by Mr. J. T. Carrington some years afterwards” (Willoughby Gardner, “Hymenopt. Aculeat. of Lancashire and Cheshire,” Liverpool, 1901, p. 50).

“This species has been bred in numbers from old shells, chiefly whelk, found on the Wallasey sand-hills by Mr. G. Arnold. A. H. H.”

Also said by Smith to burrow in hard banks, and by Saunders (“Hymenopt. Acul. Brit. Isles”) in the ground.

3. *Osmia balearica*, Schmdkt. (Palma, Majorca). Snail-using instinct recorded by author.

4. *Osmia bicolor*, Schrank. (Veyrier, near Geneva: May 15, 1909). The commonest British species with the instinct.

F. Smith’s record (1844) of this species is quoted under *aurulenta*. He also states in “Zoologist,” vol. ii, 1844, p. 609, that he had seen *bicolor* “entering her burrow formed in the perpendicular side of a sand-pit at Gravesend.” See also *aurulenta*.

“*O. bicolor* ‘commonly burrows in banks’ (F. Smith), but I have only found its nest in snail-shells, which he apparently considered exceptional! R. C. L. P.”

See also pp. xxviii, xxix for the shell-covering instinct of this species.

5. *Osmia cyanoxantha*, Pér. (Corfu: June 1, 1901). “A rarity. Instinct on authority of Fabre. F. D. M.”

6. *Osmia exenterata*, Pér. “A *Protosmia* and the link between *Osmia* proper and *Heriades*. F. D. M.” Ferton (1894) received from Bizerta a shell of *Bulimus* [*Stenogyra*] *decolatus*, containing 2 ♀♀ and 3 ♂♂ of this species.

7. *Osmia ferruginea*, Latr. (Algiers: Apr. 20–28, 1898). “This species is identical with *igneopurpurea* of Costa. S. Europe and Algeria (not rare). F. D. M.”

The associated snail-shell collected with the bees by the Rev. F. D. Morice was identified by Mrs. G. B. Longstaff and Mr. G. C. Robson as *Helicella* (*Helix*) *virgata*, Da Costa, var. *alba*, Taylor. The shell was unfortunately imperfect.

Ferton (1897) records that this species uses all kinds of shells, big and small (*Helix vermiculata*, *H. corsica*, *Bulimus* [*Stenogyra*] *decollatus*, *Cerithium provinciale* and *Trochochlea articulata*). He also states (1901) that it sometimes uses shells lying quite in the open on sand. He has not seen the work to the end, but does not believe that it buries the shells—it is not big enough! It, and *versicolor* too, often put many eggs into one shell, each in a separate enclosure. There may be as many as seven in one shell.

8. *Osmia fertoni*, Pér. Ferton (1891) records that this species chooses a shell of *Helix acompsiella*, or *Helix pisana*, lying often quite in the open and mouth upwards, and builds in it two or three mud cells, afterwards plugging up the opening (with or without an empty chamber left below the plug) by a plate about 2 mm. thick, also made of hardened mud, so that in spite of the position of the shell water cannot lie on it to any depth. Then it leaves it to its fate, and the night-dews merely re-moisten the mud and close any cracks, etc., that the sun has made in it by day.

9. *Osmia fossoria*, Pér. Ferton (1901) records that this species nidificates in shells of *Helix pisana* var. *minor* and afterwards digs a hole in the sand and buries the shell in it. It digs slowly and with difficulty, carrying out the sand an armful at a time, held between its chin and its fore-legs. Then it rolls the shell "like a barrel" to the hole, tumbles it in, and covers it up a centimetre to a centimetre and a half deep. It fills the hole nearly to the brim with sand, but takes no trouble to conceal it further. ("Les blocs éboulés sont laissés tels quels; pas de coup de rateau, pas d'apport des matériaux, brins de paille ou autres," etc.)

It digs unskilfully (Ferton suggests that it has only learnt this work recently. No other *Osmias* are "Fossors"); but it does the rolling-job magnificently, sometimes removing the shell over many obstacles to a suitable place 15 centimetres or more away, where the sand is free from roots, etc. It stands on its head against the shell and pushes it along with its front and middle legs.

10. *Osmia ligulicornis*, Friese (Jaffa, E. Mediterranean: Apr. 22, 1909). "Using small shells on the sea-shore at

Jaffa, accompanied by (parasite) *Chrysis osiris*, Buys. *Vide* Tr. Ent. Soc. Lond., Dec. 31, 1909, p. 468: *ligulicornis* was spoken of as a 'n. sp.' The Chrysid had been taken before by Abeille du Perren in Egypt, also in snail-shells occupied by another *Osmia*, viz. *l'hotellieri*, Pérez, which likewise occurs at Jaffa ('Mémoires' of Ent. Soc. Egypt, 1908, p. 38). F. D. M."

11. *Osmia rufa*, L. "The commonest British *Osmia*, using all sorts of suitable cavities: pipes, key-holes, locks, flutes, etc., have been recorded. Also in dead tree-trunks, posts, rails, etc., and in the mortar of walls (nail-holes) or in mud-walls. 'Cliffs and sand-banks' *vide* Smith. Said to have been found in shells of *Helix nemoralis*, *hortensis*, and *pomatia* in France, but I don't think it has been recorded from snail-shells in this country. R. C. L. P."

"The most variable British *Osmia* in choice of situation for its nidus. I have found it in holes in posts and occupying key-holes: a common site is the small lead overflow pipe from the water cistern, which is a frequent source of annoyance. If the bore is too large the bee will line it with mud to bring it to the required size. When finished the end is always well stopped with mud. A. H. H."

Saunders includes snail-shells among the objects in which the species builds ("Hymenopt. Acul. Brit. Isles").

12. *Osmia rufigastra*, Lep. (Algiers: Apr. 30, 1898). "Lepell. de S. Fargeau says ('Hist. Nat. Ins.,' II, p. 324), 'Cette espèce est encore une de celles qui font leurs nids dans des coquilles.' He says also (p. 322) of *O. tunensis*, 'une de celles qui font dans les coquilles du genre hélices les nids que nous avons décrits dans l'histoire des gastrilégides,' *i. e.* on p. 303 of this same vol. II, 'Hist. Nat. Ins.' (Suites à Buffon). F. D. M."

13. *Osmia rufohirta*, Latr. (Corfu: Apr. 22, 1901; Chiusi, Central Italy: May 7, 1908). "The Chrysid *Chrysis dichroa*, Dhlb., often occurs with *rufohirta* in snail-shells. *Rufohirta* is one of the commonest and most widely distributed species on the Continent, but is not British. F. D. M."

The associated shell from Corfu was identified by Mrs. Longstaff and Mr. Robson as *Pomatias (Cyclostoma) elegans*, Müller.

Ferton (1894) has found a number of *Helix ericetorum* and *carthusiana* containing each a single cell occupied by an adult *O. rufohirta*. At Marseilles he saw a *rufohirta* roll a small empty shell of a *Helix* sp. (? *Xerophila* group) to a large tuft ("touffe") covered with dead leaves, etc., 2·20 metres off. On the way it took half an hour's rest. Reaching the tuft, it surmounted with difficulty all sorts of obstacles, stones, sticks, leaves, etc., till it reached a suitable spot; then it carefully turned the shell mouth downwards, and retired for a rest before proceeding to clean and provision the shell. It was hidden two centimetres deep under a pile of leaves, in which was left an opening equal to about the diameter of the shell, making communication between the hiding-place and the world outside. On the other hand, Ferton records (1897) that the species, which is common at Bonifacio, does not generally behave like the individual observed above at Marseilles, but as often rolls shells *after* provisioning them. It utilises *Cyclostoma elegans*, also (at Poitiers) *Helix cyzicensis*.

14. *Osmia spinulosa*, Kirby (Swanage: July 20, 1900). "H. M. Hallett has very lately recorded finding this sp. in a snail-shell (I believe in Trans. of the Cardiff Ent. Soc.). F. D. M."

15. *Osmia (Protosmia) stelidoides*, Pér. "A *Protosmia* like *exenterata*. F. D. M."

Ferton (1908) states that this species nidificates in a *Helix*, at Tebessa, Province of Constantine, Algeria.

16. *Osmia tricornis*, Latr. (Nimes, S. France: May 6, 1910). "Common in S. Europe. Instinct on the authority of Fabre. F. D. M."

17. *Osmia versicolor*, Latr. (Island of Zante: May 21, 1901). "*Viridana*, Moraw. (cited by Fabre), is considered by Ducek to be a var. of *versicolor*, but Ferton emphatically denies this. F. D. M."

Ferton (1901) states that this species utilises the big shells of *Bulimus [Stenogyra] decollatus*. It does not roll these about (being far too large), but is content to choose a shell more or less hidden already, for example, in a crack or a tuft of grass.

Species of Anthidium which are known to nidificate in empty shells.

1. *Anthidium bellicosum*, Lep. (Montserrat, near Barcelona, July 9, 1904). "Not very common. Instinct on the authority of Fabre. F. D. M."

Ferton records (1901) that it uses the large shells of *Bulimus* [*Stenogyra*] *decollatus* in the same manner as *Osmia versicolor*.

2. *Anthidium septemdentatum*, Latr. (Delphi, Greece : May 12, 1912). "Abundant all over Continent and in N. Africa. Instinct on authority of Fabre. F. D. M."

Ferton (1908) has seen this species in July closing its nest in *Helix vermiculata* "cachée dans le pied d'une touffe," at Bonifacio.

3. *Anthidium sticticum*, Lep. (Narbonne, S. France : Apr., 1903). "Very common in snail-shells in Algeria. F. D. M."

The specimen from Narbonne was accompanied by a shell determined by Mr. G. C. Robson as probably *Iberus* (*Helix*) *carseolana*, Fér. The shell still contains a bee.

Vespidæ which nidificate in empty shells.

Ferton (1901) also records that certain solitary Wasps occasionally nidificate in snail-shells, viz. *Odynerus gallicus*, Sauss.; also *Odynerus mauritanicus*, Lep., in *Helix candidissima* var. *major* (Ferton received specimens from Mecheria, Province of Oran, Algeria).

A few years earlier (1896) Ferton published the following records of species of *Odynerus* :—

Odynerus alpestris, Saussure, utilises by preference *Helix* "of the group *candidissima*." Ferton has obtained it himself from *Cyclostoma sulcatum* (conical shells), *Helix aspersa*, *Helix aperta*,—a broken shell being chosen. Entire, it would have been inconveniently large, unless the inner part only were used.

Odynerus abdelkader, Saussure, an Algerian species obtained once only from *Helix cyzicensis*.

Odynerus crenatus, Lep. Two males obtained from *Helix aspersa* at Toulon, France.

Fabre's charming notes on the nidification of *Osmia* and

Anthidium have not as yet appeared in this country, and as it seemed very desirable to place them beside the observations of Ferton and the English Hymenopterists, Mr. E. A. Elliott had kindly prepared the following translation:—

J. H. FABRE, "SOUVENIRS ENTOMOLOGIQUES," 3me serie,
1866, pp. 341 et. seqq.

(N.B. The specific names are mostly French translations of the Latin names, and are here given in French. The scientific names have been added by the Rev. F. D. Morice.)

Les Osmies.

The author mentions the use made of the great *Arundo donax* for fences, sheltering gardens, etc., against the mistral, and for trays used for breeding silkworms. He mentions his unsuccessful search for *Osmia* nests in the vertical reeds, and explains that these would expose the nests to wet from rain entering the open end and disintegrating the clay stopper. He then states that *Osmia tricorne* [*Osmia tricornis*, Latr.] utilises any such hollow reeds when found in the horizontal position.

"Other localities suit *Osmia tricorne*, which appears to me willingly to accommodate itself to any place of concealment, provided that it satisfies the requirements of width, solidity, hygiene and quiet obscurity. The most original dwelling I know of is in old shells of snails, especially of the common *Helix aspersa*. On the slope of hills planted with olive-trees, let us visit the little retaining walls, built of dry stone and facing south. From the crevices of the tottering masonry we may collect old snail-shells, filled with earth to the level of the orifice. The family of *Osmia tricorne* is established in the spiral of these shells, subdivided into chambers by partitions of clay.

"Let us examine the piles of small stones, especially those resulting from the labours of the stone-breakers. There frequently the Field Mouse has established himself, and on a couch of green sward, nibbles acorns, almonds, and stones of the olive and apricot. The rodent varies his diet; to oily

and farinaceous food, he adds the snail. When he has left, there remains under cover of the stones, mixed with the remnants of his other victuals, an assortment of empty shells, sometimes so numerous as to remind me of the piles of snail-shells, which, having been prepared *aux épinards* and eaten according to the ritual of the country on Christmas Eve, are next day thrown out by the housewife outside the barn. Here is, for *Osmia tricornis*, a rich collection of apartments, of which it does not fail to take advantage. And even if the conchological museum of the Field Mouse is wanting, these same stones serve as a refuge for snails which live and die there. So, if we see *Osmias* entering the crevices of old walls and piles of stones, their occupation is evident; they exploit, for apartments, the dead snails in these labyrinths.

“ Less widely distributed, *Osmia cornue* [*Osmia cornuta*, Latr.] may also be less industrious, that is, less rich in the variety of its establishments. It appears to disdain empty shells. The only dwellings I know of are the reeds of the trays and the forsaken cells of *Anthophora à masque* [*A. fulvitaris*, Brullé, of which *personata* is a synonym].

“ All the other *Osmias* whose nidification is known to me, work with a green cement, a paste of chewed-up leaves; also all, except *Osmia de Latreille* [*Osmia latreillei*, Spin.], are destitute of the corniculate or tuberculate armature possessed by the kneaders of clay. I should much like to know what plants are used in the preparation of the cement; probably each species has its preferences and its little professional secrets; but up to the present my observations have revealed nothing of these details. By whatever worker prepared, the cement has always the same appearance. When fresh it is always of a distinct dark green. Later, especially where exposed to the air, it turns to the colour of dead leaves, to brown or earth-colour, no doubt owing to fermentation, and its origin from leaves becomes unrecognisable. The uniformity of the material for the chambers must not lead us to suppose uniformity of dwelling; on the contrary, this varies greatly in different species, with a strong predilection, however, for empty shells.

“ *Osmia de Latreille* [*Osmia latreillei*, Spin.], in company

with *Osmia tricornis*, exploits the vast constructions of *Chalicodome des hangars*. [Not *Chalicodoma muraria*. The species meant is said elsewhere by Fabre to be *C. pyrenaica*, Lep. = *pyrrhopezis*, Gerst.] It finds the superb cells of *Anthophora à masque* [*personata*, i. e. *fulvitaris*, Brullé] much to its liking; it gladly establishes itself in the hollow of recumbent reeds.

"I have already mentioned *Osmia cyanoxantha*, Pérez, which selects for its domicile the old nests of *Chalicodome des galets*. [This is *C. muraria* apparently. Fabre also calls it "Chalicodome des murailles. La Maçonne qui bâtit sur les galets." See p. 111 of the same volume of "Souvenirs."] Its closing plug is of a strong concrete, composed of pretty large bits of gravel embedded in the green paste; but for the interior partitions the cement alone is used. Since the door of the dwelling, situated in the curve of a dome which does not give any protection, is exposed to the inclemency of the weather the mother has to provide for its defence. The danger, no doubt, inspired this gravel concrete.

"*Osmia aurulenta*, Latr., absolutely demands dead snails for its dwelling. *Helix nemorale*, *Helix des gazons*, and, above all, *Helix chagrinée* (*H. aspersa*), with its more spacious spiral, distributed here and there among the herbage, at the foot of walls and rocks exposed to the sun, habitually furnish its dwelling. Its dried cement is a sort of felt abounding with short white hairs. It must come from some plant with downy foliage, perhaps a Borage, rich both in mucilage and in hairs suitable for its felt.

"*L'Osmie rousse* [*Osmia rufohirta*, Latr.] has a penchant for *Helix nemorale* and *Helix des gazons*, where I have seen it take refuge in April when the north wind blows. Its work is not as yet thoroughly known to me. It is probably very like that of *O. aurulenta*.

"The delicate *Osmia viridana*, Morawitz, lodges in the spiral staircase of *Bulima radiata*. It is very elegant, but very small, and the greater part of the dwelling consists of the green cement stopper. There is just enough room for two.

"*Osmia andrenoïdes*, Latr., so unique [*i. e.* in this genus; but here Fabre is not quite correct, for there are a few others],

with its naked, red abdomen, nests apparently in *Helix aspersa*, from whence I have taken it seeking shelter.

“*Osmia versicolor*, Latr., establishes itself in *Helix nemoralis*, almost at the bottom of the spiral.

“*Osmia cyanea*, Kirby [i. e. *Osmia caerulescens*, L.], appears to me to accept very varied lodgings. I have taken it from old nests of *Chalicodome des galets* [*C. muraria*], from galleries excavated in banks by *Colletes*, and from holes made by some unknown borers in dead willows.

“*Osmia morawitzi*, Pér., is not uncommon in the old nests of *Chalicodome des galets*, but I suspect it of having other lodgings.

“*Osmia tridentata*, Duf. et Pér., makes a dwelling for itself. With the point of its mandibles it bores a channel in a dry bramble, and sometimes in the elder [*Sambucus ebulus*]. To the green paste it adds a few scrapings of the excavated pith. Its methods are shared by *Osmia detrita*, Pér., and *Osmia parvula*, Duf.”

It would be of extreme interest to ascertain how far the shell-using instinct follows other characters and whether it is to be most reasonably explained by derivation from a common ancestor. Taking *Osmia* as a whole it is at present hopeless to attempt to estimate the proportions of the shell-using species, but of the ten British species we find in the above list records of the instinct in four. It is desirable to set down the nidification, so far as it is known, of the remaining six:—

1. *Osmia caerulescens*, L. “Posts, dead stumps, etc., and commonly in the mortar of walls and mud-walls. ‘Sometimes in hard sandbanks’ *vide* Smith. R. C. L. P.”

“Nests in old posts, choosing a ready-made hole, when available. A. H. H.”

2. *Osmia inermis*, Ztt. (*parietina*, Smith, Saund., etc.). “The cocoons of this species, according to Smith, are attached to the lower surface of stones which have a hollow space beneath them, he once had a stone with 230 cocoons under his observation, the bees from some of the cocoons did not emerge for three years after the stone was found” (Saunders, “Hymenopt. Acul. Brit. Isles,” 1896, p. 334).

“ ‘ Attaches little masses of pollen and honey to the under-side of a stone or slate lying on the ground and having a hollow space beneath ’ (Smith). A mountain or northern species, recorded as *parietina* by Smith. R. C. L. P.”

“ The true *Osmia parietina*, Curtis (nec Smith, etc.), is also a British species (*Vide* Edw. Saunders in Ent. Mo. Mag., Sept. 1906, p. 205). I have it, but do not know how it nidificates. F. D. M.”

3. *Osmia leaiana*, Kirb. (*fulviventris*, Auct. Brit.). Nidification similar to *caerulescens*. Dr. R. C. L. Perkins describes this bee as an inexpert leaf-cutter of old and yellow leaves.

“ The ‘ cutting rose-leaves in an irregular manner ’ which I recorded under *O. fulviventris* (i. e. *leaiana*) and suggested was a primitive state of the *Megachile* habit many years ago, is that described by Fabre in the passage beginning ‘ All the other Osmias, etc., ’ on p. xxxix. The portions cut out from the rose-leaves by *leaiana* were chewed up and formed the paste or cement between the cells. Fabre says when fresh it is ‘ always green, ’ but this could not have been the case with that of the bees I watched cutting and chewing the rose-leaves, as I particularly noticed they always choose the decayed or discoloured leaves, never green ones R. C. L. P.”

4. *Osmia leucomelana*, Kirb. “ Generally makes its cells in bramble stems, but last spring (May 1893), I found it rather freely, burrowing along the side of a sandy road on Woking Common ” (Saunders, p. 338).

“ In buried decayed wood; in dead stumps, or decayed wood above ground; in hollowed-out (dead) bramble stems. *Vide* Saunders in the ground (sandy), but when I have seen the bee go underground there has been decayed wood beneath the surface—often a root. R. C. L. P.”

5. *Osmia pilicornis*, Smith. “ Dead stumps, or detached pieces of dead wood lying on the ground, or in dead branches of growing trees. R. C. L. P.”

“ I once took a ♀ entering a hole in a piece of dead wood lying on the ground. A. H. II.”

6. *Osmia xanthomelana*, Kirby (*atricapilla*, Curtis). Most of the descriptions of the nidification of this species—perhaps

all—seem to have been derived from G. R. Waterhouse's observations near Liverpool in 1835 ("Zoologist," vol. ii, 1844, pp. 403, 404). Inasmuch as the copied descriptions are greatly contracted and omit important details, it appears desirable to append a full account in the words of the discoverer.

G. R. Waterhouse states that he found only females of *atricapilla* at the beginning of June, 1835, "in tolerable abundance, flying about a high bank by the riverside, near Liverpool." He then found a bee constructing a cell in a tuft of dry grass on "a projecting part of the nearly perpendicular bank, where the soil was of a light nature. Most of the cells were deposited at the roots of dry grass, the lower part of each cell being generally inserted in the soil, and the upper part exposed. In a perfect nest the cells were never detached, but always two or three, and sometimes five or six, were joined side by side. In some instances I have found the cells about an inch under ground, in a little chamber, which had apparently been excavated for their reception; the entrance to this chamber was only sufficiently large to allow free access to the bee.

"The cells are constructed of mud; the outer surface is irregular, the inner perfectly smooth, reminding one of a swallow's nest. Each cell is about five lines in length, and nearly egg-shaped; there is, however, a slight approach to the cylindrical form towards the upper end, which is truncated, and is closed by a lid, the upper surface of which is concave.

"In the newly-formed cells, which could be distinguished by the upper part being damp, there was always a small round hole in the lid, about the size of a pin's head. This I imagined was left by the insect, that it might insert additional food previous to the final closing of the lid; they already *had* some food in them.

"The food deposited in the cells for the larvae, consists, as in most of the Apidae, of honey, with but a small admixture of pollen. The honey must have been chiefly collected from *Lotus corniculatus*, that being almost the only plant on which I observed the bee to settle."

It will be observed that the usual description of the form

of the cells as "pitcher-shaped" is hardly borne out by the original account, and that no mention is made of the mud being "mixed with small pebbles" as stated by Smith ("Brit. Bees," 2nd Ed.).

It is to be observed that all six species, except the last-named, employ ready-made holes or covered spaces, or excavate in very soft material, possessing in a more generalised form the same kind of instinct as that of the shell-using species. Furthermore, all the four British species in which the instinct has been recorded, except *spinulosa*, of which very little is known, are described as also making use of other holes for nidification and thus possess the generalised form of the instinct as well as the specialised—a necessary combination for any shell-using species reaching a locality where snails are not readily to be found. Even *bicolor*, with an instinct as complex and specialised as any known in the genus, is said to burrow in banks. *O. rufa*, so commonly known to possess the generalised instinct in this country, is said to seek shells in France, but such an interesting example of geographical modification requires confirmation. The Rev. F. D. Morice thinks that there must be a mistake due to the confounding of *rufa* with *rufohirta*.—Fabre's "*Osmie rousse*."

The fact that both *Osmia* and *Anthidium* include species with the specialised instinct led me to ask Dr. Perkins whether a common ancestry was the probable explanation. He kindly replied as follows:—

"*Osmia* and *Anthidium* are not really closely allied: though belonging to one family (*Megachilidae*) they represent different sub-groups. Both genera are of huge extent and evidently not really single genera. *Osmia* is particularly composite, and the name as at present in general use rather represents 'Papilio' when this name comprised *Pieris*, *Colias*, etc., etc., as well as *Papilio*. At least, that is my opinion. In some respects *Anthidium* more nearly approaches the leaf-cutters (*Megachile*). The similarity in choice of nesting-place (shells) of several species of each genus evidently does not indicate a structural affinity—it is not even a constant habit in the case of some species.

“ Our only *Anthidium* is well known often to select the boring of some Longicorn beetle for its cells, but I have seen it burrow in the decayed beam in a greenhouse and in great plenty in the soft (from age) mortar of the side of an old house in Suffolk. I have not seen any record of this species utilising snail-shells.”

The Rev. F. D. Morice also informs me that it has been recorded from hollow stems of *Heracleum spondylium*.

When the true affinities of the various groups of species included in *Osmia* have been determined on structural characters, it will be possible to decide how far the shell-using instinct goes back to a common ancestry, an investigation in which it is hoped that the present collection of records may assist.

The Rev. F. D. MORICE followed with additional remarks on some of the species exhibited. Especially as to *Anthidium bellicosum*, Lep., and *7-dentatum*, Latr., he mentioned a suggestion he had formerly made (Tr. Ent. Soc. Presidential Address, Jan., 1913) that there might be a connection between the two facts (1) that, contrary to the usual rule, in these and other large *Anthidium* spp. the male is larger than the female, and (2) that such species habitually nidificate in ready-made tubes (snail-shells, stems, etc.) of *limited* dimensions. Too great size would clearly be especially disadvantageous to the ♀ in such cases, because she would be unable to enter far enough into any but the largest of such receptacles to line and provision them for the reception of her offspring, whereas the ♂ need never again enter a tube after emerging from that in which he had originally hatched out.

In this connection he now referred to a statement he had lately come across in J. H. Fabre's "Souvenirs" that shells utilised by the above *Anthidium* spp. contain either one only, or two chambers at most, the inner chamber in such cases—owing to the spiral form of the shell—being of course the smaller. If, as happens in about half the cases observed, the two tenants of such a shell are of different sexes, it seems to be a rule without exception that the inner (smaller) chamber shall contain a ♀, and the outer (larger) one a ♂.

In answer to a question from Dr. CHAPMAN, he said that these observations did not apply to the genus *Osmia*.

Mr. SICH inquired whether different species of *Osmia* utilise different species of shells. Mr. MORICE replied that they did so to some extent, and Prof. POULTON instanced *O. bicolor*, which chooses the shell of *Helix nemoralis*.

TWO SPECIES OF BUTTERFLIES FROM WAZIRISTAN.—Mr. G. TALBOT exhibited on behalf of Mr. J. J. JOICEY :—

Synchlœ lucilla, Butl., a pair taken by Major Peile, I.M.S., at Miranshal, Tochi Valley, North Waziristan, India, in March and April 1915. These were taken during operations against the Zadran (Afghan) marauders. Major Peile says: "I noticed *lucilla* common about the stone sangars vacated by the enemy, and three days later managed to secure some examples there. Most examples were a little worn—and females very rare, only four captured—but some were in very fine condition. They frequent almost barren hills covered with rocks and stones, most difficult hunting-ground, and one cannot go anywhere in these parts without an armed escort."

Ypthima bolanica, Marshall, taken at the same place, being a new district for this rare species.

MIMETIC GROUPING OF INSECTS.—Dr. C. J. GAHAN read the following letter which had been addressed to him as Keeper of the Entomological Department of the British Museum, and said it was very interesting not only in itself, but as a quite independent account of a phenomenon which had been discussed more than once at meetings of the Society. This phenomenon was first described by Dr. J. W. Gregory in his book on "The Great Rift Valley," and formed the subject of a paper by Mr. S. L. Hinde in the Transactions of the Society for the year 1902. Although Mr. Hinde had never seen the insects arranged definitely in the manner described by Dr. Gregory, it was clear that they are to be seen so arranged, though perhaps only very rarely. We had now the testimony of Mr. Stokes, as well as that of Dr. Parsons in relation to a West African species, in confirmation of the account given by Dr. Gregory :—

" Mar. 9, 1916.

" DEAR SIR,

" I have just received from my son, Capt. M. Stokes, F.R.G.S., who is serving in East Africa, somewhere near

Kilimandjaro, an account of what appears to be a very remarkable instance of insect mimicry. These are his words :
' At first sight I saw a plant with violet blossoms and red to orange buds or seed-pods—the pods being at the tip and flowers lower down. The whole thing shaped like a long stalk of hyacinth. There were several such stems, each with the "flowers" and "pods" regularly and naturally grouped at proper intervals round the stems.

" I plucked the "hyacinth," and each flower and pod hopped or flew away. They were grasshopper-like creatures with feathery wing-cases (the larger being about 1 inch long), and they had so arranged themselves round a bare stalk—all head-downwards—that the intervals between individuals, groups, and shading from violet to orange were perfectly observed. Cases of wonderful imitative markings in *individuals* are limitless here, but this is the first *collective* arrangement of creatures, of various colours, shapes and sizes, into one definite system that I have ever seen or heard of. Several of us examined them after I had pointed out these "flowers" growing on the banks of the Tsavo River.'

" I am, sir,

" Yours faithfully,

" F. G. STOKES."

RELATIONSHIPS IN THE GENUS *HELICONIUS*.—Dr. H. ELTRINGHAM gave a short abstract of his paper on "Specific and Mimetic Relationships in the Genus *Heliconius*," illustrated by several coloured lantern slides. He pointed out that previous work on this remarkable genus had taken into account external features only, and that anatomical study revealed some interesting points in connection with the specific relationships. Though the structure of the male armature was not in every case so valuable an aid as in the genus *Acræa*, yet it did show many remarkable features, which, taken in conjunction with gradations of pattern, supported the view that the number of good species in the genus should be reduced by about 50 per cent. Illustrations of certain remarkable intermediates from the Tring collection showed that there could be very little doubt that the whole

of the "Melpomeneformes" and "Cydniformes," with the possible exception of *H. pachinus*, were forms of one species, whereas forms of Section II of the genus seemed to be their models, and certainly belonged to several different species, thus recalling the mimicry of several species of *Planema* by forms of one species of *Pseudacraea*. He explained that the subject was rather complicated, and it was impossible to do justice to it in the short time available that evening, but the various aspects of the matter were dealt with at length in the complete paper which he hoped would shortly be published.

In connection with this exhibit Mr. W. J. KAYE showed four large cabinet drawers of *Heliconius* species, three of which contained what might ultimately be proved to be forms of the extraordinarily variable species *melpomene*. Such were *amaryllis*, *nanna*, *aphrodite*, *amandus*, *heurippa*, *xenoclea*, *plesseni*, *niepelti*, *rubripicta*, besides a number of other forms from Para, such as *thelxiope* graduating into *aglaope*; while a series of *aglaope* from East Peru was more or less constant. A fourth drawer contained a very large number of what were probably all forms of *erato*, which might be looked upon as the companion species of *melpomene*, for forms of the one were invariably accompanied by forms of the other. The forms included *microclea*, *notabilis*, *fejeryi*, *ochracea*, *etylus*, *oberthuri erythraea*, *udalrica*, *callycopis*, *hydara*, and a completely intergraded series from East Bolivia of forms from *venustus* to *sanguineus*, *anactorie*, *phyllidis*, *amatus*, and a single red blotched form very similar to *melpomene*, and practically only distinguishable by the secondary sexual character on the underside of the forewing.

SCENT-SCALES AND GENITALIA IN FORMS OF *PIERIS NAPI*, LINN.—Dr. F. A. DIXEY showed upon the screen outline drawings of scent-scales and genitalia from various forms of *P. napi*, Linn.; remarking on them as follows:—

"Some little time since, I was asked by Mr. C. B. Williams to examine the scent-scales of males which had been bred from eggs laid by a female *bryoniae*, in order to see whether they would show any recognisable difference from those of the ordinary form of *napi*. The scent-scale of *napi*, though

somewhat variable, is easily distinguished from that of other members of the genus, e. g. *rapae* and *canidia*. It is roughly cordate, broad at the base, and narrowing more or less abruptly into a distal portion, the sides of which are usually parallel. The base is furnished with well-marked cornua, which are generally inclined to one another, and frequently cross behind the stem which unites the lamina with the accessory disc. The latter structure is moderate in size and somewhat chestnut-shaped in outline.

“ On examining Mr. Williams’ specimens of *bryoniae*, I found that in one of them the scent-scales could not be distinguished from those of an ordinary English *napi*. In another, however, the proportion between the proximal and distal portions of the lamina was very different, the latter being much broader than in the usual form. The third specimen was intermediate in character, but on the whole tended towards the normal. The only conclusion that could be come to was that there was no specially distinctive character attached to the scales of the form *bryoniae*.

“ It occurred to me, however, that it might be interesting to widen the outlook by examining scales from specimens of *P. napi* from various localities, in order to gain some idea of the limits of individual variation in these structures, and also to ascertain, if possible, whether such variations as exist could be correlated with others, e. g. in the genitalia, or with conditions of topography.

“ I soon found that the great comparative breadth of the distal part of the lamina, which was apparent in one of the specimens of *bryoniae*, was carried to an even greater extent in a specimen from Algeria, and perhaps more strikingly still in one from Cannes. The Algerian specimen is also remarkable for the great development on many of the cornua of a curved spiny process, an indication of which is visible in a few of the *bryoniae*. This last feature may also be seen in the scales of a specimen from Crieff, in Scotland; here also a broadening of the distal part of the lamina is evident; while in a second specimen from the same locality, the relative proportions are very nearly the same as in the second *bryoniae*.

“ Other continental specimens do not differ from the English

form. So far from following the broadened contour of the specimens from Algeria and Cannes, those from Belgium, Switzerland, Spain and Greece might have been captured in our southern counties for anything that their scent-scales show to the contrary. The same may even be said of a specimen from the Tian Shan, though here, perhaps, there is a slight broadening of the distal portion as in some of the *bryoniae*. Altogether it does not seem possible to attach any geographical significance to these variations of outline.

“ My friend Dr. Eltringham has been so good as to make preparations of the genitalia of all the forms that I have mentioned, and also to prepare outline drawings of them. These I will show upon the screen in the same order as the corresponding scent-scales; and I think it will be seen that they are even more uniform in type than the scales, and that it is difficult, or perhaps impossible, to detect any correlation between such variations as do exist in the two structures.

“ There are certain forms which are acknowledged to be closely related to *P. napi*, and which indeed might without much violence be regarded as conspecific with it. I refer to such forms as *P. oleracea*, Harris, of North America, and *P. melete*, Ménétr., from Central and Eastern Asia. All these have scent-scales of the *napi* form, though in some, as in two specimens which I think must rank as *melete*, from Thundiani on the borders of Kashmir, and the Island of Tsu-Shima respectively, the accessory disc is enormously large in comparison with that of other allied forms. A specimen from Japan, which corresponds perhaps with *ajaka* of Moore, has a scale like that of a *napi* from Spain; while *oleracea* from Vancouver has a rather narrow but quite *napi*-like scale with a strong tendency to the formation of spiny prolongations to the cornua. I am again indebted to Dr. Eltringham for preparations and drawings of the genitalia of these forms. There is, I think, nothing to distinguish them from those of *P. napi*.

“ I have found in many cases that there are constant differences between the shape of scent-scales according to their position on fore- or hind-wing. In order to avoid errors arising from this source I have in all instances except the first *P. napi* (Oxford), taken the scales from the same situation,

i. e. the centre of the fore-wing. It should be mentioned also that all these examples are drawn to the same scale.

“ In spite of the differences that can be observed in the scent-scales that I have shown, I am quite confident that I could pronounce any of them without hesitation to belong only to the *napi* group. The scent-scale of *rapae* and its near relatives, though generally resembling that of *napi*, is always distinguishable. Still more easily so is that of *brassicæ* and its associated forms. By the kindness of Dr. Eltringham I am also able to show that the genitalia of both *rapae* and *brassicæ* show quite distinctive features when compared with any of those of *napi*.”

Dr. LONGSTAFF observed that he had detected the verbena scent peculiar to *P. napi*, both in *oleracea* and *melete*.

Wednesday, May 3rd, 1916.

The Honble. N. CHARLES ROTHSCHILD, M.A., F.Z.S., F.L.S., President, in the Chair.

Election of Fellows.

Messrs. LEONARD CHARLES BOX, F.R.H.S., Dominion Experimental Station, Fredericton, New Brunswick, and LEONARD SPENCER TATCHELL, Heathwood Road, Bourne-mouth, were elected Fellows of the Society.

Exhibitions.

A QUESTION CONCERNING THE HATCHING OF EGGS OF *STEGOMYIA FASCIATA*.—Mr. BACOT, in introducing this subject, gave in brief outline an account of some experimental work carried out in Freetown, West Africa, dealing with the hatching of eggs of this mosquito—full details of the experiments and their results being published in his Report to the Yellow Fever Commission. He pointed out that in addition to the well-known ability of the eggs of *Stegomyia fasciata* to retain their vitality when dried, that they were subject to periodic hatching when actually immersed in water. Under

certain conditions the hatching of a batch of eggs might be spread over two or three months, the fully developed larvae within the eggs awaiting the occurrence of some stimulus before breaking out of the shell. A fall in the water temperature of about 7° to 10° F. acted as a stimulus, but usually only on a moderate percentage of the resting eggs. The addition of foul, contaminated water to the breeding-pans afforded a much more comprehensive stimulus.

A research, in which Dr. E. E. Atkin joined, carried out at the Lister Institute since Mr. Bacot's return from West Africa—a full account of which it is hoped to publish shortly—threw further light on the subject. It showed that, under sterile conditions, the eggs very generally though not invariably failed to hatch, until the water, or the medium in which the eggs were resting, was infected by living organisms. Various reagents failed to produce a corresponding effect, nor was a bacterial filtrate any more effective than a culture killed by heat.

Mr. Bacot showed tubes containing eggs that had been sterilised, and had remained for a month without hatching in sterile distilled water, to which 15 per cent. of the filtrate of a culture of *Bacillus coli* had been added. He demonstrated that the addition of a minute quantity of yeast organisms from a culture tube caused the eggs in one of the tubes to hatch within 10 to 15 minutes. In a duplicate tube, which had been infected by a species of bacteria shortly after the beginning of the experiment, the eggs had hatched, and this tube now contained a number of dead adult mosquitoes which had been bred out.

The question to which an answer was sought was the exact nature of the stimulus exerted by the organisms and the manner in which it affected the larvae lying within the eggs.

In answer to questions by the PRESIDENT, Mr. Bacot said (1) that the ova when laid in dirty water became covered with bacteria, and that by sterilising the ova he meant clearing the shell of such bacteria; (2) that the larva could live in the dried egg for upwards of 8 months, and had been stated to be able to do so for 18 months, while in water they might lie as long as 5 months without hatching.

Various suggestions were made in answer to Mr. Bacot's main question by Mr. GREEN, Prof. POULTON, Rev. G. WHEELER, Drs. CHAPMAN, COCKAYNE and ELTRINGHAM, and Mr. H. WILLOUGHBY ELLIS gave reasons for ruling out any possible electric agency in the matter.

EGGLAYING OF TRICHIOSOMA TIBIALIS, Steph.—Dr. T. A. CHAPMAN exhibited living specimens of the Sawfly *Trichiosoma tibialis*, Steph., and eight eggs laid under the cuticle of hawthorn leaves, and read the following notes:—

I had this morning the pleasure of watching some specimens of *Trichiosoma tibialis*, Steph. (our common hawthorn species), laying their eggs. Broadly, their proceedings were the same as I observed in the willow species, as reported in our Transactions, vol. 1914, p. 173.

The process was very rapid, varying apparently according to whether the leaf selected was very soft and succulent, or slightly more mature. Though all the leaves available were very young the oldest of them, whether accidentally or not, were not selected.

The greatest delay was, occasionally, in making an entry, half a minute being taken in one instance, less than half a minute for the complete direct penetration (as in fig. 4, Pl. XIII, 1914), and 15 to 20 seconds from that to the completion of the excavation (fig. 6, same plate); a rest then occurred of about 8 to 10 seconds, then recurred the same movements, as of cutting, with retreat of the terebra to the position of Pl. XV, fig. 10, and the simultaneous appearance of the egg as if from nowhere.

The progress of the supports was always steady and uniform, with no to-and-fro action, but the saws were constantly moving rapidly to and fro, *i. e.* as one advanced the other retreated. The extreme tips of the saws passed decidedly further behind the supports than shown in my figures of the willow species, and consequently the strip of pocket cut behind the supports (as seen in figs. 2, 3, 4, Pl. XIII) were decidedly wider than in the willow species. In the entry (up to position fig. 4) the cutting was entirely done by the ends of the saws, by which I mean their cutting margins, beyond where the terebra begins to narrow. From position

figs. 4 to 6 the cutting was chiefly done by the forward margin.

The entry was usually on the upper surface of the leaf, almost but not quite at the actual margin. During the short time I watched them an accident happened them that I had never seen occur in the sallow species, but in this case it actually happened three or four times. The fly appeared to believe that all was going well, and, from what I observed, I thought so also, until position fig. 4 was reached, when it proved that the whole movement was not in the leaf, but on its surface, when the fly discovered the error and desisted. The leaf must have been quite glabrous and with a slightly sticky, gummy surface to render this possible.

From what Mr. Morice told us on March 1st as to the differences in the saws of the two sections of the *Trichiosomas* represented by these two species, I half expected to find some difference of procedure between these two species, but it turns out that they are precisely identical, except in a few quite trivial details.

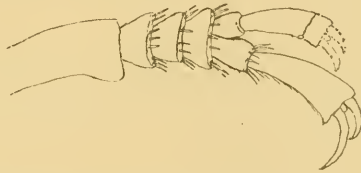
I exhibit a spray of hawthorn with some of the eggs laid this morning. In one instance a fly laid an egg in a leaf in which it, or another, had previously oviposited, and the second pocket encroached on the first. I happened to be watching and expected a catastrophe, but the working of the saws past the already laid egg did not seem to affect it; the two eggs, one pressing on the other, are in a leaf on the exhibit.

Later, as the eggs matured, the embryo twisted its head first one way, then the other, every few seconds, as did the sallow species, the brown eye-spots being seen at these intervals suddenly moving first in one direction, then back again, with rather a weird effect.

TERATOLOGICAL SPECIMEN. ADDITIONAL TARSAL JOINTS IN A BEETLE.—Dr. CHAPMAN also exhibited a teratological specimen of a beetle with additional tarsal joints, and read the following notes:—

The specimen is labelled "*Odontopus cupreus?*" "Portuguese E. Africa. Mrs. Lethaby," and belongs to the Bristol Museum, and I am enabled to describe it by the kindness of

the Director, Mr. H. Bolton. We are indebted to Miss N. M. Ward for the discovery of the specimen. The beetle is a large one, some 30 mm. long, and the affected tarsus is about 4 mm. in length. The malformation is a somewhat unusual one, I am not sure that I have heard of and have not seen a similar one. It has no trace of the extra parts, being as it were representations in a mirror of the original parts, which Prof. Bateson has shown to be so frequent in such specimens. It is, of course, not quite correct, in parts that are duplicated, to call one of the two the original and the other an addition; for it is most usual for both to have an equal claim, or neither to have any, to be called the original normal structures, making the other an addition. In the present specimen, however, it is very tempting, if it be not, indeed, the actual fact, to regard the



Rough sketch of tarsus ($\times 8$) from a dorsal but slightly posterior point of view.

affected as a normal tarsus, with additional fourth and fifth joints springing from the extremity of the third.

Except for the expansion towards the end of the third joint, to give origin to the abnormal joints, the tarsus I accept as normal appears to be so in all respects.

The additional joints arise dorsally, so that the abnormal fourth joint lies above the dorsum of the normal fourth, and it has this peculiarity, that it is, as it were dorsal in all its aspects. The normal joint has a number of terminal spines and on its ventral aspect a double set of gold-coloured bristles that are directed inwards, so that the ends of the bristles of each set meet the other in the middle ventral line of the joints.

The abnormal fourth joint is quite devoid of spines and bristles, and is smooth and rounded in all aspects. It is very little smaller than a normal joint, not apparently more than is due to its end being rounded, instead of being produced

angularly to support the special angular group of spines that a normal joint carries.

The abnormal fifth joint is unfortunately broken, the extremity carrying claws, if it did so, being lost. Its form and length seem nevertheless to be much like those of a normal fifth joint, with the same exception as occurred in the fourth joint that carries it, namely, that it is, if one may so express it, entirely dorsal and without any spines, or ventral bristles. This description is so far incorrect that the normal joints have a few spinous hairs dorsally at the distal margins, but they are sufficiently sparse to let one suppose that a special dorsal hypertrophy would thrust them aside and leave a smooth median surface, and when I describe these extra joints as being entirely dorsal, I wish to suggest that it is only such a medio-dorsal portion of a normal tarsus that has been here reduplicated to form them.

CASSIDIDAE PRESERVING THEIR BRILLIANCY.—Mr. E. E. GREEN exhibited various species of *Cassididae*, preserved in 2 per cent. formalin, displaying their natural metallic colours which are lost on desiccation.

RECOVERY OF A BUTTERFLY THAT HAD BEEN STUNNED FOR NEARLY THREE DAYS BY A FALL.—Prof. POULTON exhibited a living male *Celastrina argiolus*, L., which he had found, on April 27, lying with outspread wings on a cement path at St. Helens, Isle of Wight. The right hindwing had been displaced so as to overlap, instead of being overlapped by, the forewing, but there was no other visible injury. The wings, although of full size, were soft, and, on the left side, somewhat crumpled. The insect, placed under a tumbler on the study table, remained motionless on April 27, 28 and 29, but on the morning of April 30 was seen to have entirely recovered. Its wings had regained the normal overlap, although those of the left side had, of course, hardened in their crumpled condition. It seemed clear that the recently emerged butterfly had fallen from the ivy which grew up the side of the house close to the spot, and that the wings had been too limp to prevent a serious fall. The insect, kept in a glass-topped box with ivy leaves damped nearly every day, was alive on the afternoon of May 7, but found to be dead on the following morning.

A SCARCE BRITISH BEETLE.—Mr. H. WILLOUGHBY ELLIS exhibited a rare British beetle, *Amara nitida*, Stm., taken at Knowle, Warwickshire.

FRENCH SPECIMENS OF AN AMERICAN WEEVIL.—Mr. CHAMPION exhibited specimens of *Mascaurauxia cyrtica*, Desbr., from the Landes and Monte Video, an American weevil related to *Dorytomus*, apparently recently introduced in some way into France, where it has been found in numbers under the loose bark of plane trees. The French examples had been received from Mons. J. Clermont of Paris; the Monte Video one was captured many years ago by Commander Walker. The genus *Mascaurauxia* was stated to be probably synonymous with *Hyperodes*, Jekel (= *Macrops*, Kirby), which ranged from Canada to Chile.

Papers.

The following papers were read :—

“ Butterflies from Southern Kordofan, collected by Capt. R. S. Wilson, Lancashire Regt.,” by G. B. LONGSTAFF, M.A., M.D., F.E.S., etc.

“ New Chrysidids from Egypt and Algeria,” by the Rev. F. D. MORICE, M.A., F.E.S.

Wednesday, June 7th, 1916.

The Honble. N. C. ROTHSCHILD, M.A., F.L.S., F.Z.S., President, in the Chair.

Election of a Fellow.

Miss ALICE BALFOUR of Whittinghame, Prestonkirk, Scotland, and 4, Carlton Gardens, S.W., was elected a Fellow of the Society.

Death of a Fellow.

The death of Mr. F. ENOCK was announced.

Wicken Fen.

The PRESIDENT read a letter from Mr. H. ROWLAND-BROWN,

inviting a continuance of subscriptions to the upkeep of Wicken Fen.

Exhibitions.

SPECIMENS COLLECTED DURING A VOYAGE TO AUSTRALIA, WITH VIEWS OF SCENERY.—Dr. F. A. DIXEY exhibited specimens of insects collected by him during the visit of the British Association to Australia in 1914. He stated that the exhibit might be considered to have some interest from the extent of ground covered, but was not otherwise specially remarkable. The localities collected in included Gibraltar, the Gulf of Aden, Colombo, Townsville, Magnetic Island, Kuranda, Thursday Island, Java, Singapore, Penang, Kandy and Port Said.

Scents more or less pronounced had been determined in several of the species. The following male odours were, it was believed, recorded for the first time :—

SATYRINAE.

SCENT.

<i>Ypthima arctous</i> , Fabr.	Vanilla; very distinct.
<i>Mydosana terminus</i> , Fabr.	Vanilla-chocolate; strong.
<i>Nissanga patnia</i> , Moore.	Caramel, with trace of chocolate.
<i>Orsotriaena mandata</i> , Moore.	Pleasantly aromatic.

ELYMNINAE.

<i>Elymnias nigrescens</i> , Butl.	Vanilla; strong.
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LYCAENINAE.

<i>Hypolycaena strabo</i> , Fabr.	Strong and fruity, like an over-ripe pear.
<i>Deudorix domitia</i> , Hew.	Fragrant and flowery.

PIERINAE.

<i>Terias hecabe</i> , Linn.	Flowery; slight but distinct.
<i>Terias silhetana</i> , Wallace.	Flowery; slight and occasional.
<i>Terias lineata</i> , Misk.	Flowery on scraping scent-patches; slight.
<i>Dclias periboca</i> , Godt.	Like wallflower; slight.

Of more or less disagreeable odours, probably not confined to one sex, the following were noted :—

ACRAEINAE.

SCENT.

Acraea violae, Fabr. ♂. Straw; very faint.

NYMPHALINAE.

Cethosia nietneri, Feld. ♀. Ammoniacal.

Hypolimnas bolina, Linn. ♂. Straw; slight.

PAPILIONINAE.

Papilio pammon, Linn. ♂. "Kitchen sink."

Eurycyus cressida, Fabr. ♂. Distinctly acrid.

 " " " ♀. Ammoniacal in the field,
 afterwards musky.

The musky odour of *E. cressida* ♀ had been previously observed by Commander J. J. Walker. Of *Ypthima ceylonica*, Hew., Dr. Longstaff noted ("Butterfly Hunting in Many Lands," 1912, p. 500) that "in a few males of this abundant species a very slight scent of chocolate was detected." The present speaker had found a distinct smell of chocolate, sometimes strong, in more than half of the males examined. He was also able to confirm another observation of Dr. Longstaff (*loc. cit.*, p. 505), who records "a sweet flowery scent in two males" of *Nacaduba atrata*, Horsf. Dr. Dixey found in the male of this Lycaenid a "distinct flowery odour still perceptible on the day after capture." It might also be worth noting that of four specimens examined of *Neptis varmona*, Moore, one appeared to have a slight flowery odour. In this species no scent was recognised by Dr. Longstaff. The powerful odour of *Catopsilia pyranthe*, Linn., to which attention was first called by Wood-Mason, and which had been variously compared to that of jasmine, *Polianthes tuberosa*, *Stephanotis* and *Freesia* (see Longstaff, *loc. cit.*, p. 506) was abundantly present in male specimens caught at Colombo.

Results with *Danainae* were somewhat indefinite. Dr. Longstaff (*loc. cit.*, pp. 495-497) had recorded in a male of *Tirumala limniace*, Cram., "a very faint scent, suggesting old cigar-boxes." Observations on other occasions were doubtful

or negative. Most of the male *Tirumala septentrionis* examined by him yielded a scent noted as slight, moderate or decided, and described as pleasant or sweet. In six females out of seven the result was negative or doubtful; in the other a slight scent, compared to *Stephanotis*, was found in the field. A generally disagreeable scent, variable in strength, was detected by the same observer in both sexes of *Parantica aglea*, Cram., and *Crastia asela*, Moore. The present speaker's experience with the same or allied species corresponded fairly with the above. Thus in the genus *Tirumala*, *T. hamata* ♀ yielded no recognisable odour. One male gave a slight odour of old straw; in another a slight flowery scent seemed to be perceptible on detaching scales from the sex-brand. A third male had no distinct odour. No male was examined of *Parantica aglea*; two females appeared to be devoid of scent, in two others an odour was doubtfully present, compared in one case to the smell of old upholstery. A male, however, of *Crastia asela* was tested with a negative result, and the same was recorded of a male and two females of *Chanapa corinna*. Two other males of the latter species appeared to have a slight scent, described in one case as "rather snuffy." *Danaida affinis*, Fabr. ♂, appeared to be scentless.

Tenacity of life was specially noted in *Eurycus cressida* ♀, *Crastia asela* ♂, and *Parantica aglea* ♀.

Dr. Dixey mentioned that some notes of his journey in the East were appearing in the Entomologist's Monthly Magazine; and he concluded his exhibit by showing on the screen various views for which he had been indebted to the kindness of the Australian Government. These views were taken in different parts of Australia, and included the haunt of the great green *Ornithoptera priamus* f. *euphorion* near Kuranda, Queensland.

Comm. WALKER, Mr. E. E. GREEN, and Prof. POULTON commented on the slides and the scents of the butterflies observed.

A BRED FAMILY OF *PAPILIO DARDANUS*,* BROWN, AND RARE SOUTH AMERICAN BUTTERFLIES.—MR. G. TALBOT exhibited on behalf of Mr. J. J. JOICEY :—

* Since this exhibit was made, Mr. Leigh has written to say that the ♀ parent was of the *hippocoon* form.

A Family of *Papilio dardanus*, Brown.—This series was bred in 1914 by Mr. G. F. Leigh of Durban, Natal, from the ova laid by a single ♀. The parent was, unfortunately, not included in the series. All the specimens are in the Hill Museum, Witley.

The family consists of 26 ♂♂ and 36 ♀♀. The ♀♀ comprise 17 *cenea*, 11 *hippocoonoides*, and 8 *trophonius*. The following variation is found—

♂♂. A. Typical examples of the S. African race with the band of hind-wing of fairly uniform width and not interrupted. 5 specimens.

B. Hind-wing with an irregular band which is reduced in parts; spot in cellule 3 reduced and in one specimen isolated; spot in 5 also reduced in four specimens; variable amount of black on the tails. 7 specimens.

C. Band of hind-wing with the spot in 5 smaller than the others; variable amount of black on the tails. 6 specimens.

D. Band of hind-wing interrupted in cellule 5 in one specimen, in cellule 3 in two specimens, and in 3 and 5 in two specimens; tail only yellow at tip except in one example. 5 specimens.

E. Similar to West African examples. Band of hind-wing more reduced and interrupted; tails of two specimens uniformly yellow, of another margined with black. 3 specimens.

♀♀. Form *cenea*, Stoll.—A. The fore-wing with two indistinct white spots in cellule 5 between the two post-cellular spots. 1 specimen.

B. Fore-wing with apical spot absent. One individual with a double costal spot, the other with an additional spot in the angle of cellule 7. 2 specimens.

C. Small size with reduced spots and darker band on hind-wing, this band being much obscured at the base in one specimen. 2 specimens.

D. Band of hind-wing with a sharply-defined outer edge. 9 specimens.

Form *hippocoonoides*, Haase.—A. The discal spot in 2 on fore-wing reduced in one specimen and in another represented by some white scaling above vein 2. 2 specimens.

B. A vestigial tail at vein 5 of the hind-wing. 1 specimen.

C. The white band of hind-wing with a sharply-defined edge. 5 specimens.

Form *trophonius*, Westw.—None of these have the spots on fore-wing entirely white excepting the costal and two upper submarginal ones, which are constantly so.

A. The brown area on fore-wing extending into the cell along its lower edge; this is accompanied in one example by some brown scaling in cellule 3. 3 specimens.

B. The black marginal border of hind-wing variable in width; in one specimen is twice as broad as in the others.

C. The subapical patch on fore-wing entirely brown. One crippled specimen whose wings are not expanded.

Dates of emergence :—

♂♂ from 29. 7. '14 to 22. 9. '14.

♀♀ from 7. 8. '14 to 22. 9. '14.

Form *trophonius* from 29. 8. '14 to 22. 9. '14.

„ *hippocoonoides* from 7. 8. '14 to 21. 9. '14.

„ *cenea* from 10. 8. '14 to 21. 9. '14.

Sequence of emergence :—

The ♀ forms are indicated by their initial letter.

July 29	1♂	Sept. 2	2♂♂	Sept. 14	1♂
Aug. 1	1♂	„ 3	1H	„ 16	2♂♂, 2C, 1H
„ 2	1♂	„ 4	1♂, 1H	„ 17	1C, 1T.
„ 7	1H	„ 5	1C	„ 18	1C, 1H
„ 10	1♂, 1C	„ 6	1♂	„ 19	1H, 1T
„ 17	1♂	„ 7	2♂♂	„ 20	1♂, 1C, 1T
„ 19	1H	„ 8	1♂, 1C	„ 21	1C, 1H, 1T
„ 21	1♂	„ 9	1♂, 2C, 1T	„ 22	2♂♂, 1T
„ 28	1C	„ 10	1♂, 2C.	No date	1♂
„ 29	1♂, 1C, 1H, 1T	„ 11	1♂, 1C, 1H		
„ 30	1♂	„ 12	1C, 1T		

PROTECTIVE COLORATION IN THE LARVA OF *AGRIOPIS APRILINA*, LINN.—Mr. TALBOT also observed that it is well-known that this larva, resting on the oak-trunk by day, resembles the bark in colour and is not easily seen.

A specimen was found recently by Mr. Joicey in the Witley district. It was transferred to a breeding-cage in which the food-plant was placed in a jar of water, and inserted through a hole in the centre of a piece of white mosquito-net which covered the top of the jar.

When the cage was opened next day the larva was seen

resting on the mosquito-net which overlapped the jar, and thus rendered inconspicuous, the grey colouring and diamond-shaped marks harmonising with the lines and dirty-white colouring of the net.

If it had selected the brown twig of its food-plant, the brown earth at the bottom of the cage, or the dark wooden side of the cage, it would have been markedly visible.

We must suppose that the position of the mosquito-net in regard to the food-plant was as the tree-trunk would be, and that therefore the larval instinct would seek for no other place.

MUD WASPS FROM A NEST MADE IN AN INSECT BOX.—A nest of four cells, exhibited by Mr. TALBOT, together with specimens of the wasp, *Odynerus (Ancistrocerus) parietum*, was built in the groove of a store-box in the Hill Museum, Witley, in the summer of 1915. Two individuals emerged at the end of April 1916, and two others on May 22nd.

A second nest was made in the groove of a setting-board, but sustained injury. It was not known whether both were made by the same wasp.

RARE BUTTERFLIES FROM FRENCH GUIANA.—MR. TALBOT also exhibited the following species of butterflies from French Guiana :—

Papilio coelus, Boisd. ♂ ♀, the ♀ mimicked by *P. ariarathes*, Esp. ♀.

Agrias narcissus, Stgr.* Perhaps the rarest of the genus. No specimens have been recorded for many years.

Morpho hecuba, L. This is the true *hecuba*, and differs from the form found on the Amazons.

Morpho marcus, Schall. (= *eugenia*, Deyr.). One of the rarest of Morphos. It is suggested by Mr. Kaye that this may possibly represent a wet-season form of *adonis*, Cram. We hope to obtain some data from the collector, which may throw light on the question.

Morpho adonis, Cram.

LORD ROTHSCHILD and Prof. POULTON remarked on this exhibit.

* A form of this was found on the Amazon near Obidos by Michaelis, and is described and figured by Fruhstorfer in the "Iris," vol. 15, p. 179, pl. iii. This certainly represents a distinct race and will require a name.

A LETTER WRITTEN BY THE LATE COLONEL N. MANDERS ON THE DISCUSSION FOLLOWING HIS PAPER ON MARCH 3, 1915.—Prof. POULTON said that he had received the following letter written by Col. Manders just before he started for the Dardanelles, where he gave his life for his country. He felt sure that Fellows would wish to preserve in the Proceedings these words of a distinguished naturalist, not only because of their pathetic interest, but also because they were a contribution to the discussion initiated by the writer himself (Proceedings, 1915, pp. xxiii—xliv):—

“1 *Shareh Borsa-El-Gedida,*
“*Kasr-El-Nil, Cairo.*
“3. iv. 15.

“MY DEAR POULTON,

“I am off with the Australians and New Zealanders for an unknown destination on Wednesday next, to-day being Good Friday. I am just writing you a line to say that Wheeler has sent me a draft of the Proceedings in which my paper and debate are described. If I had been present I should have said in reply to your criticism that I had unfortunately not seen Swynnerton's paper in the 'Ibis.' I am out of the way of libraries, and cannot afford an extensive subscription to scientific literature. I am glad Wheeler drew attention to the object of my paper—that it was in opposition to a 'test case.'

“Will you please congratulate Swynnerton for me on what I consider to be his monumental paper? I hope his observations will put mimicry on a firm footing and put me out of what you rightly call a 'dreary' position. I would gladly join your ranks if I could, and S's paper is a light in the darkness! It may put the coping-stone, or shall I say the foundation-stone, on your labours. I am in a great hurry. I shall always remember your friendship more than your opposition! Good-bye.

“Yours sincerely,
“N. MANDERS.”

HAASE'S HYPOTHESIS THAT DISTASTEFUL QUALITIES OF LEPIDOPTERA ARE DERIVED DIRECT FROM THE FOOD-PLANT.—Prof. POULTON said that he had long thought that Haase's

hypothesis did not provide the true interpretation of the distasteful qualities of many butterflies and moths with warning colours. It was indeed probable, although he believed it had never been proved, that the ready-made acid or poisonous substances of a food-plant might be utilised by the larva and retained in the imago of certain species; but such qualities could also be built up in the laboratory of the animal's body by insects feeding upon innocuous plants. Among the examples quoted by Haase, the *Danainae* feeding on Asclepiads and the *Pharmacophagus* swallowtails on Aristolochias and their allies, were probable examples of the utilisation of a ready-made protection. On the other hand, Dr. O. Stapf, F.R.S., had informed him that the *Passifloraceae*, the food-plants of the *Heliconinae* and their allies are not, as Haase maintained, acrid or poisonous.

Mr. W. A. Lamborn had shown in the last few years that *Acraea* larvae of many species, in the Lagos district, feed on a great variety of plants, thus rendering it improbable that Haase's hypothesis applies to them.

The Pierine genus *Delias* had recently occurred to Prof. Poulton as a specially significant example. These highly conspicuous butterflies had been shown to be distasteful, and they were well known to be mimicked by other Pierines (*Prioneris*), by Elymniines and by moths (*Chalcosiinae*). Furthermore, the larvae of some species at any rate were gregarious, and in some the conspicuous pupae were freely exposed on the larval web. Mr. E. E. Green had observed that the larvae of a Ceylon *Delias* emitted a strong smell of musk. Now, so far as we know, the species of *Delias* feed upon the Mistletoes (*Loranthaceae*), which, Dr. Stapf informed him, possessed no special acrid or distasteful qualities. Mr. H. N. Ridley, F.R.S., had also found the leaves of *Loranthus* always indifferent to the senses of taste and smell. The extraordinary development of *Delias* in New Guinea led Prof. Poulton to inquire whether there was any special predominance of these plants in the island or in the Malayan region generally. Dr. Stapf had kindly replied as follows:—

“ The *Loranthaceae* are generally well represented in the Malayan region as far as the number of species goes, and that

applies no doubt to New Guinea also, where about 14 species are known, and a few more are described in Ridley's paper on the botany of the Utakwa expedition, which will be out shortly. The highest altitude recorded in New Guinea for *Loranthus* is 2000 metres, which would be well below the tree line. The island is, however, *very* imperfectly explored. Mr. Ridley tells me that in the Malay Peninsula *Loranthus* is often found on the mountain tops on stunted trees and shrubs."

POLISTES GALLICUS, L., TAKEN IN BRITAIN.—The Rev. F. D. MORICE exhibited a worker of the social wasp *Polistes gallicus*, L., taken by Mr. J. W. H. Harrison on the day after August Bank Holiday 1915 at Wolsingham, "in the hilly west of Co. Durham, at about 1200 ft., far away from the sea or even houses."

The exhibitor made the following comments:—

It seems that for some reason this wasp, so common in all other parts of the Palaearctic Region from Scandinavia to Algeria and Syria, is unable to effect a permanent settlement in these islands. From time to time individuals reach our seaports; and as their nests (of which I exhibit also a specimen from Majorca) are attached to all kinds of easily transportable objects, stones, planks, growing plants, such as reeds and even grasses, etc., etc., a whole colony might easily be brought over accidentally. But, so far as I know, no such case has been reported, only isolated captures of individuals (*e. g.* Major Robertson lately took one near Southampton), and almost always under circumstances which suggest that they have come from some French or Spanish port, in some vessel whose cargo had attracted them.

In 1866, and again in 1867, specimens of another *Polistes* species were taken at Penzance, and the late Frederick Smith (*Entomologist's Annual*, 1869, p. 68) inquired fully into the circumstances of the capture, with the result that the insects were practically proved to have been brought from South America in two voyages of the same vessel laden with hides.

It is possible, and even perhaps most probable, that the Durham specimen was similarly imported from Norway. But, even if so, I think it is worth exhibiting; since it has at least made its way to a much more inland British locality

than any from which I have seen it recorded. Possibly, if the locality were revisited, it might be found that the insect is actually established there. As it would not be altogether a desirable addition to our regular Fauna, it is to be hoped, perhaps, that such is not the case!

EGG-POCKETS MADE BY SAWFLIES.—Dr. CHAPMAN showed some dried leaves of birch and hawthorn, with the egg-pockets of *Cimbex sylvarum* and *Trichiosoma tibiale* respectively, from which the larvae had hatched, showing the different relation of the pockets to the margin of the leaf in the two species (and genera?), and made the following remarks:—

I happened to find last autumn on a birch in my garden a larva of *Cimbex sylvarum*, Fab. From its cocoon there duly emerged this spring a ♀ of that species. Having recently interested myself in the egg-laying of some sawflies, I at once submitted it to observation, and report the results so far obtained, as presenting two points, at least, of interest.

She emerged on May 14th, and I placed her at once on some birch, when she immediately and apparently with eagerness began to oviposit.

At first it seemed that she did so in the middle of the leaf. It soon, however, appeared that she selected a spot at a definite distance from the margin, actually about 5·0 or 6·0 mm. from the edge of the leaf, the varying irregularities of the leaf outline making more accurate measurement difficult or illusive, say, a quarter of an inch. What struck me very much, was that she moved with the slow lumbering manner these large sawflies affect, and carelessly (to all appearance) but quickly, took up what seemed an indefinite attitude, so that one could not say it was always the same, or even very similar, yet invariably the saws commenced operations at the regulation distance from the margin of the leaf.

In the two species of *Trichiosoma* I have watched, the same apparently happy-go-lucky movements had an equally constant result; in them, however, the entry of the saws was so close to the edge of the leaf that one supposed the actual margin was desired. The egg did not appear to fill the pocket, but occupied its long axis, parallel with the edge of the leaf. The small space between the point of entry and the elliptic

pocket, usually so closed by the cuticle reattaching itself to the tissues below, that the point of entry seemed often to have nothing directly to do with the pocket and egg. The egg appeared to increase a little in size, and more completely fill the pocket. Eye movements of the larva within for some time before hatching were but slight and at considerable intervals. In *Trichiosoma tibiale* they had much amplitude and were frequent, just as in the sawfly species (*v.* "Trans. Ent. Soc. Lond." 1914, p. 180). What purpose this regular movement of rotation of the head serves is not obvious, but probably has some respiratory object.

On the day of her emergence (May 14th) this *C. sylvarum* laid twenty-four eggs. This seemed to satisfy her wants in the matter. On the 17th she laid five eggs, on the 18th she laid two, and made two pockets, but placed an egg in neither. On the 19th she laid two eggs, was quite strong and lively and inclined to buzz and fly. Thereafter she laid no more eggs, and though she continued to drink for a day or two, she gradually weakened, got lethargic and stupid, and died on May 23rd.

The two eggs last laid did not hatch, and the two before produced weak larvae that soon died. The dead ♀ contained a goodly number of eggs, I did not count them but perhaps 30 to 50.

I have now a fair number of larvae feeding, in their second and third instars. According to records, unfertilised eggs of *C. sylvarum* produce males, so this will probably be the result with these larvae.

One can hardly avoid coming to the conclusion from these observations, that in this species the newly emerged female hastens to lay a certain number of unfertilised eggs (producing males) and then pairs, the remaining fertilised eggs producing females. Further, that the reserved eggs destined to produce females after fertilisation, cannot be laid unfertilised to produce males. This is in some degree confirmed by the fact that a specimen sleeved by Mr. B. S. Harwood, was sent me after its death and equally with my specimen contained many eggs.

Further, more or less obvious, observations and experi-

ments seem necessary, to confirm, modify or upset this hypothesis. Assuming it to be correct, it applies for the present only to this species, and cannot, of course, without radical alteration refer to those sawflies whose unfertilised eggs are reported always to produce females.



1. Birch leaf with egg-pockets of *Cimbex sylvarum*. The short lines by the pockets are the incisions of entry of the saws.

2. Hawthorn leaf with egg-pockets of *Trichiosoma tibiale*.

OBSERVATION NESTS OF ANTS ON BATTLESHIPS.—MR. DONISTHORPE announced that on some of our battleships the men were much interested in observation nests of ants; and it was found that the ants were entirely unaffected by the firing of the great guns.

Papers.

The following papers were read :—

“ On new and little-known *Lagriidae* and *Pedilidae*,” by G. C. CHAMPION, F.Z.S.

“ On certain forms of the genus *Acraea*. A reply to M. Ch. Oberthür,” by H. ELTRINGHAM, D.Sc., M.A., F.Z.S.

Wednesday, October 4th, 1916.

Commander J. J. WALKER, M.A., R.N., F.L.S., Vice-President, in the Chair.

Election of a Fellow.

Mr. HOWARD M. PEEBLES, 13 Chesham Street, S.W., was elected a Fellow of the Society.

Vote of Condolence.

A vote of condolence with Mrs. Trimen, on the death of her husband, a former President of the Society, was passed unanimously.

Exhibitions.

METHOD OF DESTROYING LOCUSTS.—Mr. P. A. BUXTON called the attention of the Society to some remarkable work published in the Ann. Inst. Pasteur (Paris) for July and August 1916. A plague of the locust (*Schistocerca peregrina*) has been successfully stayed in Morocco by infecting a few thousands with the cocco-bacillus of a fatal enteritis. The individuals infected are devoured by the healthy ones, and so an epizootic may be started which may kill as much as 70 per cent. of the swarm of locusts. Experiments were conducted on one host which was advancing on a continuous front of 50 kilometres.

A NEW BRITISH ANT.—Mr. DONISTHORPE exhibited ♂♂, ♀♀ and ♂♂ of *Myrmica schencki*, Emery. He stated that it had been discovered at Sully, Glamorganshire, by Mr. Hallett last year, and had been identified and introduced as British by himself. He had recently been to stay with Mr. Hallett, and on September 16 they had found three colonies, ♂♂ being taken which had not been captured in Britain heretofore. He considered it to be a good and distinct species.

LEADEN-COLOURED ABERRATIONS OF *AGRIADES THETIS*.—Mr. L. W. NEWMAN exhibited two leaden-coloured ♂♂ of *Agriades thetis* and a curious ♂ having part of the wings leaden colour

and part the normal blue; all taken on the wing in September 1916 in East Kent. It was noticed when this leaden-coloured ♂ flew that normal ♂♂ chased it, taking it for a ♀; this happened in three cases. This leaden form very much resembled a ♀ at first sight. A friend, who was collecting on the same ground for aberrations, made a practice of netting every ♂, and before liberating it rubbing it so that he would know it had been examined. This removed most of the blue scales, and when flying they looked very curious; dozens of times ♂♂ were seen to chase these specimens thinking them to be ♀♀. These observations seemed to point to the fact that *thetis* ♂♂ are attracted to the ♀ by colour.

The Rev. G. WHEELER inquired whether the leaden-coloured specimens had been examined for androconia. As the rubbed specimens would have been deprived of them, it was possible that the absence of their scent might be the cause of their being mistaken for ♀♀.

Mr. NEWMAN said that they had not been examined, but should be.

Dr. COCKAYNE said that the fact that the ab. *semisyngrapha* of *A. coridon* was pursued by ♀♀ (as the typical ♂♂ are at Royston), looked as if they judged by colour.

TERATOLOGICAL COLEOPTERA.—Mr. O. E. JANSON exhibited a male specimen of *Carabus catenulatus* taken by Mr. Bonaparte Wyse on Snowdon, showing arrested development in the left posterior leg.

An example of *Tetropium gabrieli* bred by Mr. C. J. C. Pool from larch from Sutton Park, Staffs., in which the right antenna consisted of only eight joints and bore a basal branch of three joints.

A specimen of *Dorcadion egregium* from Mongolia, exhibiting a very rare instance of an almost symmetrical duplication of a limb, both of the antennae bearing a short three-jointed branch arising from the large basal joint, the antennae themselves being otherwise normal.

ABERRATIONS OF ARCTIA CAJA.—Mr. JANSON also exhibited on behalf of Mr. F. W. FROHAWK two remarkable varieties of *Arctia caja* reared this season from larvae from the Scilly Islands.

Papers.

The following papers were read :—

“Gynandromorphous Lepidoptera,” by E. A. COCKAYNE, M.A., M.D., F.E.S.

“The Rein-sheath in Plebeiid Blues. A correction of and addition to Paper VI,” by T. A. CHAPMAN, M.D., F.Z.S.

“Resting Attitudes in Lepidoptera. An example of Recapitulation in Habit,” by the same.

“The Evolution of the Habits of the Larva of *Lycaena arion*,” by the same.

“*Micropteryx* entitled to Ordinal Rank. Order Zeugloptera,” by the same.

Commenting on the second of Dr. Chapman's papers Comm. WALKER said that many tropical *Lycaenidae* and *Erycinidae* rest with their wings spread out and flat. He had also seen *Papilio ulysses* resting almost in the position of a *Catocala*.

Dr. CHAPMAN suggested that this might be only a temporary attitude.

Mr. KAYE, however, said that it was the usual resting attitude in most S. American *Erycinidae*, and that they rested on the underside of leaves, so that they could not be sunning themselves.

Mr. C. J. F. FRYER added that *Papilio polytes* rested the whole night in a flat position.

The Rev. F. D. MORICE inquired whether there was anything remarkable about the undersides of these *Erycinidae* which called for concealment, and Comm. WALKER said that they were often more brilliant than the uppersides.

Dr. LONGSTAFF commented on the rapidity with which many “Skippers” adopt their usual resting attitude on alighting.

In confirmation of certain observations in Dr. CHAPMAN's paper on *L. arion*, Mr. KAYE commented on the parasitism practised by the larva of this insect, observing that all parasitism was regarded as comparatively modern.

In agreement with the paper on *Micropteryx*, Mr. DURRANT remarked that for years he had considered that it was not lepidopterous, and was inclined to take up the same position

with regard to *Eriocrania*; Dr. CHAPMAN replied that the latter had lost an abdominal segment like the Lepidoptera.

Mr. BETHUNE-BAKER pointed out that though both *Micropteryx* and *Eriocrania* had scales, they were quite different from those of the (other) Lepidoptera, and that the ♂ organs also differed.

Wednesday, October 18th, 1916.

Dr. T. A. CHAPMAN, M.D., F.Z.S., Vice-President, in the Chair.

Election of Fellows.

Prof. E. BUGNION, La Luciole, Aix-en-Provence, France, and Rev. BRUCE CORNFORD, 13 Havelock Road, Portsmouth, were elected Fellows of the Society.

Exhibitions.

SOME NEW AND LITTLE-KNOWN EXAMPLES OF RESEMBLANCE IN BUTTERFLIES.—Mr. G. TALBOT, on behalf of Mr. J. J. JOICEY, exhibited:—

1. Chinese examples.—A remarkable form of the genus *Rahinda*, which strongly resembles *Danaïda tytia*, Gray. This was described as *Neptis imitans*, Ob., but the neururation agrees more with *Rahinda* than with any other genus. In size and pattern it departs widely from the known species of *Rahinda*. Associated with this mimic in China are the well-known ones: *Papilio restricta*, Leech, and *Hestina nama*, Doubl.

Athyma punctata, Leech, and *Limenitis albomaculata*, Leech, are well known to resemble one another closely in the male. The very rare females also resemble one another, and are brown like the similarly coloured *Neptis*, as for example, *N. chinensis*, Leech. The ♀ of *Abrota pratti*, Leech, also enters into this association, in colour and pattern.

2. South American.—A remarkable new species of *Vila*, of which we possess three specimens from the Upper Amazons

and Bolivia. This departs widely from any known species of the genus, and presents a strong resemblance to the Heliconiid genus *Eueides* as represented by *E. canides*, Stich., and its aberration *aides*, Stich. The general pattern of *Vila* is black and white, bearing a general resemblance to forms of *Ithomiinae*.

Prof. POULTON and Mr. KAYE commented on this exhibit.

EXPERIMENTS ON SPIDERS WITH BUTTERFLY FOOD AND OBSERVATIONS ON THE ATTACKS OF BIRDS ON BUTTERFLIES, IN BRITISH EAST AFRICA, BY THE REV. K. ST. AUBYN ROGERS. —Prof. POULTON gave an account of the following experiments and observations conducted in 1908, 1910, and 1911 at Rabai, about 14 miles N.W. of Mombasa. The spiders were all of the same species—large, black, with red and black legs and a marking something like a Chinese scroll on the back of the abdomen. Their webs were much stronger than those of any English species. In the dry season they disappeared, but at other times spun their webs in Mr. Rogers' verandah, where the experiments were carried out.

From the above description of the spiders, Mr. R. I. Pocock, F.R.S., believed that they were the same species as that made use of by Dr. G. A. K. Marshall in 1897 (Trans. Ent. Soc. Lond., 1902, pp. 319–322) and named by the Rev. O. Pickard-Cambridge, F.R.S., *Nephilengys malabarica*, Walck. This spider was found in the Oriental Region and South America as well as Africa, and Mr. Pocock was inclined to believe that its habit of spinning webs on houses—Mr. Marshall's as well as Mr. Rogers' experiments were conducted in verandahs—had led to its accidental spread in timber, building materials, etc. Its near allies, without this habit, were far more restricted in range.

Except when otherwise stated, the butterflies mentioned in the following list were always devoured by the spiders.

1908.

- Aug. 10. *Eurytela dryope* and 2 *Papilio demodocus*.
 „ 13. *Papilio nireus*.
 „ 14. *Mycalesis safitza*, *Phycscænura leda* and *Mylothris agathina*.

1908.

- Aug. 15. *Euxanthe wakefieldi*.
 Sept. 5. *Acraea insignis*.
 " 7. *Acraea neobule*.
 " 12. *A. doubledayi* and *A. rabbaiae*.
 " 26. *Amauris ochlea* refused.
 Oct. 17. *Amauris niavius* refused after trial.
 Nov. 2. *Hypolimnas misippus*.
 " 3. *Danaida chrysippus* rejected 3 times.
 Euralia wahlbergi.
 " 4. *Junonia clelia*.
 " 7. *Acraea natalica* ♀.
 " 20. A small bee got into the web and was released,
 great caution being exercised.
 " 21. *Euxanthe tiberius*.
 " 23. *Acraea natalica* ♀.
 Dec. 2. *A. niavius* offered. A small part was eaten and
 it was then rejected.
 Papilio demodocus neglected.
 " 3. *Papilio demodocus*.
 " 12. *Acraea serena*.
 " 19. *Danaida chrysippus* refused.
 Catopsilia florella.

1910.

- May 12. *Catopsilia florella* ♀.
 " 13. *Leuceronia argia* ♂.
 " 14. *Papilio dardanus* ♂.
 Aug. 6. *Tirumala limniace* refused.
 " 12. 2 *Acraea serena*.
 " 13. *Acraea serena* and *Mylothris agathina*.
 " 15. *Papilio dardanus* ♂.
 Pentila amenaïda.
 " 19. *A. serena*.
 " 20. *Papilio demodocus*.
 " 24. *Papilio nireus*.
 " 27. *A. serena*, *H. misippus* and *Euryphene senegal-*
 ensis.
 Sept. 2. *Pentila amenaïda*.
 10. *Acraea acara* refused by two different spiders.

1910.

- Nov. 12. Saw a drongo try to capture a *H. misippus* ♀, which was going to rest on a branch of an orange tree late in the afternoon. The bird missed the insect, and it flew away.
- Dec. 4. Again saw drongo try to capture *H. misippus* ♀ under identical circumstances. I heard the beak of the bird distinctly snap twice, but without success. After this both bird and insect got behind the tree, and I could not see what happened.

1911.

- May 28. Saw drongo make an attempt at two *Papilio nireus* which were fluttering together.
- „ 30. Saw drongo make a similar attempt at three *Papilio demodocus* under similar circumstances. Both attempts were futile, and in both cases the click of the bird's beak was distinctly heard.

Prof. Poulton said it was interesting to compare Mr. Rogers' results with those obtained by Dr. G. A. K. Marshall in 1897. The Natal spiders in these experiments were apparently more susceptible to the distasteful qualities of *Acraeas*, while, in the rejection of *Danaine* butterflies, the two sets of experiments gave very concordant results. The one *Acraeine*, *A. acara*, refused by the Rabai spiders was peculiarly unpleasant to the human sense of smell; Mr. W. A. Lamborn in fact considered that its western race *zetes* had a more offensive odour than any other *Acraea* known to him in the Lagos district.

Mr. E. E. GREEN remarked that when he kept specimens of *Mygale* (the "bird-eating spider") they used to take *Euploeas* freely.

Mr. BACOT said that a *Mantis* to which he gave a specimen of *Danaida chrysippus* ate the head, but rejected the body.

OBSERVATIONS BY DR. R. HANITSCH ON THE PROPORTIONS OF THE FEMALE FORMS OF *PAPILIO POLYTES*, L., ON SINGAPORE ISLAND.—Prof. POULTON exhibited all the females and a selection of the males of the series of *P. polytes* f. *romulus*, Cr.,

tabulated below. Dr. Hanitsch had written, May 11, 1916 : " All were caught on the wing, I am sorry to say, as I have not yet been successful in breeding them. They are all from Singapore Island, mostly from the residential part of the town."

Dates in 1916	<i>Papilio polytes romulus</i> , Cr.			MODEL
	Non-mimetic male.	<i>Cyprus</i> , Hübn., ♀, male-like.	<i>Polytes</i> , L., ♀ mimicking <i>P. aristolochiae</i> .	<i>Papilio</i> (<i>Phar-macephagus</i>) <i>aristolochiae</i> , F.
January . .	7		5	3 ♂
February 11 .	2	4		
February 14 .	4		1	
February 15 .	5	2		
February 16 .				1 ♀
February 17 .	3	1	2	
February 19 .				1 ♀
May 1 . . .	3	1		
May 6 . . .	3			
No data . .			1	
Totals . .	27	8	9	5

The mimetic females were all of the *polytes* form with white in the hind-wing cell. In three of those taken in January and in one taken February 17 the submarginal red spots of the hind-wing upper surface were, except at the ends of the series, greatly reduced and some of them altogether absent. There was, however, no corresponding reduction on the under surface, where the whole of the series remained distinct and well marked. This form of the *polytes* female represents a closer approach to the model; for in *aristolochiae* the submarginal spots are dim and indistinct on the upper surface of the hind-wing, but bright red and startlingly conspicuous on its under surface.

Dr. Hanitsch's results contrasted sharply with those recorded by Dr. Seitz, who found only the mimetic *polytes* females at Singapore (Proc. Ent. Soc. Lond., 1913, p. xxxii.).

It was, however, possible that the discrepancy was due to a difference between Singapore Island and the nearest mainland, and Prof. Poulton hoped that Dr. Hanitsch would be able to settle the matter by collecting on the mainland as well as a further series on the island. Different observers had given very different estimates for Hong Kong, and here too it was hoped that indiscriminately collected specimens or, better still, the imagos reared from indiscriminately collected larvae would show what are the actual proportions.

SPECIALISATION IN THE RESPONSE OF BUTTERFLIES TO STIMULI.—Prof. POULTON drew attention to an observation an *Agriades thetis* (*bellargus*), Rott., made September 12 of this year on the steep slopes of Maiden Castle near Dorchester. He found that when a butterfly was carefully approached so that it was evidently unaware of the presence of the observer, it could be gently tapped or stroked with the feathery end of a long grass stem without causing it any alarm. Often, when thus disturbed, a butterfly would fly a few inches and then return to the same flower-head. It was evident that such stimuli, which would continually be caused by the wind under natural conditions, were sharply distinguished from those normally caused by possible enemies. It was, of course, only what we should expect, but it was interesting to obtain the experimental demonstration in so simple a way.

A GYNANDROMORPHOUS ANT.—Mr. DONISTHORPE exhibited an ergatandromorph of *Myrmica laevinodis* which he had taken in his garden at Putney on October 11. It was very like an ordinary worker in appearance, but by the curious jerky manner in which it walked he at once saw there was something strange about the insect. Under the lens it is seen to have a single ocellus (the left lateral one), the mesothorax enlarged on one side, a long spine on the left side of the epinotum and a very short one on the right. The gaster shows five segments and is mostly black, and the legs are striped with black. This is the 35th known gynandromorphous ant in the world, the 6th *Myrmica*, the 9th British specimen, and the 8th described by the exhibitor.

MERMITHOGYNES OF *LASIUS FLAVUS* AND *L. ALIENUS*.—Mr. W. C. CRAWLEY exhibited mermithogynes of *Lasius*

flavus and *L. alienus* taken at Porlock. Only these two species were affected and only in a few nests. Several ♀♀ contained two of the worms apiece. The wings and ovaries of the imagines were very small, but otherwise normal ♀♀ were developed. It is supposed that the worm enters the larva, but its subsequent history is unknown. The exhibitor first found them in the same two species of ant in Oxfordshire in 1899 and 1900. Prof. W. M. Wheeler found similar worms in ♀♀ of the American species *Pheidole commutata*, where the ♀ assumed a quasi-female form, with ocelli.

WINGED FEMALES OF *FORDA FORMICARIA* AND *F. VIRIDANA*.—Mr. CRAWLEY also exhibited the alate ♀♀, hitherto unknown, of the common ant aphids, *Forda formicaria*, Heyden, and *F. viridana*, Buckton, taken at Porlock with *Lasius alieno-niger*.

Mr. DONISTHORPE commented on the rarity of both exhibits.

JAPANESE FEMALE PSYCHID AND CASE.—Dr. COCKAYNE exhibited a ♀ Psychid bred July 1916 from a larva found on a Japanese dwarf cedar at Hammersmith, together with the larval case.

Dr. CHAPMAN observed that the case was near that of *Acanthopsyche atra*.

MELANIC AND OTHER ABERRATIONS OF BRITISH GEOMETERS.—Mr. L. W. NEWMAN exhibited true melanic (unicolorous black) specimens of *Eupithecia lariciata* from Warwickshire; melanic specimens of *Boarmia consonaria* from Kent; dark type, intermediate and melanic specimens of *B. consortaria* from Warwickshire; also on behalf of Mr. G. B. Oliver two curious aberrations of the latter species, a ♀ almost entirely cream-coloured, and a ♂ with both right wings heavily and the left hind-wing slightly marked with yellow.

PUPAL CELL OF *DYTISCUS MARGINALIS*.—Mr. H. MAIN exhibited a pupal cell *in situ* of the beetle *Dytiscus marginalis*, together with a spectroscopic photograph of the pupa in its cell, showing how it rested on its extremities, the rest of the body being unsupported.

RARE BRITISH COLEOPTERA.—Mr. BEDWELL exhibited on behalf of Mr. C. J. C. POOL, who was present as a visitor, an exceptionally large ♂ of *Emus hirtus* taken near Rochester

in September, and also a specimen of *Megapenthes lugens* taken by Mr. D. Cumming, in May 1915, on holly blossom near Lyndhurst.

Mr. BEDWELL also exhibited a living specimen of *Elater coccinatus* from Waltham Abbey, with examples of *E. pomonae* and *E. sanguinolentus*, and the thorax of each species mounted separately for comparison.

Papers.

The following papers were read :—

“Falkland Islands Diptera,” by C. G. LAMB, M.A., B.Sc.; communicated by F. W. EDWARDS, F.E.S.

“Observations on the Growth and Habits of the Stick Insect, *Carausius morosus*, Br.,” by H. LING ROTH; communicated by Prof. POULTON, D.Sc., F.R.S., etc.

Wednesday, November 1st, 1916.

Dr. C. J. GAHAN, M.A., D.Sc., Vice-President, in the Chair.

Election of Fellows.

Messrs. HASSAN EFFLATOUN, Choubrah Avenue, Cairo, Egypt, and S.E. Agricultural College, Wye; FRANK HANNYNGTON, Mercara, Coorg, S. India; HARRY HADEN MAY, Blackfriars House, Plymouth; and AKIO NOHIRA, Tchiyoji, Ottagigun, Kyoto, Japan, were elected Fellows of the Society.

Nomination of Special Life Fellows.

The names of Col. YERBURY and Prof. MIALL, nominated by the Council as Special Life Fellows, were read for the first time.

Exhibitions.

AN OBSERVATION BY MR. C. O. FARQUHARSON ON THE HESPERID BUTTERFLY, *RHOPALOCAMPTA FORESTAN*, CRAM.—Prof. POULTON gave an account of the observations described

in the following note extracted from a letter written June 29, 1914, by Mr. Farquharson to Mr. W. A. Lamborn :—

“ On the 24th of June, 1914, I observed on the arm of a verandah chair in my house at Ibadan, a specimen of the Hesperid butterfly *Rhopalocampta forestan*, Cram. This species is locally very common, and to find it in or about a house is not at all unusual. The hour was about 1.30 p.m., the day being dry, with little breeze, and overcast sky, typical of a “dry” day in the wet season. On the previous day there had been heavy rain. For no special reason, except to admire the creature, I stopped about a yard from where it was resting. Though on the alert, it did not attempt to fly away.

“ I noticed that it was eagerly sucking up a drop of liquid from the surface of the chair arm, and before I had time to wonder how the drop of moisture came to be there, and why it should not have gone to fuller sources, I was astonished to see it push forward the slightly incurved abdomen to within a few millimetres of the end of its proboscis, and eject a drop of clear fluid, which was absorbed in a few seconds. I watched this proceeding being repeated several times, when it struck me that I might time the operation. A drop was ejected about every ten seconds, sometimes a little longer period elapsing, but at no time was the interval less than five seconds. How long this might have gone on I cannot say, but I continued watching for quite five minutes, after which, fearing that the butterfly might suddenly fly off, I captured it. I kept it for a short time in captivity, but it was too alarmed to renew the proceedings.

“ Sometimes the drop was almost deposited on the proboscis by the abdomen being thrust well forward, but several times the drop was evidently shot forward, suggesting actual squirting. It was further noticed that the abdomen was rather swollen, recalling in appearance that of a newly emerged imago.

“ What interpretation Lepidopterists may put on this I cannot say. As it happens, there ought to be an abundance of food for butterflies at this time. A plot of Zinnias now in full flower in my garden may fairly be said to swarm with

butterflies at present, *Rhopalocamptas* being not infrequent among the visitors. It may be that the greedy Skipper absorbed more nectar than it could immediately digest and stored the surplus. This raises the question of where this surplus was stored. If this takes place in the so-called 'sucking stomach' or 'food reservoir,' why was it necessary to 'excrete' it before it could be assimilated in the ordinary way, and by what channel did it pass to the posterior? These questions are for the anatomists to answer.

"It is here assumed that the excreted liquid really was nectar, though I was unable to taste it."

Prof. Poulton said that it might be remembered that his son, Dr. E. P. Poulton, had made a very similar observation in 1912 on a small European Skipper believed to be *Hesperia linea*, L. (Proc. Ent. Soc. Lond., 1913, p. xl). In this case Dr. Poulton described the insect as trying to drink the dried ink on his paper and then discharging the liquid apparently as a solvent. This record suggested that there may have been a trace of sugar or some other substance desirable to a Skipper—perhaps even ink a second time—on the arm-chair. Now that the habit had been observed in Hesperids so utterly different as these two we might feel confident that it was widespread in the group, and that the full meaning would probably soon be made out.

[Dr. E. P. Poulton has since read Mr. Farquharson's account and has added the following details, which shew that the behaviour of the two insects was remarkably similar.

"The drop of liquid was about the size of a small pin's head; it was clear and colourless. The insect protruded its abdomen forward beneath the thorax, and the fluid came out from the tip. This was done several times. Each time the proboscis was moved about so as to disperse the drop over the paper, which caused the ink to smudge. It was then sucked up by the proboscis. It looked as if the object of the fluid was to moisten the ink, which had already dried on the paper. The ink was ordinary blue-black ink, bought in Germany or Austria."]

MAN ATTACKED BY A TABANID FLY OF THE GENUS *PAN-
GONIA* ON THE WING.—Prof. POULTON exhibited the specimen

referred to in the following note, written July 2, 1916, by Dr. G. D. H. Carpenter, then attached to the Belgian Expeditionary Force operating in German East Africa, west of the Victoria Nyanza. The fly was probably a form of *Pangonia oldii*, Aust., although this species had not hitherto been recorded from so northern an area.

“ I was bitten one day [June 16, 1916] in this locality [30°, 55' E.; 2°, 5' S.] by a *Pangonia*, the first I have met. I heard its hum (an unmistakable *Tabanid* hum), and looking towards the sound saw what I thought was a fine Bombyliid hovering at my bare forearm sucking up moisture from the skin, as Syrphids often do. The proboscis seemed to me to be laid along the surface. I could not quite reconcile the *Tabanid* hum and the Bombyliid appearance, and was interested to notice that the proboscis was shrinking, *i. e.* its tip had penetrated, but obliquely and so gradually that I had not felt it. So it seems that this species feeds on the wing. I send the specimen. I had always wondered how *Pangonia* managed its long proboscis.”

MALLOTA CIMBICIFORMIS, FLN., BRED FROM ROTTEN WOOD.—Prof. POULTON exhibited examples of *M. cimbiciformis* bred by Mr. H. Britten of the Hope Department. Mr. Britten had given an account of his observations in the following note :—

“ The larvae were found on April 24, 1916, in a recently cut elm tree at Thame Park, Oxon. The entire centre of the tree was completely rotten, and only a thin shell of living wood remained. The hole left by a large branch which had blown off many years previously gave access to the hollow, which contained at least three feet of debris from old nests of the stock dove, several still retaining fragments of the old eggshells, with one rotten, much discoloured egg. Below this pile of old nests, where the wood was sodden with water, and about eight feet from the ground when the tree was standing, I came across a large number of rat-tailed larvae which seemed to be different from anything I had previously seen, and, as they appeared to be almost full grown, I took a number to attempt to breed the fly. The larvae commenced to pupate at the end of April, the pupae still remaining in the rotten wood throughout which other larvae were feeding. In order

to ascertain whether pupation occurred in the same manner in nature, I again visited the hollow tree and succeeded in finding the pupae still buried in several inches of the rotten wood.

“The first fly emerged on May 22, and they continued to appear until June 22.”

PTERONUS SERTIFER, GEOFF., BRED FROM PINE.—The Rev. F. D. MORICE exhibited specimens of *Pteronus sertifer* ♂♂ and ♀♀, and read the following notes:—

I exhibit a number of ♂♂ and ♀♀ which I have reared (some in a glass breeding-cage, others in a closed large tin box) from larvae sent to me by Mr. E. E. Green, which abounded on pines at Camberley in June. The species is *Pteronus* (= *Lophyrus*) *sertifer*, Geoffr. (Fourcr.). The cocoons were formed in July. Emergences of the imago began towards the end of September, and have continued nearly daily ever since.

Last year I exhibited about 100 of the same species reared similarly from larvae taken by Mr. Green and myself at the same place and time of year. They were without a single exception females! But this year, though females still largely preponderate, I have obtained no less than 26 specimens of the other sex.

Curiously enough (but this must have been a mere accident), for the first week or so ♂♂ only appeared in the glass cage and only ♀♀ in the tin box. But afterwards ♀♀ appeared freely in both places, and at least one ♂ in the tin.

Owing to other engagements I have had very little opportunity to watch the behaviour of the imagines. They generally appear very lethargic and stupid insects, especially the ♀♀. They will sit motionless for hours together on a pine needle, but now and then in bright sunshine wake up and move about in an aimless fashion on the needles, and sometimes climb up the sides of the cage, which generally ends in their tumbling down and lying on their backs kicking helplessly. Sometimes they simply lie so till they die. Oftener they right themselves with difficulty, crawl back to the pine, and again remain motionless on the needles.

The colour of the ♀♀ seems to me probably *cryptic*. It agrees very well with that of the reddish-brown pine stems,

especially when their transparent and crumpled wings are closed, as generally happens, over the abdomen. They are then not easy to see at all, so closely do they correspond with their surroundings. And when they *are* seen, they look rather like small twigs or buds of the food-plant than living insects, so long as they remain without motion. The ♂♂, being black above, are much more easily distinguished.

I have tried hard to induce the ♀♀ to oviposit, but I do not believe that any have done so. Some I have removed, before they emerged from the cocoon, to a separate glass, containing a small live pine tree in a flower pot. Others I left in the cage with the ♂♂, and supplied fresh branches from a larger tree. But nothing seems to suit them! I have never seen any ♀ attempt oviposition, though such as I have killed and dissected have always been full of eggs. Nor have I ever seen the ♂♂ and ♀♀ take any notice of one another. The ♀♀, I think, must sometimes fight; as, both this year and last, many of that sex were observed to have got one or both of the antennae more or less severely mutilated,—apparently bitten through! But I never caught them in the act, and never saw them take any apparent interest, friendly or unfriendly, in their fellow-captives.

The so-called saw of this and other species of the same genus is a very complicated and singular instrument. Its outlines as a whole, as viewed from the sides and also from above, remind me of the beak of a cockatoo, the “supports” representing the upper mandible, and the “saws” the lower. Viewed from above the “supports” are exceedingly broad at their bases, while their apices are exceedingly narrow, so that they make a sort of long spine which bends downwards and forms the apex of the entire organ. As for the “saws,” they are blunt at the apex, and toothed very strongly and sharply not on the lower edge, but on their exterior surfaces diagonally, with parallel rows of projecting spines. Such an implement, driven through the tissues of the pine-needles, in which the eggs are said (truly, no doubt, though I never saw the process) to be deposited, must necessarily, as it appears to me, combine the actions of (1) a *plough*, and (2) a series of parallel rakes, or, in other words, a *harrow*! In this case, certainly,

besides simple *cutting* of the substance penetrated, there must also be *splitting* and *mangling* of it on a considerable scale. Anything like a "scissors"-action, such as Dr. Chapman has described in the case of *Trichiosoma* (a Cimbicid), must in the present case—if it exists at all—be quite subordinate, since the rows of teeth, which lie on the exterior surfaces of the paired saws, cannot possibly come into contact with each other, any more than those of two harrows placed back to back. But I should discuss this matter with a great deal more confidence, if I had ever seen the saws in actual use, or even the wounds inflicted by them; and in this, as yet, I have been altogether disappointed.

Mr. E. E. GREEN said that he had observed the larvae in myriads on small pines at Camberley, on an area of a quarter of an acre, and that they were doing much damage by eating off the older needles.

A VERY RARE NEUROPTERON.—Mr. G. T. PORRITT exhibited specimens of *Symphorobius striatellus*, Klap., and of *S. elegans*, Steph., for comparison. *Striatellus* was differentiated from *elegans* two years ago by Mr. Kenneth J. Morton (Entom., August 1914, pp. 209–212). As yet only four British specimens had been recorded, from Nottinghamshire, Lincolnshire, and Kent; but Mr. Porritt had no doubt that if the collections of the late Mr. McLachlan and the late Mr. Alfred Beaumont could be got at and examined, specimens would be found in them. Judging, too, from the widely separated localities of the specimens known, the species is widely distributed in Britain.

GYNANDROMORPHOUS LEPIDOPTERA, ETC.—Mr. G. TALBOT exhibited on behalf of Mr. J. J. JOICEY :—

(1) A gynandromorph of *Papilio lycophron*, race *phanias*, R. and J., from North Peru.

(2) *Polygrapha cyanea*, G. and S., the unique and hitherto undescribed female, apparently a mimic of *Opsiophanes*.

(3) A hybrid gynandromorph of *Amorpha populi* × *Smerinthus ocellatus*.

Papers.

The following papers were read :—

“ Further notes relating to the Jurinean Genera of Hymeno-

ptera," by the Rev. F. D. MORICE, M.A., F.E.S., and J. HARTLEY DURRANT, F.E.S.

"On a collection of Heliconine forms from French Guiana," by J. J. JOICEY, F.E.S., and W. J. KAYE, F.E.S.

The latter was illustrated by a large collection of *Heliconius melpomene*, which was exhibited by Mr. KAYE, including, besides typical *melpomene*, *melpomenides*, *lucinda*, *lucia*, *melanippe*, *diana*, *deinia*, *faustina*, *karschi*, *eulalia*, *cybele*, *funebri*, *tyche*, *hippolyte*, *augusta*, *rufolimbata*, *penelope*, *thelxiope*, *thelxiopeia*, *aglaopeia*, besides some dozen newly described forms. The series showed a complete transition of forewing pattern from the red patch to the "*thelxiope*" group of yellow spots with (1) a black hindwing, (2) a red basal streak on hindwing, and (3) a red basal streak and flame streaks on hindwing.

Wednesday, November 15th, 1916.

Comm. J. J. WALKER, M.A., R.N., F.L.S., Vice-President, in the Chair.

Election of a Fellow.

Capt. H. DOUGLAS SMART, R.A.M.C., Shelley, Huddersfield, was elected a Fellow of the Society.

Proposed New Bye-Law.

The following proposed new Bye-law was read for the first time.

"Chap. xxiii. The Society shall not and may not make any dividend, gift, division or bonus in money unto or between any of its members."

The Secretary explained that this bye-law was necessary in order to comply with the Act of Parliament which enabled Scientific Societies, when registered as such, to be free from all local rates, which would benefit the Society to the extent of some £10 or £11 a year. The proposed bye-law copies the exact words of the act.

Nomination of Officers and Council.

The following list of Fellows nominated by the Council to serve as Officers and Council for 1917, was read:—

President, C. J. GAHAN, M.A., D.Sc.; *Treasurer*, A. H. JONES; *Secretaries*, COMM. J. J. WALKER, M.A., R.N., F.L.S., and Rev. G. WHEELER, M.A., F.Z.S.; *Librarian*, G. C. CHAMPION, A.L.S., F.Z.S.; *Other Members of Council*, A. W. BACOT; T. A. CHAPMAN, M.D., F.Z.S.; E. A. COCKAYNE, M.A., M.D.; W. C. CRAWLEY, B.A.; H. WILLOUGHBY ELLIS, F.Z.S.; J. C. F. FRYER, M.A.; A. E. GIBBS, F.L.S., F.Z.S.; G. B. LONGSTAFF, M.A., M.D.; S. A. NEAVE, M.A., B.Sc., F.Z.S.; R. M. PRIDEAUX; Hon. N. CHARLES ROTHSCHILD, M.A., F.L.S., F.Z.S.; A. E. TONGE.

NEUROPTERA AND ODONATA FROM SALONICA.—Mr. W. J. LUCAS exhibited, on behalf of Captain E. F. STUDD, R.F.A., a Fellow of the Society now serving with the Expeditionary Force at Salonica, several Neuroptera and Odonata collected in the neighbourhood of Salonica, viz.:—

Palpares libelluloides, L., ♂; *Calopteryx splendens*, Har., ♂; *Crocothemis erythraca*, Brullé, ♂, full-coloured; *Orthetrum brunneum*, Fonsc., ♂, full-coloured; *Onychogomphus uncatulus*, Charp., 2 ♂♂; *Platycnemis pennipes*, Pall.; *Sympetrum fouscolombii*, Selys, 2 ♀♀.

Mr. LUCAS also exhibited various Neuroptera and Odonata taken by Mr. P. J. BARRAUD, F.E.S., near Salonica in April, May, and June 1916, and transmitted to him through Mr. A. E. Gibbs. **Neuroptera**—one *Nemoptera sinuata*, Oliv.; one male *Ascalaphus macaronius*, Scop., var. *kolyvanensis*, Laxm. **Odonata**—one female *Libellula fulva*, Müll.; one male *Orthetrum brunneum*, Fonsc., in teneral colouring; one male *Gomphus schneiderii*, Selys, somewhat teneral; one female *Anax parthenope*, Selys; one male and one female *Aeschna isosceles*, Müll., with wings rather yellow; one very teneral male *Epallage fatime*, Charp.; two male *Calopteryx splendens*, Harris, one teneral, the other full-coloured, both large specimens with broad wings; a male and a female *Platycnemis pennipes*, Pallas, of the var. *lactea*; one male *Agrion pulchellum*, Lind.

THE INHERITANCE OF AN EXCESSIVELY SMALL LOCAL COLOUR VARIATION IN A HAWAIIAN WASP.—Prof. POULTON said that his recent address (May 25, 1916) to the Linnean Society on the inheritance of small variations had suggested the following striking evidence to Dr. R. C. L. Perkins, D.Sc., who had permitted him to bring it before the Entomological Society, and had kindly lent the series of specimens exhibited to the meeting. Dr. Perkins' paper "On the Colour-groups of the Hawaiian Wasps," in *Trans. Ent. Soc.*, 1912, p. 667, and *Proc. Ent. Soc.*, 1912, p. lvi, might be consulted for further examples of local colour variation.

"If you were to look at my series of *Odynerus molokaiensis*, Perk., from the intermediate islands Maui and Molokai, and that of *O. xerophilus*, Perk., from Oahu, you would find that the former varies from a black-bodied insect to one with two yellow abdominal bands and some thoracic spots, all sorts of slight intermediates being present. Just beyond the point where the development in colour of *molokaiensis* ends, the Oahuan form *O. xerophilus* begins, so that the distinction between them at this point is of the most trivial character (far less than that which separates the extreme varieties of *molokaiensis* itself), and under ordinary circumstances would, I think, by any hymenopterist be called a 'small variation.' Yet it is possible to distinguish absolutely every Oahu example (*xerophilus*) from any of the others (*molokaiensis*) by the fact that the 2nd abdominal band of the former always extends far enough forward (*i. e.* is broad enough) to include distinct punctures, while that of *molokaiensis* never does so. I doubt whether there is any other constant character to distinguish these forms! Yet this trifling difference is so perfectly inherited it has never been found to break down!

"The fact is that the Oahu form (*xerophilus*) is always associated with other species with bands well developed like its own, while the other mixes largely with black-bodied species or such as have only inconspicuous or subobsolete bands, not noticeable in life.

"It would seem that the presence of a certain width of band in the one case, and in the other of a lesser width or even total absence of banding, must be of great importance in the life of

the creatures, since such a trivial colour distinction is always maintained and transmitted. Since *xerophilus* associates with several other species which have similarly developed bands one naturally supposes that the colour of all these is kept uniform for some definite purpose, or, as you would say, so that they may as nearly as possible resemble one another.

“ In the one case (*xerophilus*) the banding probably never decreases to such an extent that it plays no part in life or when the insect is on the wing, while in *molokaiensis* it either is unnoticeable or at least never conspicuous enough to make this form discordant with the other species among which it flies.

“ On reading this over I see that you might possibly infer, from what I said about ‘ punctures ’ in the abdominal band, that there is a difference in structure. This is not so, but the punctures not reaching quite to the apex of the 2nd segment are excluded from the very narrow apical band of *molokaiensis*, but included in the rather wider one of *xerophilus*.”

THE HABITS OF *PANGONIA VARICOLOR*, WIED., OBSERVED IN S. AFRICA BY W. J. BURCHELL IN 1813.—Prof. POULTON exhibited a *Pangonia* captured by Burchell at Uitenhage on Nov. 27, 1813. The species had been kindly determined as *P. varicolor* by Mr. E. E. Austen. The specimen, which was one of the group with a very long proboscis, bears “ 1332 ” in Burchell’s handwriting, and under this number, in his manuscript “ Catalogus systematicus Insectorum in Itinere per Africam australem extratropicam Annis 1811–1815 captorum a Gul. Joh. Burchell,” he had written the following entry :—

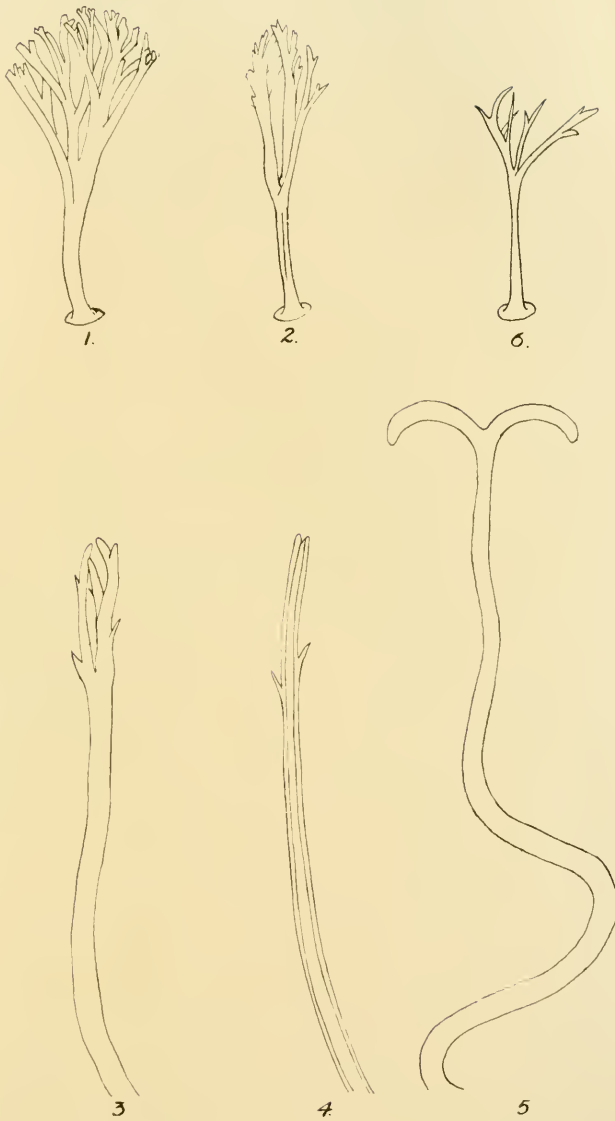
“ *Pargenia*

“ 1332 . . . 27. 11. 13 Uitenhage.

The fly that sucks the oxen without settling upon them.”

“ *Pargenia* ” was probably an erroneous rendering of the generic name. Westermann, as Dr. Guy A. K. Marshall had pointed out at the last meeting, recorded the same fact in 1821 (Germar’s “Magazin der Entomologie,” Bd. IV, p. 427), stating that *Pangonia rostrata*, L., was only able to attack when on the wing.

THE EMERGENCE OF *CYDIA DESHAISIANA*, LUCAS (CARPO-



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Fig. 1-5 DIFFERENT KINDS OF HAIRS ON THE LARVA OF ANERGATES ATRATULUS SCH. Fig. 6 HAIR OF LARVA OF TETRAMORIUM CESPITUM (ALL $\times 475$). LENGTH OF Fig. 1, 0.087 MM.; FULL LENGTH OF Fig. 5, NOT INCLUDING CURVES, 0.25 MM.

CAPSA SALTITANS, WESTW.).—Prof. POULTON exhibited the moth and pupa-case, as well as the Euphorbiaceous seed from which both had emerged, having pushed open the hinged lid prepared by the larva. Another seed containing a dead larva, but nevertheless prepared for emergence, was also exhibited.

Mr. DURRANT remarked on the extraordinary number of current errors in connection with this insect. Both generic and specific names were incorrect—indeed *saltitans*, Westw., did not even exist. Errors were also current with regard to the habitat, the food-plant, and the native name, and even the genus, of the latter.

LARVAL HAIRS OF ANERGATES ATRATULUS.—Mr. W. C. CRAWLEY exhibited drawings of five different varieties of hairs on the larva of the parasitic ant *Anergates atratulus*, comprising small bush-like hairs with truncate points; similar ones but with fewer branches and acuminate points; longer ones with a bunch of points at the apex; still larger ones, straight with one or two sharp lateral spikes; and longest of all, curved spring-like hairs with anchor-shaped tips. A single bush-hair of *Tetramorium caespitum* (the host) larva was given for comparison. It was similar, but much less developed than in *Anergates*. (See Pl. A.)

Mr. Crawley enquired whether similar hairs were known to exist in other larvae, and though such extremely ramose hairs appeared not to be known, the Rev. F. D. MORICE said that ramose hairs occur in the larvae of two genera of Sawflies, and in the imago of most bees. Dr. CHAPMAN observed that branched hairs occur in the larvae of many Lycaenids, and Dr. GAHAN added that they occur also in some coleopterous larvae.

Papers.

The following papers were read:—

“An Intersex of *Amorpha populi*,” by E. A. COCKAYNE, M.A., M.D., F.E.S.

“The Relation between the Secondary Sexual Characters and the Gonads and Accessory Sexual Glands in Insects,” by the same.

“On the Factors which determine the Cocoon Colour in *Plusia moneta* and other Lepidoptera,” by Mrs. ONERA H. MERRETT HAWKES, B.Sc. (Lond.), M.Sc. (Birm.) (communicated by Dr. A. D. Imms, F.E.S.).

The latter paper gave rise to a long discussion in which many Fellows took part, giving their experience as to the effect of damp on the colour of cocoons, and it was agreed that further experiments on the subject are very desirable.

Wednesday, December 6th, 1916.

Commander J. J. WALKER, M.A., R.N., F.L.S., Vice-President, in the Chair.

Election of Special Life Fellows.

Prof. L. C. MIALL, F.R.S., Norton Way N., Letchworth, and Col. J. W. YERBURY, F.Z.S., 2 Ryder Street, St. James's, S.W., were elected the first Special Life Fellows of the Society.

Appointment of Auditors.

The Chairman announced that on behalf of the President he had appointed the following Fellows as Auditors of this year's accounts.

On the Council: MESSRS. A. W. BACOT, H. WILLOUGHBY ELLIS, and J. C. F. FRYER.

Not on the Council: MESSRS. R. ADKIN, R. W. LLOYD, and Rev. F. D. MORICE.

Exhibitions.

SCARCE AND LOCAL INSECTS.—Mr. J. C. F. FRYER exhibited, (1) on behalf of Mr. H. F. FRYER, specimens of the beetles *Anthicus bifasciatus* and the bug *Lygus rubicundus*, two species which have only been recorded in Britain from a restricted area in Cambridgeshire and Huntingdonshire. (2) Specimen apples illustrating the serious injury caused by the bugs *Plesiocoris rugicollis* and *Orthotylus marginalis*, which appear to have adopted apple as a food-plant only within comparatively recent years.

Mr. CHAMPION commented on the change of food-plant illustrated by the latter exhibit.

RHOPALOCERA FROM FERNANDO PO.—Dr. H. ELTRINGHAM exhibited examples of *Papilio dardanus* ♂, taken by Mr. G. H. Bullock (British Vice-Consul at Fernando Po) near Santa Isabel, Fernando Po, and kindly presented to the department, and pointed out that in the fore-wing, the general line of the inner edge of the black area was nearly straight. It was a remarkable fact that this feature was essentially eastern and ancestral, being characteristic of Madagascar and Ethiopian forms, examples of which were shown, together with specimens from other localities. In the latter the inner edge of the black area was shown to be always markedly concave. Female examples of *dardanus* received from the same locality were of the *hippocoon* form, and the model *Amauris niavius* was of the typical pattern.

Similar instances of the recurrence of certain eastern features in the extreme west were mentioned, notably the ♀ of *Acræa egina* subsp. *medea*, which was a black-and-white form closely resembling *A. egina* ♀ f. *alba* found by Dr. Carpenter on Sesse Island.

The exhibitor also showed a curious example of *Danaida chrysippus* f. *alcippus* taken near S. Isabel, Fernando Po, and entirely devoid of yellow pigment, the result being that the specimen had the appearance of a monochromatic representation of the insect. In his opinion it showed that two pigments only exclusive of the white were nominally present in the wings, the beautiful shades of yellow in the fore-wings being due to the varying density of the sepia pigment, precisely as a shaded effect may be obtained in chromo-lithography. That the absence of yellow pigment was not due to contact with chemical substances was shown from the following extract from a letter from Mr. Bullock, in reply to inquiries relating to the specimen.

“ I remember catching the grey *Danaida chrysippus* quite well. It was on a small shrub about twenty yards in front of my house, I think a rose-tree, since removed. It was one of the first butterflies I had caught; but I realised its different colour before I caught it, and the colour has not changed

since. It was in 1914, as marked on the paper, and of course after my arrival here in October, but I do not remember the date exactly."

Mr. E. E. GREEN observed that in Ceylon the yellow pigment was absent in the case of three species of *Teracolus*, and Dr. ELTRINGHAM added that in *Acraea egina* the red pigment failed in Sesse Island.

THE TRAGIC HISTORY OF A BUTTERFLY, PROBABLY *HYPOLIMNAS BOLINA*, L., FROM EASTER ISLAND.—Prof. POULTON said that his friends Mr. and Mrs. Scoresby Routledge, who had been investigating the wonderful stone images of Easter Island, had tried to send to him the only butterfly seen during their visit. It was quite unknown to the natives, who have no word for "butterfly," and spoke of the visitor as "the little bird." Mr. Routledge captured the insect, and it was packed up and handed with letters, etc., to von Spee's German Pacific Squadron when it touched at Easter Island. Letters were posted at Valparaiso and duly received, but the package with the butterfly was probably retained under the impression that the contents were valuable. If this interpretation were correct there could be little doubt that the specimen went down in the Battle of the Falkland Islands. Prof. Poulton had shown examples of *H. bolina* to his friends, who felt sure that their butterfly was a male of this species.

W. L. W. FIELD'S RESEARCHES UPON N. AMERICAN BUTTERFLIES OF THE GENUS *LIMENITIS* (*BASILARCHIA*).—Prof. POULTON said that he wished to draw attention to three important papers on the species of *Limenitis* (*Basilarchia*) from the north-eastern United States, contributed by W. L. W. Field, of Milton, Mass., to "Psyche." In the first paper, "Problems in the genus *Basilarchia*" (vol xi, Feb. 1904, p. 1, Plates I-III) the author summarised "the existing knowledge of these forms, in order to prepare the way for methodical investigation." After defining the range and giving the larval food-plants of the three generally recognised species—*arthemis*, Drury, *astyanax*, Fab., and *archippus*, Cram.,—he described and figured the problematic forms which seemed to connect the above-named insects—*proserpina*, Edwards, between *arthemis* and *astyanax*; *arthechippus*, Scudder, between

arthemis and *archippus*; and an unnamed form between *astyanax* and *archippus*.

1. *Proserpina*.—Several different forms were figured, showing a transition from those more like *astyanax* to those approaching *arthemis*. The complete historical account included a full summary of Scudder's strong grounds for concluding that *proserpina* was a hybrid produced by the crossing of *arthemis* and *astyanax* in the narrow zone where these two forms met and overlapped.

2. *Arthechippus*.—Only three examples, all males, and one uncaptured specimen, were known to the author.

3. The unnamed form.—Only three or four examples were known. The sex of one only was given—a male.

This first paper stated the facts and the problems, and expressed the author's hope that he might succeed in reaching their solution by experimental breeding.

Field's second paper, "The offspring of a captured female *Basilarchia proserpina*" (vol. xvii, No. 3, 1910, p. 87, Plate VI), described a breeding experiment made in 1908 with a female *proserpina* taken Aug. 14 at Springfield, Vt. The butterfly refused all the available food-plants of *arthemis*, but laid 31 eggs on wild cherry (*Prunus serotinus*) a food-plant of *astyanax*. From these eggs 16 butterflies were bred—9 (five males, four females) *proserpina* closely resembling the mother, 7 (four males, three females) *arthemis*. The mother and a pair of each type of the offspring were figured on Plate VI. Thus "the observed facts accord with those noted by Edwards, who in 1877 reared three *arthemis* and one *proserpina* from eggs deposited by a *proserpina* captured in the Catskill region." Furthermore, "these observations, considered in the light of the Mendelian principles of heredity, give fresh support to the view of Scudder (1889) and others, who have believed *proserpina* to be a hybrid between *arthemis* and *astyanax*."

The author considered that the male parent was probably *arthemis*, inasmuch as Springfield "is north of the zone in which *proserpina* ordinarily occurs." He also suggested "that *proserpina* is a hybrid between *arthemis* and *astyanax*, in which the dark coloring of *astyanax* incompletely dominates the white band of *arthemis*." In the regular zone of *proserpina*

these hybrids when they breed together would produce "offspring of which 50 per cent. must resemble the parents (*i. e.* are heterozygotes), while 25 per cent. are pure dominants (*astyanax*) and 25 per cent. are pure recessives (*arthemis*). Farther north, where *astyanax* seems not to thrive, but the recessive white-banded *arthemis* holds sway, occasional stray examples of *proserpina*, mating with *arthemis*, will yield offspring of which 50 per cent. will be *proserpina* and 50 per cent. pure *arthemis*.* In this division the Springfield brood probably belongs. South of the zone of hybridization the white band must be almost swamped; for when *proserpina* mates with *astyanax*, the offspring will all be dark, and half of them will be pure dominants (*astyanax*)." The occasional white-banded *Basilarchias* taken south of the zone the author interpreted as among the 25 per cent. of extracted recessives produced by the occasional "interbreeding of southward-spreading heterozygotes (*proserpina*)." It must be remembered, however, that these southern extracted recessives are not pure, inasmuch as they resemble "*astyanax (ursula)* in many ways, yet having the white band well developed on all the wings" (Field, 1904, p. 4).

The author's third paper in "Psyche" was entitled "Hybrid butterflies of the genus *Basilarchia*" (vol. xxi, No. 4, 1914, p. 115, Plate VII). A pairing was secured and lasted about half an hour, on Aug. 20, 1910, between a bred female *archippus* and a male of *arthemis* captured at Alstead Center, New Hampshire. The female in seven days laid 62 eggs on and near the leaves of willow. Only 19 larvae hatched—none of them "from eggs laid toward the end of the period of oviposition." Eight imagos emerged, all males and all like the 3 captured specimens of *arthechippus* figured in the first paper. A ninth pupa which did not emerge was, from its small size, considered to be a male. Efforts to mate these males with females of *arthemis*, *archippus*, *astyanax* and *proserpina* led to no results, although marked sexual excitement was evident in both males and females. Two of these male *arthechippus* were represented on Plate VII.

* The Mendelian interpretation of Edwards' 1877 results was also suggested in Trans. Ent. Soc. Lond., 1908, p. 473.

Copulation, lasting 55 minutes, occurred on Aug. 30, 1910, between a female *astyanax*, bred from a Brooklyn larva, and a male *arthemis* captured at Alstead Center. The female in nine days from Sept. 5 deposited 82 eggs on the leaves of wild cherry. From these eggs 8 imagos were reared—"five males and three females, all rather dark examples of *proserpina*." Attempts to breed these butterflies together and with other *Basilarchias* were unsuccessful. A male and female of these *proserpina* were figured on the accompanying Plate VII. As a result of the breeding experiments the author justly claimed that "the hybrid character of *arthechippus* and *proserpina* is now established," while the facts recorded in the second paper "make it clear that *proserpina* will at least breed with one of the parent species."

The author was much to be congratulated on the successful results of his carefully conducted and important researches. It was now reasonable to conclude that *arthemis* and *astyanax* were subspecies or geographical races of a single species, interbreeding, not indeed commonly, but quite normally with the production of fertile offspring, in their zone of overlap. Furthermore, the rarity of *proserpina* as compared with both the parent forms pointed strongly to the reality of sexual preference as a factor in evolution. From the observed facts it could hardly be doubted that *arthemis* as a rule preferred to mate with *arthemis* and *astyanax* with *astyanax*. The male genitalia of *arthemis* and *astyanax* were closely similar, as shown by the figures of Scudder ("Butterflies of the Eastern United States and Canada," Cambridge, Mass., 1889, Plate 33, figs. 9 and 15) and Eltringham ("Mimicry in North American Butterflies: A Reply"; Poulton, Proc. Acad. Sci. Phila., 1914, p. 161, Plate V, figs. 5 and 4), whereas those of *archippus* (Scudder, figs. 11, 12; Eltringham, fig. 6) were distinctly different from either. Furthermore, the extreme rarity of *arthechippus* pointed to a strong disinclination to pair—all the more evident inasmuch as the common range of *archippus* and *arthemis* was much wider than that of *astyanax* and *arthemis*. In fact, according to Scudder, the area of *arthemis*—Canada east of the Rockies, and the north-eastern States—was wholly included within that of *archippus*. A further indication that the pairings of

archippus and *arthemis* were not such as to produce normal fertile offspring was probably to be seen in the fact that all known examples of the hybrid—whether captured or bred—were males. Field's valuable results supported the conclusion that *arthemis* and *astyanax* were a single species, but that *arthemis* and *archippus* were distinct species. Prof. Poulton suggested that we might understand the origin of *astyanax* from *arthemis* by comparison with our own White Admiral, (*L. sibylla*, L.) and its rare black variety. The intrusion into the south of England of a dark, specially protected butterfly like *Papilio* (*Pharmacophagus*) *philenor*, L., would probably cause a gradual increase in the numbers of the Black Admirals, and finally their complete predominance, to the exclusion of the type form, which would still exist further north. Along the zone of overlap we might expect interbreeding with Mendelian results, although the genetic relationship between *sibylla* and its variety had not as yet, he believed, been determined. Starting from this foundation, gradual changes in the pattern of the "Black Admiral" would probably produce a closer resemblance to the model, just as *astyanax* has not only lost the conspicuous white markings of *arthemis* but has also gained a large increase in the greenish or bluish iridescence of the upper surface, and a change in tint, accompanied by a much greater prominence of the reddish markings, on the under surface (Trans. Ent. Soc. Lond., 1908, pp. 471-2).

It was interesting to observe that *arthechippus*, so far as one could judge from Field's figures, resembled in two important features the Utah and Arizona species *L. (B.) obsoleta*, Edwards (*hulstii*, Edwards), which was itself intermediate in pattern, as well as in the male claspers, between *archippus* and *arthemis*, or the closely similar *weidemeyeri*, Edwards. One of these features was the distinct representation of the white band of *arthemis* by a row of white spots crossing the hind-wing; the other was a trace of the linear white mark in area 1a of the fore-wing, representing the termination of the white fore-wing band upon the inner margin. The former feature was distinct in all four of Field's figures, and strongly marked in those of the captured examples; the latter was distinct in three figures, two of the bred and one of the captured

examples. It would be interesting to investigate whether the male claspers of *arthechippus* bore any resemblance to those of *obsoleta*. It was not to be wondered at that a hybrid combining the features of *arthemis* and *archippus* should approach in certain respects an ancestral species intermediate between the two, but the resemblance did not warrant the conclusion that *obsoleta* originated as a hybrid. Such a view was opposed by its geographical distribution, as also by the results hitherto obtained from the pairing of *archippus* and *arthemis*—offspring of a single sex not yet known to pair with any allied female.

A COLOUR-ASSOCIATION OF MYLABRIS (COLEOPTERA) FROM S. NIGERIA, by K. G. BLAIR AND PROF. E. B. POULTON.—Prof. POULTON said that he had received a fine series of Mylabrid beetles, including many pairs *in coitû*, collected by Mr. C. O. Farquharson from “ground-nut,” *Arachis hypogaea*, L. (*Leguminosae*, Tribe *Hedysareae*), at Moor Plantation (480–580 ft.), 4 miles west of Ibadan, S. Nigeria. The conditions under which the beetles occurred were described in the following extracts from Mr. Farquharson’s letters:—

“ May 28, 1915.

“ I forgot another item of news. I have a very special experiment with ground-nuts in hand just now, and a wretched beetle has arrived in considerable numbers to eat the flowers. Dr. Lamborn got it last year on bush hosts, and it turned out to be *Decatoma* * *affinis*, Oliv. [also other species] and *D. affinis* var. *calternauti*. [This first determination of the var. proved to be erroneous.] On comparing his types there seems to me to be more in it than that. I am to send you a series, which may interest you. I may say that the entomologist is on active service on the frontier, hence my dabbling with beetles on ground-nuts.

“ May 31, 1916.

“ I added a few more to the *Decatoma* series on Saturday, but I am in hopes that I may get a few more pairs *in coitû*, which should make the series more valuable.

* See footnote on p. cvi.

“ July 3, 1915.

“ This week I added a small lot of *Decatoma* pairs taken *in coitû*. I am sorry the pairs are not so interesting as they might be, and as they ought to be, but Nos. 11 [*hermannioides* ♂ × var. *lamborni* ♀, June 23, 1915, in table on p. cii, and Plate B. fig. 10,] and 25 [F in table on p. cv, and on Plate B] are, I think, promising. . . . The *Decatoma* beetles have appeared in hundreds on our ground-nut (*Arachis*) plots. On two acres of this crop I had two boys collecting. They each gathered about 300 per day for several days and the beetles are still very numerous. The var. *calternauti* [see above] is the most uncommon. The most common are those with three more or less complete yellow bars. The large two yellow barred forms are next in point of numbers.

“ February 26, 1916.

“ I forgot to mention that the ‘Decatomas’ were nearly all actually found *in coitû* (that is, those I definitely sent as pairs) by myself. Some few were found by my clerk, but if coitus had ceased by the time he brought them to me—even though he is quite reliable—I rejected them. As a rule, however, they remain *in coitû* for quite a long time, even when being carried about. Next tour also I’ll do my best to get a big series. The complexity shown in their identity is extraordinary.”

Mr. W. A. Lamborn had also sent a number of these beetles from the same locality to the British Museum and also to the Hope Department. Concerning a series of 8 *Coryna hermanniae*, F., taken June 13, 1913, he had noted:—

“ These Coleoptera feed on the anthers of cotton. This appears to be a favourite food, for 3 or 4 are often found in one corolla, but they are frequently found eating grass seed and the young leaves and shoots of a variety of other wild plants.”

For an undated example of *Decatoma affinis*, Ol., in the British Museum, Mr. Lamborn had written a note that these beetles “ feed on anthers of cotton and on grass seeds.”

The Mylabrid beetles sent by Mr. Lamborn and Mr. Farquharson had been carefully studied by Mr. K. G. Blair in the

British Museum, and in the Hope Department by Mr. H. Britten, who had prepared and examined the male armature and other structural characters of a large number of specimens, and had also determined the sexes of all the pairs as well as the entire series of *Mylabris farquharsoni* and of *M. hermannioides*. As a result of these investigations, the assemblage was found to break up into 4 species belonging to three genera or subgenera. Two of the species were new and each of them was represented by a variety sufficiently distinct to receive a name, as well as by the typical form. Detailed descriptions will be found in Mr. K. G. Blair's systematic section of this paper (p. cvi). The fact that these beetles occur together is sufficiently proved by Mr. Farquharson's letters* and in still greater detail by the tabular statement on page cii, showing the dates of Mr. Lamborn's captures in 1913 and 1914, and Mr. Farquharson's in 1915.

The table on p. cii shows that these protected species form a combination with common warning or synposematic colours and also probably with the instinct to associate together, as in the Ithomiine butterflies, etc. The close resemblance between their patterns is well shown in Plate B, where the insects are figured slightly below the natural size. It is, of course, possible that their association is an indirect result of other instincts, viz. that of seeking certain food-plants. Against this view is the fact that the food-plants are varied and also the occurrence of all these forms in great numbers (all the 1915 records in the table) on *Arachis*, which, as Dr. O. Stapf informs me, is an annual plant "of Brazilian origin, but now grown all over the tropics. Very little seems to be known about its enemies. See Jean Adam, L'Arachide, Paris, 1906 (publ. by Gouvernement Gén. de l'Afr. Occid. Franc.), particularly p. 65. See also Kew Bulletin, 1901, pp. 175-200."

As to the date at which *Arachis* was probably introduced into Africa, Dr. Stapf has kindly sent the following references:—

"Je ne suis pas éloigné de croire à un transport du Brésil en Guinée par les premiers négriers et à d'autres transports

* In a note written Dec. 15, 1916, Mr. Farquharson stated that "all the Decatomas occurred together and all disappeared together."

	<i>Coryna hermanniae</i> , F.	<i>Decatoma affinis</i> , Ol.	<i>Mylabris hermannioides</i> , sp. n.	<i>Mylabris hermannioides</i> , var. <i>lamborni</i> , var. n.	<i>Mylabris farquharsoni</i> , sp. n.
W. A. Lamborn. 1913.					
June 5		1			
„ 6		2			
„ 12	3	7			1
„ 13	8				
„ 14			1 ♂ in cop.	with 1 ♀ (Plate B, fig. 11)	
July 5	1	1			
„ 10	1	2			
W. A. Lamborn. 1914.					
April 27	6				
May 7				4	
„ 11				1	
„ 13	12			3	
„ 14	1			9	1
„ 17				3	
„ 18	1	1			1
C. O. Farquharson. 1915. <i>On Arachis.</i> End May to June 22	1 pair in cop. (Plate B, fig. 7)	1 pair in cop. (Plate B fig. 1)			8 pairs in cop. (Plate B, figs. A, C, D, E, G, I, K, M.)
June 23			1 ♂ in cop.	with 1 ♀ (fig. 10.)	
„ 24					2 pairs in cop. (figs. B, N.)
„ 25	1 pair in cop. (Plate B, fig. 8.)	7 pairs in cop. (four in figs. 2, 3, 4, 6.)	1 pair in cop. (fig. 9.)		1 pair in cop. (fig. H.)
„ 26		2 pairs in cop. (one in fig. 5.)			4 pairs in cop. (figs. F,* J, L, O.)
Undated, probably from late May to end June.	35	25	1 ♀	10 ♂ 8 ♀	94
Totals	72	59	5	40	127

* The pair of *M. farquharsoni* indicated by F had been dated "26. v. 15" evidently intended for "26. vi. 15." It had been numbered "25" by Mr. Farquharson, and all dated numbers earlier than 25 were given as June.

du Brésil aux îles du Midi de l'Asie par les Portugais, depuis la fin du XV^e siècle." A. De Candolle, "Origine des plantes cultivées," p. 333.

"Il n'est pas douteux que l'introduction sur la côte occidentale d'Afrique se soit faite par l'intermédiaire des négriers portugais, dès le XVI^e siècle. La culture de l'Arachide sur le continent noir prit rapidement une grande extension, car, au dire de Sloane, les négriers chargeaient leurs navires de cette graine pour nourrir les esclaves pendant la traversée." Dubard in Bull. Mus. Hist. Nat., vol. xii (1906), p. 340.

Mr. Farquharson does not state whether the beetles feed on the large conspicuous sterile flowers on the upper part of the plant, or on the small inconspicuous imperfect flowers producing hypogaeal pods. [Mr. Farquharson has since stated that the former are eaten.]

Dr. G. A. K. Marshall has described and figured South African Cantharid associations with their Müllerian mimics belonging to the Longicornia, the Phytophaga and the Hemiptera (Trans. Ent. Soc., 1902, pp. 518, 519, plate XIX, figs. 1-17). The patterns are similar to those here described. He has also shown that certain South African Cantharids have adopted the prevalent and very powerful Lycoid aposeme (ibid., p. 517, plate XVIII, figs. 20-23).

Another interesting feature of Mr. Farquharson's collection is the possible indication of sexual preference, although the evidence, to become convincing, would require to be immensely increased. The table on p. cii shows that only 5 examples (3 ♂, 2 ♀) of the type form of *M. hermannioides* were captured, as compared with 40 of the var. *lamborni* (10 ♂, 9 ♀ in Mr. Farquharson's series). Two of the ♂ type were paired with ♀ vars.; the third ♂ type was paired with a ♀ type; the second ♀ type was unpaired. Thus, considering the small number of ♂ and ♀ types, there is a very slight indication that type prefers to pair with type—an indication sufficient, I hope, to stimulate the collection of evidence on a large scale. The absence of any pairs of the var. ♂ and ♀ is surprising. Four of the type form and six of the var. are shown in the lowest row of figures on Plate B.

Nothing can be made of *C. hermanniae* or *D. affinis*, from

this point of view, because at Ibadan both were constant in pattern as compared with the other species. But *M. farquharsoni* was extremely variable, and at the same time the commonest of all the species and with the largest number of pairs (see Plate B, where pairs taken *in cop.* of these three species are represented). Out of the 127 specimens captured, 125 are classified in the table on next page, the patterns being *very* gradually transitional from light forms in which the black is reduced, to dark ones in which it is increased. The two omitted specimens were both males which combined the patterns of grades 1 and 6. Although the absence or presence of a black humeral stripe forms logically a sharp demarcation between the two sets of grades A and B, it is not a conspicuous feature, and does not constitute an obvious break in the series, and the same is true of the isthmus between the pairs of bars. Asymmetry is common, so that some of the specimens in grades 7-9 would be placed in one grade by the pattern of one side, in another by the pattern of the other. Furthermore, the isthmus described in these grades is present, although usually very reduced, in a few individuals of grade 5. The table shows at a glance that there is no sex-linking in the patterns, although the females are especially numerous in grade 5, which nearly represents the average pattern.

Allowing for the extremely small difference between the grades, a close resemblance is manifest in pairs B, D, G, H, I, J, L, M, N, and O; viz. in two-thirds of those captured. A, C, and K are distinctly different, E and F less so. A, although separated by only 3 grades like F, is a far more discordant union, because of the entire absence of the anterior black bar in the ♀. On the whole, the results afford some indication that sexual preference may be influenced by pattern or by some other character correlated with pattern. All 15 pairs are figured on Plate B, but it is difficult to show such minute differences in the patterns of beetles satisfactorily. It is hoped that the form of table here proposed will afford a convenient means of testing this most important hypothesis, which was proposed long ago by H. W. Bates in his historic paper on mimicry.

E. B. P.

SYSTEMATIC SECTION, BY K. G. BLAIR

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A small collection of beetles belonging to the genus *Mylabris* (fam. Meloïdae) has been referred to the British Museum for determination by Prof. Poulton, to whom they were sent by Mr. C. O. Farquharson and Mr. W. A. Lamborn from Ibadan, Southern Nigeria; they were taken in some numbers feeding upon the flowers of an experimental crop of ground-nuts (*Arachis*).

An examination of the series reveals the interesting fact that it is an association of four distinct species, all, with the exception of a very striking variety of one of them, having a marked superficial resemblance (see Plate B). Two of these species, *Mylabris (Decapotoma)* affinis*, Oliv., and *M. (Coryna) hermanniae*, F., are well-known West African insects, but the remaining two appear to be undescribed.

The genus *Mylabris* contains a large number of species, many of which are extremely variable in colour and in size. Unfortunately they do not lend themselves at all well to classification upon structural characters, so that for determination we have to rely almost entirely upon their scheme of coloration, a state of things which makes the group notorious for the difficulty of delimiting its species.

The colour group to which Mr. Farquharson's collection belongs is one of rather small species (10 mm. to 20 mm. in length, with a medium of about 14 mm.), black, sometimes with slight metallic reflections, the elytra being black with fulvous markings disposed as follows: a basal dorsal longitudinal band extending to $\frac{1}{4}$ or $\frac{1}{3}$ the length of the elytron, and a marginal basal patch invisible from above; these are followed by two transverse bands, more or less sinuous or irregular, the first median or submedian, the second half-way between it and the apex; the black apical area may be intact or may contain a fulvous spot.

The following key will serve to distinguish the West African species.

* Proposed by Voight because *Decatoma* is preoccupied (Hymenoptera).

- Antennae 9-jointed (subg. *Coryna*) . *hermanniae*, F.
 ,, 10-jointed (subg. *Decapotoma*) *affinis*, Oliv.
 ,, 11-jointed (*Mylabris*, s.s.)
 Apical black area of elytra intact.
 Antennae yellow, with basal
 joints black *temporalis*, Wellm.
 ,, black *hermannioides*, nov.
 Apical black area enclosing
 yellow patch.
 Black areas fail to reach margin,
 which remains yellow
 throughout *holosericea*, Klug.
 At least the two post-median
 black areas reach the
 margin *farquharsoni*, nov.

M. (Coryna) hermanniae, F., a series of 72 specimens sent by Mr. Farquharson and Mr. Lamborn, shows some variation in size, but is remarkably constant in markings (see Plate B, figs. 7, 8). One specimen from Northern Nigeria in the British Museum Collection has both the transverse yellow bands broadly interrupted towards the margin.

M. (Decapotoma) affinis, Oliv. The series of 59 specimens represents the largest of the species from Ibadan, ranging from 12 mm. to 20 mm. with the head extended. It, again, is very constant in colouring, the yellow markings varying but little in size (see Plate B, figs. 1-6). The var. *calternauti*, Mars., in which the yellow colour occupies the whole of the anterior half of the elytra to the exclusion of the sub-basal black area, is not represented in Mr. Farquharson's species, though the British Museum possesses specimens from Sierra Leone received together with the typical form.

Mylabris temporalis, Wellm., described from Angola, is not represented among the Ibadan series, but it is to this species that I refer a single specimen in the British Museum collection from Yapi, Gold Coast. Though described by Dr. Wellman as a *Decapotoma*, two co-types in the British Museum received from the author have distinctly 11-jointed antennae.

The Yapi specimen does not quite agree with these in that it has the first transverse yellow band only very narrowly interrupted before the lateral margin.

Mylabris hermannioides, sp. nov. (see Plate B, fig. 9 and the left-hand specimens of figs. 10, 11). Of the size and facies of *Coryna hermanniae*, F., from which it may readily be separated by its black antennae; these are rather indistinctly 11-jointed, the last two joints fitting closely together, but not so completely fused as in the subgenus *Decapotoma*.

The intrahumeral basal patch is more elongate than in *hermanniae*, extending well beyond halfway to the first transverse band; both these bands are broader towards the suture, though almost or quite interrupted at the suture itself, and both are again almost interrupted near the margin by a process from the black area behind them.

From small specimens of *Decapotoma affinis*, Oliv., it may be distinguished by the intrahumeral patches being subparallel, not becoming wider behind and not tending to come together on the suture; in *affinis* they are subtriangular, somewhat oblique and tending to coalesce on the suture. In the latter species too the transverse bands are broader and of roughly even width throughout.

Var. *lamborni*, nov., is a striking variety (see Plate B, figs. 12-15, and the right-hand specimens of figs. 10, 11) analogous to *D. affinis*, var. *calternauti*, with which it was at first confused. The black has disappeared from the anterior half of the elytra except for a small humeral patch and a long narrow wedge running back along the suture almost as far as the post-median black band. The apical half of the elytra remains unaltered. It may be distinguished from var. *calternauti* by its yellower, less tawny colour, its less silky pubescence, and by the shape of the scutellar black area. In *calternauti* this forms almost an equilateral triangle, with sometimes an extremely narrow prolongation along the suture. The variety would seem considerably to outnumber the typical form, 40 specimens in all having been received against only 5 of *hermannioides*, but of these 21 were sent in the two previous years by Mr. Lamborn as a distinct species. The *hermannioides* form has doubtless been largely over-

looked amongst the more common species which it so closely resembles. No specimens of an intermediate character were taken.

Two cases were noticed of a *hermannioides* ♂ *in cop.* with a var. *lamborni* ♀ (figs. 10, 11). In one case both members of a pair were *hermannioides* (fig. 9), but no case was noted in which the variety was found paired.

Mylabris farquharsoni, sp. nov., is rather a short broad species, with the elytra considerably broader behind than in front (see Plate B, figs. A-O). It is black with a faint greenish metallic lustre, covered with a silky pubescence. The antennae are red with the first three joints black, and the next two piceous. The intrahumeral fulvous stripes in typical specimens are rather broad, about one quarter the length of the elytron, and somewhat oblique, with a tendency to become confluent behind; the extrahumeral is frequently confluent marginally with the first transverse band, both transverse fulvous bands are rather broad in their dorsal part with a tendency to become interrupted on the suture and again towards the margin; the intervening black band and the apical black area both reach the margin, the apical black area encloses a transversely oval fulvous spot immediately before the apex.

The series of 127 specimens shows a great range of variation. The general tendency is for the black markings on the anterior part of the elytra to become reduced until a form is reached analogous to *hermannioides*, var. *lamborni*, mi., or *affinis*, var. *calternauti*, Mars., in which they have practically disappeared. This form may be called var. *ibadanensis*, n. v. (see Plate B, fig. A, the right-hand specimen). Unlike the two cases above mentioned, a wide range of intervening stages is found. Most commonly the black partition between the two basal patches has disappeared, leaving a transverse black band in front of the median yellow which gradually fades away towards the margin. Occasionally the posterior or transverse portion of this basal black area disappears, so that we have left the var. *ibadanensis* with a black humeral stripe.

This species bears a certain superficial resemblance to *M. holosericea*, Klug., described from Senegal. It differs in

its shorter broader form, in its shorter and more scanty pubescence, and in not having the outer margin of the elytra bordered with yellow. It is probably more closely related to *D. affinis*, from which it differs in the colour as well as in the number of joints of the antennae, and in the presence of the subapical yellow patch on the elytra.

In addition to the series from Ibadan the British Museum possesses specimens from Onitsha (J. A. de Gaye), whence again it was received in conjunction with *D. affinis* and *C. hermanniae*.

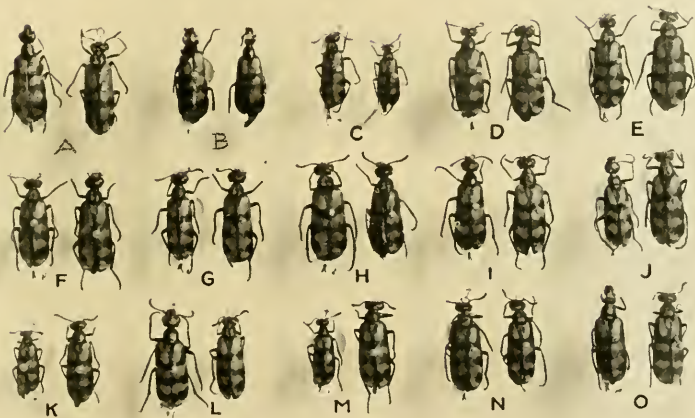
K. G. B.

DR. G. D. H. CARPENTER'S NOTES ON SOUTH-WEST UGANDA AND ON LATE GERMAN EAST AFRICA WEST OF THE VICTORIA NYANZA.—Prof. POULTON said that he had received several letters and boxes of specimens from Dr. Carpenter, and he felt sure that the Society would be glad to record the observations on this little-known area, made by so keen and all-round a naturalist, and would welcome them all the more warmly because they had been written during the historic expedition of the Belgian Northern Forces.

At the end of 1914 and during the greater part of 1915 Dr. Carpenter had been resident as Medical Officer at Kakindu, about thirty miles W. of the Victoria Nyanza and about 500 feet above lake level. Kakindu Hill (4046 feet) was in late German E. Africa (about 1° 10' S., 31° 30' E.), a few miles to the N.W. of the Kagera River, from which it was separated by an open grassy plain. The river flowed N.E. with a sinuous course to its mouth on the western shore of the Victoria Nyanza, a little north of the late Anglo-German boundary. Dr. Carpenter was at Kakindu when the communications from him, printed in our Proceedings for 1915, were written (pp. xliv, lxiii, lxiv, lxxv, lxxxiii, lxxxix, xcvii). While at Kakindu Dr. Carpenter made, on Apr. 20–22, 1915, the little expedition to the N.E. described in the following passage:—

“April 25, 1915, Kakindu.

“I had a very interesting little safari, about four miles E. of the Minziro hills, to a hill named Bulembe, a hog's back rising suddenly out of the forest with its S. end abutting on the



Alfred Robinson. Photo.

Half-Tone Eng. Co. Ltd.

MYLABRID BEETLES FROM S. NIGERIA.

EXPLANATION OF PLATE B.

Synposematic Mylabrid beetles occurring together at Ibadan, S. Nigeria. (Slightly less than natural size.)

All figs. except the last four are of pairs taken *in coilú*, the males to the left.

FIGS. 1-6. *Decapotoma* (*Decatoma*) *affinis*.

„ 7-8. *Coryna hermanniae*.

„ A-O. *Mylabris farquharsoni*.

„ 9-15. *M. hermannioides*; l = var. *lamborni*.

river. We have a post there, as there are enemy trenches on the other side of the river 1400-2000 yards away. I went there in my capacity as medical officer, as the post has recently been allotted to my section of the line. The first day was from here to Mirziro (4360 feet), about ten miles to the N.N.E. I got some nice things in the forest en route—quite a number of specimens of a Pierine [*Phrissura phoebe*, Butl., especially ♀♀] which is decidedly rare here—but I seemed to have come across a brood just emerged and got a lot of beauties. Just the other side of the forest I came across Elephant spoor for the first time in my life. Next day I went to Bulembe (4251 feet) and back—and had a strip of forest of two miles or so to traverse. This took one and a half hours each way, as the track was simply a sea of pea-soup mud well over the tops of one's boots, and in places one was in water up to one's knees. This bit of forest, although continuous with that at Kakindu, was slightly different. There were some quite big trees, and the plant which formed the main undergrowth on Bugalla was the main feature there, whereas here it is hardly seen. Consequently I was not surprised that the butterfly fauna should show differences. There were not many butterflies, and it wasn't easy to look out for them when stumbling about on slippery roots at the bottom of a foot of mud!—but I saw several of that fine black and yellow *Papilio* which I reared on Kome [*P. hesperus*, Westw.] and have never seen here at Kakindu. Also I got four specimens of a fine Nymphaline which was quite new to me—a sort of African '*Kallima*' [*Kallima rumia*, Westw.]—dead leaf below, orange and purplish above. I also caught a *Euphaedra* [*E. uganda*, Auriv.] which I have never done before. One feels that this very extensive forest here would repay several years' study—as probably the different areas have different faunae. From Bulembe hill one looked right on to the Geriman trenches, down below, across the rushing river, and I actually saw a man move in one—so I have seen an enemy at last! Shots are occasionally exchanged there. From Bulembe I also got a blue glimpse of my beloved lake, which was very refreshing. We just can't see it here—though they can at Minziro. I wonder when I shall get back to it? All quiet here.”

The end of Dr. Carpenter's residence at Kakindu came on August 9, 1915, when he wrote to say that he had been suddenly moved to Rukuba, about seven miles west of his former station.

“August 9, 1915, Rukuba Hill.

“Alas—woe is me—ολωλα—οιμοι-φεν-φεν—etc. I have been torn up by the roots and dumped down at another post, where I fear me much I shall be able to do little butterfly work, for it is very much further away from the forest, and what there is is thin and only a strip. I got the message yesterday evening (and also a mail at the same time), after I had come back from my hunting. I knew all along that I couldn't expect to be at Kakindu for ever! My new post is on a range of hills further west, just beyond the edge of the map I sent you (we call it Rukuba), but I must not say too much. From a butterfly point of view it's a dreary place—rolling grass downs with the grass all kept down by burning, and no trees save a few thorns. The forest also does not approach very near. It's a much bigger camp here than at my last home, and there will be a bit more medical work; but there is an assistant here to do that, and a sanitary sergeant to do the sanitary work, so it doesn't look as if the M.O. had as much to do as I had at Kakindu, where I did everything. It looks as if I shall have to come down to sleeping in the afternoons, which doesn't suit my activities at all, so that I always feel worse than before when I awake!

“However, though there are no butterflies to speak of just on the hill there are great numbers of wagtails about the wells, and I may be able to do some more observations. I must find *some* naturalist work to do! Well, after my initial grouse I will deal with your letter, which I got yesterday. (I am writing in the *afternoon*, look you!—What am I missing in the forest?)

“As regards what I said about the *present flat plain having been at one time under water*—I was much struck one evening, when on Itarra hill (about two miles to the S.E.) to see, on the range of hills further west, whence I now write, a regular mark at one level all along the range, as if there had been a water-level there once. As this must be 150 feet or so above

the present plain I was interested to see shortly afterwards, in 'Nature,' a review of an account written by a geologist who visited B.E.A. (Kavirondo) and found shell beaches 300 feet above present water-level."

The next letter contained the news that he was likely to be moved much further west at an early date; also the following paragraphs:—

"November 10, 1915, Rukuba Hill.

"I have no time for collecting where I am now, and it's not a good locality like Kakindu, of which I often think longingly, and look over the top of the forest which lies between us and it, and think of the treasures there.

"I have managed to rear the larva of *Cosmodesmus angolanus* here, and it was *very* much like the larvae of *policens* and *leonidas*, also the pupa. I wonder if it's been described before?

"I have also got the larva and pupa of a Nymphaline allied to **Charaxes*, which flies about the overgrown banana shambas. It has only a single 'tail' to the hind-wings, which are greenish or creamy white with a broad light-brown border. It flies like a *Charaxes*, and larva and pupa are both typically *Charaxes*, so the genus must be very closely allied. We had a little expedition for four days about a fortnight ago—we didn't accomplish what we intended owing to an unexpected circumstance over which we had no control. I took my net, as much of our route lay through the forest, but didn't get anything much. I saw one rather interesting thing—a medium-sized Acridian ♂ courting the ♀ in a thicket. He had *antennae brilliantly white like Baoris niveicornis*—the ♀ hadn't—and my attention was first attracted by seeing them violently vibrating. At first his body was hidden, and I thought they must be antennae of a large Sphegid, as they vibrated in that sort of way. He was very importunate, and pressed close to the female—and I lost them because she moved away into a dense part of the bush and he followed."

The next letter, written from S.W. Uganda, described the journey from Rukuba.

* Evidently *C. varanes* or one of the forms allied to it.—E.B.P.

“January 11, 1916, Kabale viâ Mbarara, Uganda.

“I have been unable to write to you for a long time, for military reasons! About the end of November we started out on a long safari westwards, ending at a point on the Kagera River about $1^{\circ} 10' S.$ and $30^{\circ} 50' E.$! The idea was to make a bridge across and attack a German (supposed!) fortified position on the S. side of the river. We eventually got the bridge across, but could find no enemy on the other side, and all we did was to burn a large camp. It was very interesting country. On our way I got a distant view of the great snow peaks of Ruwenzori, very far away, but towering up in a sublime manner.

“The Kagera valley was very nice: the river at one time evidently, like the Thames, filled up a broad valley between hills rising up to about 1500 feet on each side, but now it has cut a narrower channel for itself, and flows through grassy meadow-land, covered with fine grass and dotted thorny Mimosas—very delightful country to walk in (but the haunt of *Glossina morsitans*!). We made a long stay in camp by the river—while looking for the enemy!—and I *did* want my net! I had left all that sort of thing behind, as we had only been allowed four porters each to carry kit. There were several nice *Teracolus*, and other Pierines new to me, and I saw *one* *Acræa zetes* of a type as western as it could be. I found that one or two species of Pierines, which had been exceptionally scarce at Kakindu and Rukuba, abounded here, so that Kakindu was the E. limit.

“I went on one patrol in force for three days into the enemy country S. of the Kagera River,—most curious country, a mass of jumbled-up hills all about the same height, cutting into each other anyhow, so that one would very easily lose one's way; grass-covered—no trees—but, where weather had cut out ravines on the sides of the hills, enough soil had apparently collected to nourish a thick growth of bush, which filled up these ravines, so that from a distance they were marked out by dark streaks. I was much pleased to see a herd of seven magnificent Roan antelope—which I believe is next largest to Eland. The generic name *Hippotragus* certainly does express a characteristic which impresses itself on you—

their neck and shoulders are extremely horsey! They didn't occur anywhere in Uganda, N. of the Kagera. Curiously enough, I saw on this patrol, again, the black stridulating ant (*Megaponera foetens*), which I first saw at Kyaka, also S. of the river, and have not yet found *north* of it. I wonder if the river is a natural barrier? Well, at the end of this patrol I got back to the camp, and found that the kit which I had sent for in expectation of my move westwards had arrived, so that on Christmas Day I was able to catch some of the fine Pierines which abounded.

“ On the next day I started off for my present situation, the station Kabale, in S.W. Uganda, (30° E., 1° 15' S.), which I reached in five days, getting occasional butterflies en route. I have been here about a fortnight now. It has been an administrative station for two years only, and the natives are very wild. It is situated among high and steep (bare except for grass) hills, in a fairly open valley, well cultivated. There are practically no trees. It's 6000 feet up, and the early mornings are very misty. Indeed, the climate (at present) reminds one of delightful October weather at home, and I feel quite braced up!

“ The more interesting district round Kigezi itself lies further west (only about thirteen to twenty miles, but two days' safari, owing to the numerous steep hills)—the country of great volcanoes and forests, lava plains, and lakes. At present I see no prospect of getting there, but must content myself with Kabale. As there is so little but grass here it doesn't look likely for butterflies. Last Sunday, however (at present weekdays are fully occupied), I caught three species of Lycaenid quite new to me—two very common. I've also seen a typical 'Copper,' which I've never met before in Africa [*Chrysophamus abboti*, Holl.], and a *Belenois* new to me—the black markings on under-side margined with yellow scales [*Synchloe johnstoni*, Crowley]. I have spoken of the 'Englishness' of the climate. Many of the plants, too, keep up the illusion. In the valleys grow an obvious species of Forget-me-not and some kind of thing like the riverside Mint at home, and a *Rubus* abounds everywhere. The cultivated peas and beans keep up the illusion!

“As regards the war—we are not very near the Germans here, and all is quiet. It's probable that things are happening in G.E.A. and B.E.A., but we hear nothing of it.

“*February 1916, Kigezi, S.W. Uganda.*

“Well, now to get on with the real object of the letter—to give you an idea of Kigezi, where I now am, and very delighted to be! You know, of course, all about the well-known Rift Valley in B.E.A.; but perhaps do *not* know (as I did not) of the other that runs down the W. edge of Uganda, and contains the chain of lakes from Tanganyika up to Albert Nyanza. The part I am concerned with is in the far S.W. corner of Uganda, and I am at Kigezi itself, only about three hours' journey from the Congo border to the W. and the German border on the S., and about a day's march from the N. of Lake Kivu. Longitude $29^{\circ} 45' E.$, Latitude $1^{\circ} 15' S.$ The rift here is, I suppose, some forty miles across, and is bounded on each side by much crumpled ranges of hills, running up to 8000 feet, the floor of the valley being about 6000 feet. The post where I am is just at the foot of the E. border of the valley, and I have seen the hills of the W. border. The whole country is excessively volcanic. Rising out of the valley floor are innumerable little hills of a few hundred feet high, quite often showing very typical craters on their tops, and usually conical in shape—very obviously volcanic. There is lava everywhere, and the floor of the valley is practically nothing else. The great feature of this district north of L. Kivu is a group of giant volcanoes, from ten to nearly sixteen thousand feet high—from my present post (known as Kigezi itself) we have an uninterrupted view of four, and can see the tops of two others. The nearest one is a perfect cone—black lava without much vegetation. Further away are others of older date, showing many rifts and cracks, and with very jagged summits—they have obviously suffered much in successive eruptions. The one furthest away often has a deposit of snow on its top; it has never been climbed yet. I suppose it must be very difficult. I believe that further west there are not so many volcanoes dotted about over the valley floor; it is here called the Rutchurn plain, and is great game

country. There are several small, probably shallow, lakes in this neighbourhood, so that, with the numerous small volcanic hills dotted all about and rising out of them, the scenery is very picturesque.

“ Between Kabale and here it is very hilly country—one goes up and down, up and down, passing to a height of about 7500 feet. It is only twelve miles as the crow flies between the two places, but owing to the hills the journey takes two days. It’s a very interesting one. The first part lies along the N. side of a lake named Bunyonyi, lying all among hills, so that it’s of very irregular shape, but about fifteen miles long, with many islets and peninsulas. It’s said to have no crocodiles or hippos: certainly I saw no signs of any. There is practically no papyrus—the steep hills slope straight down to water edge, which is fringed with reeds and rushes, reminding one of an English lake—save for a fringe of blue water lilies in front. There were many wild duck, indistinguishable to me from the mallard, and numbers of gulls I thought different from any I had found on *the Lake* (Victoria). I found at the margin two *Limnaeidae* (*Planorbis* and *Ancylus*) much like our *P. corneus* and *A. fluviatilis*, and there was also crawling about on the vegetation numbers of young of a snail which might have been young *Helix hortensis*!

“ I found two specimens of a most splendid worm—lying quite freely on the surface of the path under some trees—quite six inches long and as thick as my little finger.* It was not at all active, and didn’t seem much upset at being handled. It was really quite a nice thing to handle—slimy, of course, but beautifully firm to the touch. It gave one the impression of not having much in the way of chaetae. While being handled it suddenly extruded a lot of thick white fluid. Some of this came from a ventral orifice not at the extremity of the body, other from lateral openings at anterior extremity—possibly orifices of vesiculae seminales. I was rather surprised that this fluid was not malodorous, as it was apparently defensive. The fact that the worm lies freely exposed, and

* *Later*. I found another crawling on the path that was longer than my booted feet placed one behind another—and I take large tens. It must have been over twenty-four inches long! No chaetae could be felt.

was sluggish, rather suggests it must have some such means of defence—otherwise what a meal it would make ! Its slime was beautifully iridescent.

“ After passing the Lake one had to dip down into a narrow, sheltered ravine, with steep sides, and a little stream running through. There I have found quite a nice lot of butterflies which were new to me, including a *Papilio* [*P. mackinmoni*, E. M. Sh.], an *Amauris* [*A. ellioti*, Butl.], and an *Acraea* [*A. amicitiae*, Heron], a Lycaenid or two, and a Hesperid. I was rather surprised to find in this little stream, which is marked on the map as not running anywhere in particular, apparently losing itself again * (though I think it very probably starts from a certain marsh that I know of high up among the hills), a small *Crab*. I have, of course, found these often in the Lake Victoria, but the conditions here were so different that I should expect the crabbling to be different, and am drying him for a specimen. I think I mentioned, from Kabale, the fact that *Mole heaps* made one think of England—there are many other things also that remind one. *Melœe*, for instance, of which I have found two species crawling about on grass just as one does at home. Also much in the vegetation that brings up English things to one’s mind : thus in wet places one finds a kind of Crowfoot, Mint, Persicaria, and a Plantain. On the hills between here and L. Bunyonyi is a large Heath ; together with this, curiously enough, are Red-hot-Poker Plants ! At the very bottom of the valleys, in the apex of the inverted triangle, grow wild banana plants differing from the cultivated form in that the crown of leaves comes straight out of the ground. One often sees the mid-line of narrow deep valleys marked out by a single row of these plants—apparently they are very particular. I have also seen on these hills a few plants of the very interesting giant Lobelias, of which I need say nothing, for there are full descriptions and pictures in Johnston’s ‘ Uganda.’ But to see them at their best, I believe, you must go up the big volcanoes. There are, on the hills, also small ‘ Everlastings,’ which I haven’t seen growing wild before. A very fine Composite, which I am sure must be a kind of *Senecio*, makes a great show,

* *Later*. It has a very roundabout connection with L. Bunyonyi.

with large clumps a couple of feet high or so. Thistles abound, and some very fine nettles—one much like our ‘Roman’ nettle at home, the other very handsome with leaves deeply cut; neither of them like the *Fleurya* I knew in the jungles of the islands. I have mentioned, from Kabale, the abundance of a *Rubus* which grows everywhere, like our blackberry, but has red fruits, and another, more like the raspberry.

“The great feature of my present whereabouts is the absence of trees—nothing save an occasional ‘Candelabra’ *Euphorbia*, and some queer things which I call *Dracaena*, but don’t know if they are. I had expected, from what I heard, to find, at any rate, the *lower* hills, covered with forest: they are not! The big forest, inhabited by gorillas, etc., is a long way away from here, and at present quite unget-at-able (owing to the Germans, wild natives, and sundry encumbrances of that ilk!). But on the top of the ridge, forming the E. boundary of the rift, is bamboo forest, and I’ve been there several times to take our porters to get building material. It takes three hours to get there, and one has a stiff climb. Having got up to the top of the ridge (nearly 8000 feet, I suppose) one looks down the other side into a large basin, the sloping sides of which are covered with bamboo only—with only here and there the dome of a tree. The bottom of the basin appears a marsh, and leading down to it are well-worn tracks made by the small race of elephant which lives there. The other M.O. who is with me has seen them and shot them, and says they are very wild, and only run to about eight feet high. There are also lion there—a queer place, one would think, but I have seen their fresh track in the herbage. I took my net there each time I have been, but it’s singularly deficient in butterflies. What there are are interesting. A species of *Amauris* [*A. ellioti*], which I don’t know—of the *echeria* type, but with butter-yellow spots and larger pale area at h.-w. base below. I could never catch them in the bamboo forest; they fly rather high up, and circle round the bamboos—in fact, I thought they must be Nymphalines when I first saw them. But I have caught a number drinking at mud by side of the stream I have before mentioned. There is also there an *Acræa* [*A. amicitiae*], red and black, which I know not;

which I have likewise caught in numbers drinking at the same stream. I haven't seen a *single* Lycaenid in that bamboo forest—only one Nymphaline—a brown *Charaxes* which seems abundant—I think a species I know, but it's always out of reach. One species of Hesperid abounds, and I caught also a *Baoris*; also one black Satyrine marked with white, which occurs indiscriminately all over the hills, but doesn't come down to the plains.

“ The *birds* of this region are not particularly noticeable—rather few. Perhaps the most noticeable are Shrikes—which live in couples—long-tailed, black-and-white species. It seems to be rather a characteristic of these birds that they have a joint call—that is, one of the pair utters a few notes, simultaneously with which the other one of the pair utters the complement. The whole cry—one can't call it song—thus produced is often very musical, but the effect is so simultaneous that it's difficult to realise it's the effort of two birds. Apart from them, insect-eating birds are scarce. I've seen no Rollers or Bee-eaters (both abundant at Kakindu and Rukuba posts where I was so long); Flycatchers extremely scarce, Swallows also (I've seen one on the hills, probably a Martin, all black, that I have not seen before). One species of Coly is very plentiful where tall herbs and bushes grow, and Sun-birds are not uncommon in some places. Coucals are common on shore of Lake Bunyonyi. There being no trees, there are no Hornbills or Parrots or Plantain-eaters. The Crowned Crane and ubiquitous dark green Ibis are occasionally seen. Crows abound (perhaps because of dirty habits of natives). Ducks are common on the lakes, Gulls on L. Bunyonyi, but I saw there none of the Lily-trotters so abundant on L. Victoria, nor Herons and Egrets. There are Kingfishers among the rushes, but no Divers or Cormorants (so I think there must be few if any fish in that lake). One hears Nightjars on moonlit nights, but I haven't heard Owls.

“ As regards the *people* of this part—they are known as Bakiga—fine, powerful, but oh, so smelly, people! They are quite different in many ways from the Baganda; wear one filthy old goat or sheep skin hung round them according to the direction of the wind; wear their hair either in long

thrums or else with the whole head shaved save for two ridges running in a spiral manner; they eat peas and beans instead of banana, and live in queer little groups of houses—perhaps half a dozen houses together, making a sort of small clan, surrounded by a thorny ring of bushes, with a little extra house for the evil spirits to live in! The hill-sides are covered with neat, allotment-like patches of peas and beans, while the familiar banana plantations are quite absent. They are of dirty habits, and far below the relatively clean and tidy Baganda. But the most interesting people are the Batwa, who live in the depths of the aforesaid dense bamboo forest, and are never seen by any one unless by a party which *has* to penetrate—when all they usually see is a poisoned arrow sticking in the corpse of some one who has lagged behind! They occasionally raid their neighbours, who fear them much. They are described as very small pigmies with long arms and hairy chest and face, and are very little known, as they are very retiring!

“ In all this long screed I’ve said nothing about the war! All is quiet at Kigezi just at present, but there have been two or three local ‘scrap’ along the frontier recently. One took place about three hours away from here. A lot of the German natives, unarmed save for spears, bows, arrows, etc., about a thousand, surrounded and attacked one of the Belgian outposts. They had a medicine man with them, and a sacred white sheep! Things at one time might have been unpleasant, till a lucky shot killed the medicine man, and the rest dispersed! I wish I had been there, but as the place was surrounded it would not have been possible to get there, and as a matter of fact we weren’t needed! We know absolutely nothing of what Smith-Dorrien and the Boers are doing, but hope that *some* time an advance will be ordered from this part of the line. So that I hope I may be enabled to send you specimens from the plains still further south (Ruanda).

“ On a return journey from Kigezi to Kabale I saw on the 25th Feb. a ♂ *P. dardanus* in the valley where the *Amauris* [*A. ellioti*], new to me, with butter-yellow spots, and large yellow area at base of h.-w. below, is so common. How nice if the local ♀ *cenea* copied this—for *echeria* is not *nearly* so

common, though it occurs with the other. But I didn't see one, alas!

“ April 6, 1916, Kabale, S.W. Uganda.

“ I had quite a short visit to Kigezi, being soon recalled to Kabale—and in a week or two shall have left Kabale (30° E. and 1° 15' S.—did I give you that before?).

“ I may not say anything, save that the next box of insects I send you will have come from G.E.A.; for when our advance *does* come I'm not going to leave my net behind: though I expect to be so busy that there will not, at first, at any rate, be much time for collecting. But one never knows when one is going to be stuck at a place—and *then* the net comes in!

“ I'm very well, and much looking forward to 'the Real Thing,' which appears to be at last a probability and not merely a possibility. I've put my address back to c/o P.M.O., as I don't know what else—the 'S. frontier force' ceases to be so when it has begun the invasion of G.E.A.!

“ *With the Belgian Northern Forces in
late German East Africa,*

“ June 5, 1916.

“ Well, here I am, in what was G.E.A., as part of the force which the Belgians have pushed in (with the aid of the Uganda porters) from the far S.W. corner of Uganda (but just E. of the Kigezi district). You may say that they went in about 30° E., and have reached as far as Kigale—on 2° S., the administrative centre of this part of Ruanda. It's a very interesting country, although just to the E. of the mountains of Kigezi it's quite hilly enough, and bad country for safaris—there seems no system in the arrangement of the hills, and you have to keep getting out of one valley into another, up over watersheds, etc.—very tiring for porters. The hills are of rounded outline—thinly grass clad, sometimes granitic, more often of some reddish soil that makes beautiful patches of colour when freshly turned up. Here and there one sees masses of a herbaceous sunflower, which makes beautiful patches of colour in the landscape—the first time I have seen patches of colour made by one kind of flower in masses, in the tropics. The plantations of millet lie very thickly in the fertile valleys

—principally this, as the Ruanda people don't eat banana, and only grow a little for beer. They are a fine people—tall, thin, alert and agile (very different from the fat, sluggish Baganda), with aristocratic thin features.

“The most noticeable feature of the country, so far, has been the absence of trees, which often, on safari, makes fire-wood very difficult to get. As you may imagine from this, butterflies are not *very* abundant. *Eronia cleodora* is much commoner here than I've ever seen it before (it was *very* rare indeed at Kakindu), but I find it extremely difficult to catch.

“One day, when I happened on a piece of country of the thorn-bush type, with long lush grass under thorn trees with sweet-scented fluffy yellow balls of flower, I put up a herd of six fine Eland, which was very delightful! We have had no fighting so far, as the Germans have retreated in front of us. The Boers seem to be getting on very well—so that one rather expects they will finish up before we have got very far!

“We had an *awful* wet season this year—thank Heaven, it's over now—but when we started off at end of April we had some terrible days, and the numerous rivers were all in flood. For days one had feet always wet, and boots and puttees had to be put on wet in the morning, and bedding also wet. This weather, of course, knocked out numbers of porters (it was the worst there had been for sixteen years), but it's only a bad dream now! I've kept fit save that I was in bed for about five days recently—fortunately we were not moving forward—with what I should certainly have diagnosed as 'flu.' at home!

“*July 2, 1916. With Belgian Northern Forces.*

“Now we are in dried-up country of brown grass with trees shedding their leaves—a real dry season such as I haven't met. As regards the war, there has been no fighting, the Germans retreating steadily in front of us. We have kept a steady S.E. direction, and are now not far off the S. end of Victoria Nyanza. The country we first came through was named Ruanda, a treeless country of high, rounded hills all jumbled together, with highly cultivated valleys inhabited by fine, tall, alert natives with good features and very friendly to us—fortunately, as they are of warlike disposition. I didn't

get any collecting (and, indeed, owing to the rains there was little opportunity) till we reached the German post of Kigale (which you may have seen noted in the papers) at end of May.

“ We left Kigale June 6th (I refer, of course, only to our ambulance), and soon got out of the difficult hilly and riverine country—catching butterflies as I went along. On the 6th I got the first specimen of a beautiful *Precis* new to me [*P. artaxia*, Hew.] f.-w. dark blue-black with large steely blue subapical marks, h.-w. brownish with eye spots. I have since got two more specimens, but have never found it abundant.

“ For a day or two we went through very dull country—low, flat ridges much cultivated—but on the 12th came to a striking outcrop of granite and quartz. In one place where we camped the quartz blocks lay about so thickly that they were dazzlingly white in the sun. This was the edge of a stretch of very barren, stony country, after which we found ourselves on some hills overlooking the broad valley of a large river* (whose name, I suppose, I mustn't mention, but I have said it often to you before!)—a glorious view of papyrus with a broad open channel meandering through, and hills on each side covered with ripe, dry grass and clumps of bushes and small trees, which I found magnificent collecting ground and made the most of, as we stayed several days.

“ As regards *Papilios*, ♂ *dardanus* abounded, so I anxiously looked for ♀, and the only ones I saw were two *planemoides*! Remarkable, as it was most un-*Planema* country [see p. cxxvi], and there were only one or two *Acraeines*! *Amauris* was represented only by one or two *echeria* (or *albimaculata*) and *T. petiverana*; so there were no models—save *D. chrysippus*. The locality was 30° 55' E. and 2° 5' S., on the west side of the river. Has *planemoides* been taken as far south as that before?

“ Of *Nymphalines*, the main thing I noted was the abundance of forms of *Precis*, several species new to me (but possibly only wet and dry forms of one species). I collected what I could on the dates I was there (June 13–18) to show how they all flew together, and you will be interested to see them. Of *Hesperids* I got several new to me—of particular interest one that was found among the high grass with underside much

* Kagera River.—E. B. P.

broken up into a network of dark brown and yellow [*Cyclopides willemi*, Wallengr.]. I got a lot of beautiful specimens.

“ The only *Lycaenid* here of interest was a curious sluggish Liptenine [*Telipna reticulata*, Butl., ♂]. I found it sitting on a dry grass stem, and it seemed strictly analogous to the above-mentioned skipper.* I only found the one specimen. I wonder if it's new? On *June 19th* we had a day at another nice collecting ground along the river, and I got some more things I had not got before: A large *Lycaenid*, with some coppery tints [*Deudorix diocles*, Hew., ♂]. A curious *Hesperid* [*Abantis zambsiaca*, Westw.], which I saw sitting on a flower with wings widespread and took for a moment to be a *Syntomid*; its blue-black wings and large semitransparent whitish spots, with coloured body certainly suggested that it was aposematic (but whether Syn- or Pseud- I know not). A large *Asilid* abounded in the grass, and I caught six with prey as follows: Honey-bee, 2; small bee; small (fossorial?) Hymenopteron; a large black frog hopper with conspicuous white blotches, which one *might* regard as aposematic. These five thus had *protected* insects as prey (or four, at any rate)—the sixth had a Satyrine,—*Yphthima*. In some cases the *Asilid* escaped, but I got the prey.

“ After a day or two more we reached a point (30° 55' E., 2° 25' S.) where two big rivers became confluent, and the scenery was strikingly interesting from a geographical point of view. Above and below the confluence, the rivers flow through broad valleys between ridges on each side, covered with dried-up grass and scattered bush (for the dry season seems very marked here). The valley is almost filled with papyrus, leaving a channel meandering in the middle, through which flow the rivers—about the breadth of the Cher in Mesopotamia at Oxford, but with much greater flow. They join at right angles, and shortly afterwards the river flows over some falls and cascades and then through a narrow gap with 300-foot-high cliffs on each side. This was a particularly interesting feature geographically, for the river flowed straight

* Dr. G. A. K. Marshall has noted the resemblance at rest, and the similar resting habits of this *Hesperid*, and an allied *Telipna*,—*T. nyassae*, at Salisbury, Mashonaland. Trans. Ent. Soc., 1902, p. 496.—E. B. P.

through a high ridge, running at right angles to the general lie of the ridge, which is N. and S. It looked to me as if this transverse ridge had been torn across by an earthquake, owing to want of conformity with the surrounding country; for the faces of the cliffs were rough, and had not the appearance of having been worn through by water. If this is so, then the ridge must at one time have held up a great lake behind it, with the overflow perhaps trickling over a low neck somewhere. To my pleasure we had to stop here a day, owing to the delay caused by large numbers having to cross the river in a few canoes. So I caught butterflies in the *very* small patch of forest (perhaps half a mile along the river and 200 yards broad) which flourished where the falls and cascades were, and to my great interest found a regular collection of typical forest species, though surrounding country for miles is dried-up open bush (and on the E. side almost waterless!). On the evening of arrival I had caught *Acraea jodutta* (a rather abnormal specimen*), and *Baoris niveicornis*. Next morning (June 21) I first caught a magnificent blue *Salamis* quite new to me—a real prize. Next, a ♂ and ♀ *Planema poggei*, which was nice after seeing the *P. planemoides* mentioned above. I didn't see any ♀ *dardanus* here. I could have done with a little more collecting here, but we had to move off, and subsequently I haven't seen much.

“ On June 29 we reached the (formerly German) post whence I now write—near S. end of Lake, but I must not mention names. There are a few—no, I mustn't say that! It's *awful* dull country all round—very open, with no bush, and all dried up: moreover, there are plenty of sick to look after, and so there will be no more butterflies so long as I'm here. We have had no real scrapping—only shots fired by a few Germans as they retreated. We have captured a few prisoners (German men and women) and some stores, but nothing of any real importance—the scrapping has yet to come (on *our* side of G.E.A., but the Boers seem to be having plenty). Keep a look-out in the papers for news of the Belgian Northern columns, with whom I am!

“ Oh, one more interesting fact. You remember my saying

* It is *A. esebria*, Hew.—E. B. P.

that on both occasions when I had crossed the [Kagera] river I found on the other side the stridulating ant *Megaponera foetens*? So this time, as soon as I crossed over again (just above the falls mentioned) I kept a careful look-out and had hardly gone a mile away from the river before I saw it *abundantly*, and yet had not seen it before! So I think the three localities, very far separated from each other, may be held to establish the fact that for this ant the K—— (I *nearly* said it that time) river does form a barrier!

“July 12, 1916. *With Belgian Northern Forces.*

“We have arrived at last at the S.W. corner of the lake (and didn't I cry *θάλασσα* when I first saw it!), and are now only two days off Entebbe, as we are in touch with the steamers.

“As you will have seen in the papers the Belgians had an excellent scrap down here, and utterly routed a very superior German force, killing and capturing most of the white officers. But long before you get this you will have seen in the papers about the doings of some English columns; as I can't say anything about them I will change the subject.

“The country down here is very different from the lake scenery I am accustomed to. No forest, but bush and scrub and thorn trees scattered about among long grass now all dried up, and haunted by *G. morsitans*. In wet weather there must have been lots of game here, judging by prints (and some one has seen three giraffe since we have been here). But now, it being dry season and all the grass brown, there are no game, and not much in the way of butterflies; as the country has been burnt to destroy the cover for the German askaris, who have been routed and scattered all over the country. The climate is nice, as the nights are very much cooler than at the N. end of the lake, and during the day there is always a fresh S.E. wind—I suppose trade wind. Day after day the sky is cloudless and blue, and that again is different, for up north one never gets a day without lumpy cumulus clouds, and rarely passes a night without seeing lightning flickerings.

“You will have seen in my last letter notes about again finding *Megaponera foetens* south of the Kagera River, where

it was not north. I saw this morning a detachment—perhaps 100 strong—evidently going off for food, moving along in a column *very* orderly, and quite slowly, three or four abreast (very different from the feverish activity of the *Dorylus* columns!). When disturbed they got excited and stridulated very vigorously. It's an interesting ant, and I should like to see it raiding. From what I've seen so far it only feeds on Termites.

“July 16, 1916. *With Belgian Northern Forces.*

“I am still with the ambulance at the S.W. corner of Lake Victoria, awaiting orders. We are gradually gathering together sick porters from the numerous columns and awaiting a boat to Entebbe for their removal, so that by day I am very busy.”

The following letter, received only a few days ago, showed that Dr. Carpenter was still in the same locality at the S.W. corner of the Victoria Nyanza. An earlier letter describing the ‘place of rocks’ was not received.

“October 5, 1916. *With Belgian Northern Forces.*

“I am still in the place of rocks with my hospital, and fear I am stuck here for many a long day! So I missed the actual capture of Tabora, which was bad luck, as it's the most important thing the Belgians have yet done. I hope the papers have been fair to them, and given them the credit which is theirs. Draw a line from Tabora westwards to Ujiji, and northwards to the S.W. corner of Lake Victoria, and you will see that the Belgians have taken a fair share of G.E.A.! But the papers at home talk as if Smuts' was the only force operating! There was some very bloody fighting, I believe, but I am so out of the way here. We get no news, and you probably know better than I what is going on in G.E.A.!

“I wish this was a better place for butterflies; they are very few indeed. The weather just now is perfect—like a nice English June. Light rains at night—all the bushes and trees flowering and in full fresh green; it's just a lovely springtime—the first I've met in Africa. It's very nice after the eternal sameness of Uganda.

“I've taken to collecting Coleops—my first love! I haven't

any tubes or sawdust, so keep only sizeable ones. There are some grand Carabids—huge black fellows! I *did* laugh one evening. I was sitting out with one of my convalescents from fever (a man who has ‘seen life’ and knocked about all over the world—spent two winters at Klondike in the first days, etc.!), and he suddenly screamed like a woman on seeing one of these black giants which had climbed up him! I said I had seen what I didn’t suppose any one else had ever seen—viz. *him* frightened!! Many of them have a dull white patch on elytra.

“I see a good deal of the ant *Megaponera foetens* here: one is always coming across their long, solemn, slowly marching, black processions—of any number from 50 to 500 or so. I have *never* seen them carrying any other booty but the species of Termite which abounds here—the one I have alluded to before. It lives *under* ground and makes no hills—coming out of little holes and running about, *uncovered*, in the open, to get bits of live *or* dead grass which it carries down the holes. Presumably in correlation with its open-air habits, its colour is much darker than the large Termite whose hills I used to destroy on the islands, and which devoured my house. *This* one does not attack wooden posts, nor does it make covered runs. Curiously enough, I have never seen any soldiers, which is perhaps why *Megaponera* wages such ceaseless war against it. This ant, when it goes out in column, wanders about looking for the Termite holes. Immediately one is found there is great excitement. The little bits of grass which sometimes plug the entrance are dragged out, and the ants scramble down the hole, very shortly reappearing with Termites, feebly struggling, in their jaws. Sometimes there seems evidence of an underground barricade, as ants come up to the surface with bits of dead grass, etc., as if they were breaking down hastily erected barricades! One can almost picture the Termites hastily throwing up partitions of grass and earth to keep back the invaders!

“It would be interesting to know if the reason why *Megaponera* is absent from some parts, is because this particularly defenceless Termite is absent also!!

“There is a peculiar *Skipper* in these parts which seems

to spend the day-time lurking in the shelter of 'Ant-bear' (*Orycteropus*). I found the first quite by accident. When passing one of these large tunnels I idly kicked some loose earth down, and a number of things flew out which I naturally thought were moths. They came back to the mouth of the hole, and one after another settled there, or went inside. I found they were a dull-coloured Skipper of the 'Dingy' type. Since then I have very frequently turned them out in the same way, but they are not always catchable. I wonder if it is a crepuscular or nocturnal species? I have never seen it elsewhere."

The observation described in Dr. Carpenter's last paragraph certainly refers to one of the species of *Sarangesa* mentioned below.

The first record known to Prof. Poulton was that of Dr. G. A. K. Marshall, who, in Ann. Mag. Nat. Hist. (7), II, 1898, p. 33, speaking of his experience in S. Africa, contrasted *Precis natalensis*, Staud., which "frequents the highest points in any neighbourhood," with the *sesamus* form, which "is more partial to shady spots, and is to be found in ravines and sprits spruits] or rocky wooded slopes, and shares with the Hesperid *Sarangesa motozioides*, Holl., a marked affection for disused mining-shafts and cuttings." The species of Hesperid was subsequently identified by Dr. Marshall as *S. eliminata*, Holl. (Trans. Ent. Soc., 1902, p. 422).

The next record was by Mr. S. A. Neave, who, writing on the butterflies of Northern Rhodesia in Proc. Zool. Soc., 1910, p. 69, stated of *Sarangesa plistonicus*, Plötz :—"This species, as well as its allies, has a predilection for very shady spots, as has already been pointed out by Marshall in the case of *S. eliminata*, Holl. Jumping on the ground above a hole made by an Ant-bear will often cause clouds of them to issue forth."

To these could be added two records as yet unpublished.

In 1908 and 1909 Mr. Walter Feather had observed *Sarangesa* frequenting Porcupine as well as Wart-hog burrows at Mandera (3000 feet), 47 miles S.W. of Berbera, Somaliland. Mr. Feather had written—

"I am certain I took the Skipper in Porcupine burrows, as

there were quills and dung in and close to the holes. I also took it on one occasion in a Wart-hog's burrow. I should say the species is *Sarangesa eliminata*, but will send the insects. Nearly all my *Sarangesa* were taken from burrows, as I very rarely saw the butterfly flying in the open. I have seen from 30 to 40 specimens, at the very least, come out of a burrow. When left alone they used to return; in fact, I have disturbed them many times in succession at intervals of a few minutes on purpose to see them return to the burrow. I remember on one occasion only a few coming out on being disturbed. I then got a longer stick, perhaps six to seven feet long, and on pushing this down as far as I could reach, quite a lot more came out. In British East Africa I used to take *S. motozi* and *ophthalmica* under overhanging rocks in deep shade. They rested flat on the rock with outspread wings, and they too returned after being disturbed."

Mr. Feather's notes, taken at the time, recorded that on "June 7, 1909, quite a small cloud came out of a Wart-hog's burrow. They were very active." The animal was dug out; so there was no doubt about the burrow. Feb. 20, 1908, and July 2, 1909, were recorded in the notes as dates on which the Porcupine burrow was visited and Skippers captured from it. Several specimens of the Hesperids thus taken were sent by Mr. Feather and identified as *S. eliminata*.

Finally, Mr. W. A. Lamborn had written from British Central Africa, Aug. 28, 1915—

"A few days ago I made an interesting find—of a large number of skippers, all of one species, resting by day in the burrow tenanted by a Wart-hog, and this appears to be their regular habit. In these burrows also are a great number of larvae of the fly *Auchmeromyia luteola*, F., so that it seems that, though man is assailed by the grubs, the pig is the more favoured host."

Further details were received in a letter of Sept. 4, telling of observations made at Monkey Bay, on the S. of Lake Nyassa. A few additional details sent to Dr. Marshall have been incorporated. Examples of the Hesperid captured on Sept. 3 received in London and Oxford, were identified as *Sarangesa motozi*, Wallengr.

“ On 27th August I examined one of the burrows and saw inside, at a distance of two or three feet from the entrance, a number of Lepidoptera resting on the side walls. From the position of their wings I took them to be Geometers, but on catching one was surprised to find it was a dull, dingy Skipper. On attempting to take more they mostly retired deeper into the hole, but a few came out, immediately seeking shelter under leaves in moth-like fashion. They were obviously rather dazed with the light, and, when left undisturbed, gradually returned to the burrow again. I took eight or ten; then, as the burrow was teeming with fleas, which soon harassed me, I left them alone. Later in the day I opened up the burrow and a number of the butterflies escaped. I have since looked into various other burrows at all times of the day, and have invariably found the insects. If one does not see any, a few handfuls of earth thrown into the burrow always brings out one or two. On the eve of Sept. 2, at dusk, I sat close to a burrow and watched them come out and fly off, and there is little doubt in my mind that they are nocturnal. I am waiting for a moonlight night to make certain of the matter. Yesterday I thought I would see how many I could get out of one hole. Shortly after dawn I managed to take nineteen, and there were a number more still which eluded me either by retiring deeper into the hole or by coming out too suddenly for me. At 1 p.m. I took another four, which came out when I bombarded them with earth, and there still seemed to be more. I have seen them still there with the setting sun very low down. The other denizens of the holes include multitudinous ticks, and the larvae of *Auchmeromyia*, two species, I think.”

It was clear from the above records from many parts of Africa that this interesting habit was highly characteristic of two types of *Sarangesa*—one including dingy forms like *eliminata*, the other variegated forms like *motozi*. How many true species were included would probably only be known when the structural characters were worked out, and all the above-quoted names of *Sarangesas* were employed with this reservation.

Mr. K. G. BLAIR and the CHAIRMAN commented on Prof. Poulton's exhibits.

A SCARCE LONGICORN.—Mr. O. E. JANSON exhibited a specimen of *Thaumasus gigas*, Oliv., a rare and remarkable Longicorn beetle recently received by him from Venezuela.

Papers.

The following papers were read:—

“New species of Hymenoptera in the British Museum,” by ROWLAND E. TURNER, F.E.S.

“Descriptions of South American Micro-lepidoptera,” by E. MEYRICK, B.A., F.R.S., F.E.S.

“Notes on some British Guiana Hymenoptera,” by G. E. BODKIN, F.Z.S., F.E.S.

ERRATA.

TRANSACTIONS.

- Page 142, line 3 from bottom, *for Agrais read Agrias.*
Page 339, line 6 from bottom, *for austati read austauti.*
Page 347, top line, *for Clitumini read Clitumni.*

ANNUAL MEETING.

THE Annual Meeting was held on Wednesday, Jan. 17th, 1917, Commander J. J. WALKER, M.A., R.N., F.L.S., Vice-President, in the Chair.

The Balance Sheet was read by Mr. R. WYLIE LLOYD, one of the Auditors, and adopted on the motion of Mr. F. H. WOLLEY-DOD, seconded by Mr. G. E. FRISBY.

Mr. Lloyd drew special attention to the recovery by the Treasurer of three years' Income Tax on the investments of the Society.

The Rev. G. WHEELER, one of the Secretaries, then read the following

Report of the Council.

During the past year the Society has taken a new departure in the institution of Special Life Fellows, the number of whom may not exceed twelve, the distinction being conferred on British subjects only (these being ineligible for Honorary Fellowships) who have been Fellows of the Society for not less than fifteen years and who have rendered distinguished service to Entomological Science. Two have been elected, Prof. L. C. MIALL, F.R.S., and Col. J. W. YERBURY.

The Bye-laws have been thoroughly revised during this session, numerous alterations having been made, especially with a view to the simplification of procedure in the election of Officers and Council, a ballot for whom had hitherto been required, even in the very frequent cases when no alternative names had been proposed.

The Society has lost thirteen Fellows by death, as against two last year, one of whom, Mr. ROLAND TRIMEN, F.R.S., was a former President of the Society, and had just been recommended by the Council for a Special Life Fellowship, and another, Mr. G. MEADE-WALDO, M.A., was a Member of the Council. Two others, Capt. R. D'A. MORRELL and

2nd-Lieut. H. BALDWIN HUDSON, have given their lives for their country. Death has also removed from our meetings the familiar figures of Mr. J. PLATT BARRETT and Mr. F. ENOCK. The other Fellows whom the Society has lost include Messrs. C. A. BRIGGS, C. CARRINGTON, J. W. ELLIS, A. T. GILLANDERS, Col. A. M. LANG, R. H. RELTON and A. TETLEY. Four Fellows have resigned and three have been removed from the list, while seventeen ordinary and two Special Life Fellows have been elected, our numbers being thus reduced by one, the Society now consisting of twelve Honorary Fellows, two Special Life Fellows and five hundred and ninety-three ordinary Fellows, making a total of six hundred and seven, as against six hundred and eight at the close of last session.

The Transactions will, when completed, form a volume of 444 pages, illustrated by 110 plates and one map, and consisting of twenty-four papers by the following authors: Messrs. P. A. BUXTON, B.A., F.E.S. (in conjunction with Mr. C. B. WILLIAMS, M.A., F.E.S.), G. C. CHAMPION, A.L.S., F.Z.S., F.E.S. (2), Dr. T. A. CHAPMAN, M.D., F.Z.S., F.E.S. (5), Dr. E. A. COCKAYNE, M.A., M.D., F.E.S. (4), J. H. DURRANT, F.E.S. (in connection with the Rev. F. D. MORICE), Dr. H. ELTRINGHAM, M.A., D.Sc., F.E.S. (2), Mrs. O. A. M. HAWKES, Messrs. R. JACK, F.E.S., J. J. JOICEY, F.L.S., F.Z.S., F.E.S. (2), W. J. KAYE, F.E.S., C. G. LAMB, M.A., B.Sc., Dr. G. B. LONGSTAFF, M.A., M.D., F.E.S., Rev. F. D. MORICE, M.A., F.E.S. (2, one being in conjunction with Mr. J. H. DURRANT), H. LING ROTH, and C. B. WILLIAMS, M.A., F.E.S. (in connection with Mr. P. A. BUXTON). Of these, sixteen refer to the Lepidoptera, two each to the Coleoptera, Hymenoptera and Orthoptera, one to the Diptera and one is on the subject of Nomenclature. The plates comprise 2 Chromos, 6 three-colour plates, 93 half-tones and 9 line-blocks. The cost of two chromos and four three-colour plates is contributed by Mr. J. J. JOICEY, Prof. POULTON bears the cost of one three-colour plate, and Dr. CHAPMAN contributes half the cost of sixty-four half-tones and one line-block. The Map is given by Dr. LONGSTAFF, and Mr. LING ROTH gives numerous text figures in illustration of his paper as well as a donation of

£5 towards the printing. In all cases the drawings have been contributed by the respective authors. In consequence of the increased cost of printing the volume is not quite so large as in late years, but the number of plates is considerably in excess of the average.

The Proceedings will occupy about 100 pages, and are illustrated by one line block and one half-tone plate, and contain several valuable papers in addition to the usual record of exhibits.

Although the war has deprived the meetings of the presence of almost all our younger Fellows, except when home on leave, the attendance has been well maintained by the older Fellows in spite of darkened streets and irregular train service.

The TREASURER reports as follows :—

The item of £434 14s. under the heading of “ Subscriptions for 1916 ” shows a falling off of £40 19s. compared with the previous year.

The sale of Transactions, which amounts to £163 4s., is £24 9s. 8d. in excess of the year 1915.

The recovery of £11 17s. 3d. for income tax for three years, deducted from the dividends on our investments, is satisfactory.

Comparing our liabilities of £294 with our balance of £237 14s. 9d. shows a deficit of £56 5s. 3d. This sum, however, is covered by arrears of Subscriptions which, after careful analysis, may be considered good. The value of our Securities shows a further depreciation of £83 11s. 1d.

A. HUGH JONES,
Treasurer.

The LIBRARIAN reports as follows :—

Three hundred and nineteen Volumes have been issued from the Library for home reading, and twenty-two Volumes and a large supply of Separata have been added to the Library.

The Library has been used very largely for purposes of reference. As was the case last year, very few foreign magazines are coming to hand.

A munificent donation of numerous illustrated books to

the value of £31 10s. has been given by Mrs. Meldola in memory of her husband. These books have been selected by the Librarian, and the titles will be given in the " Additions to the Library " for the year 1916.

The Report was adopted on the motion of Mr. H. MAIN, seconded by Mr. W. J. KAYE.

In consequence of the absence of the PRESIDENT through illness, his Address was read at his request by the Rev. JAS. WATERSTON, who showed a number of slides in illustration.

The Rev. F. D. MORICE proposed a vote of thanks to the President, regretting his absence and its cause, and expressing the hope that the Address might appear in the Proceedings of the Society. He also referred to the excellent way in which Mr. Waterston had performed a very difficult task. The vote of thanks was carried unanimously, after being seconded by Mr. HAMILTON DRUCE.

A vote of thanks to the Officers was passed on the motion of Mr. STANLEY EDWARDS, seconded by Mr. J. HARTLEY DURRANT, and each of the Officers said a few words in reply.

ENTOMOLOGICAL SOCIETY OF LONDON.

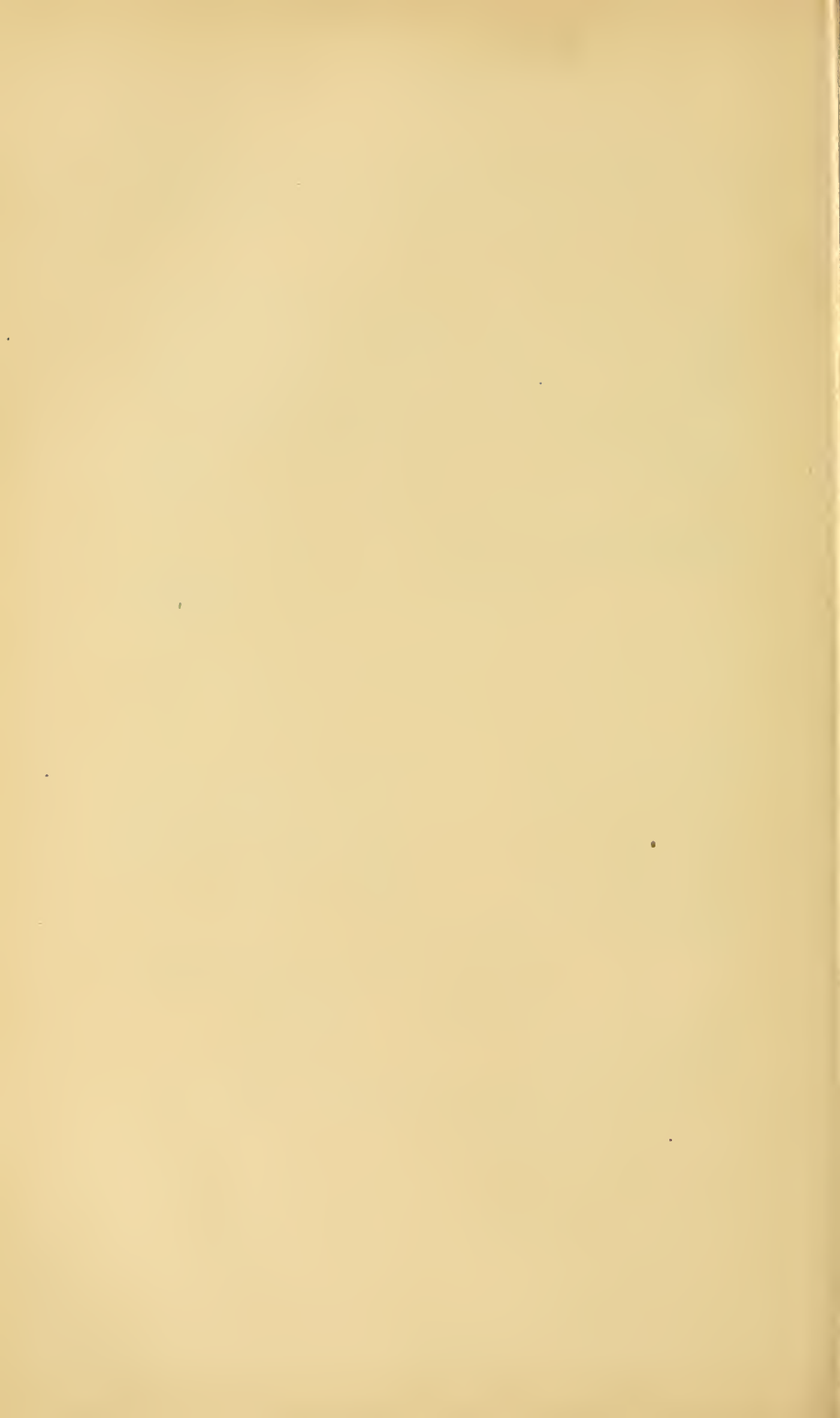
Balance Sheet for the Year 1916.

RECEIPTS.			PAYMENTS.		
	£	s. d.		£	s. d.
Balance in hand, 1st Jan., 1916	224	18 7	Printing Transactions, etc.	353	0 6
Subscriptions for 1916	434	14 0	Plates, etc.	223	0 8
Arrears	26	5 0	Rent and Office Expenses	177	6 10
Admission Fees	25	4 0	Books and Binding	13	7 8
Donations	86	1 0	Subscriptions in Advance as per contra carried to 1917	17	17 0
Sales of Transactions	163	4 0		784	12 8
Interest on Investments—			Balance in hand	237	14 9
Consols	£26	13 4			
Birmingham 3 per cents.	5	13 3			
		32 6 7			
Income tax for three years recovered on above		11 17 3			
Subscriptions in Advance		17 17 0			
	£1,022	7 5		£1,022	7 5

ASSETS.			LIABILITIES.		
	£	s. d.		£	s. d.
Subscriptions in arrear...	120	0 0	Outstanding account	16	0 0
Cost of £1,354 2s. 2d.			Cost of printing Parts 2, 3, 4 and 5, say £250. Estimated cost of Plates in hand, £36, from which has to be deducted £8, the amount promised by contributors towards the cost thereof, leaving a total liability of, say, £294 for the year 1916.		
Consols. Present value at the price of 55½ on the 30th December, 1916, £748 2s. 10d.	1,233	3 0			
Cost of £239 12s. 4d. Birmingham 3 per cents. Present value at the price of 60 on 30th December, 1916, £143 15s. 4d.	250	0 0	Audited, compared with vouchers and found correct, January 5th, 1917—		
Balance in hand	237	14 9			
	£1,840	17 9	F. D. MORICE.		
Additional Assets:—			R. W. LLOYD.		
Contents of Library			A. BACOT.		
Valued at, say, £3,800.			J. C. F. FRYER.		

The value of Securities shows a total depreciation of £591 4s. 10d.

A. HUGH JONES, *Treasurer*.
5th January, 1917.



THE PRESIDENT'S ADDRESS.

LADIES AND GENTLEMEN,

YOU have already heard in the Report of the Council all details connected with the working of our Society during the past year, and taking into consideration the effects, direct and indirect, of the war, we shall, I think, all agree that the position of the Society is satisfactory.

I shall not therefore detain you with any preliminary observations, but proceed at once to the subject of my address.

CONVERGENT DEVELOPMENT AMONG CERTAIN ECTOPARASITES.

In submitting a few notes to the Fellows of The Entomological Society of London on some aspects of parasitism, I may possibly be excused for offering a word of explanation as to why this theme was selected.

Both fleas and bed-bugs have been of great interest to me for a long time, and my knowledge of these groups suggested that some attempt to put together a few observations concerning certain modifications in the structure of Ectoparasites, occurring repeatedly in those orders or families which are wholly or partially parasitic, might prove of interest to my audience this evening.

My two friends, Dr. K. Jordan of the Tring Museum, and the Rev. James Waterston, of the Imperial Bureau of Entomology, have been good enough to supply me with information concerning those parasitic insects about which I know little or nothing, and Mr. Hugh Scott of Cambridge has likewise placed his great knowledge of the Nycteribiidae at my disposal, and it must therefore be understood that many of

the facts embodied in this paper are compiled from the notes my friends have kindly given me.

Parasitism is not an original form of existence; on the contrary, it is an acquired habit, acquired slowly through ages. Parasites are derived from non-parasitic forms, and the alteration of habit is accompanied by corresponding morphological changes. Parasitism and non-parasitism are two conditions somewhat analogous to pathological and normal states, the pathological being a modification of the normal or healthy tissue. The study of parasites and parasitism is fascinating and delightful to the speculative mind, as a comparison between the various parasitic insects and their non-parasitic relatives enables the observer to trace changes and modifications which are more apparent among parasites than among normal insects.

Ectoparasitism is a mode of life adopted by the members of several orders of insects either in one stage of the life of the individual or throughout its entire existence. In some cases it is only the young stages which adopt an ectoparasitic existence, for example, many mites; in others it is the imago only which is an ectoparasite, for example, fleas; while in others again, the parasitic habit obtains from birth to death, as in the case of *Anoplura* and *Mallophaga*. Some of these Epizoa never leave the host on which they dwell and feed, while others are temporary visitors only when they are in need of food. A third association appears to occur in at least one case, the curious *Hemimerus*, a parasite on an African rat, which appears to use its host more as a means of locomotion than for any other purpose, it being supposed that the *Hemimerus* does not secure any food from the skin of its host.

The great variation which obtains in the degree of parasitism, in the number of hosts frequented, and in the orders from which parasites are derived, has naturally produced numerous and varied species of parasitic tracheates. Notwithstanding this fact, even the casual observer must notice the repeated recurrence in widely different orders of similar morphological details. While there is no general uniformity, many Epizoa exhibit points of remarkable resemblance.

This agreement in certain characters may be likened to the colour-similarity found in cave insects, or to the resemblance of certain marine animals to fish, or of subterranean lizards (*Amphisbaena*) to earthworms and snakes. In fact, parasites show that a similarity of surroundings is frequently accompanied by, or associated with, a certain amount of agreement in structure and colour. I hope that a short survey of the chief points of resemblance exhibited by those ectoparasitic insects which live on birds and mammals may be of some interest to you.

INSECTS ECTOPARASITIC ON WARM-BLOODED
VERTEBRATES.

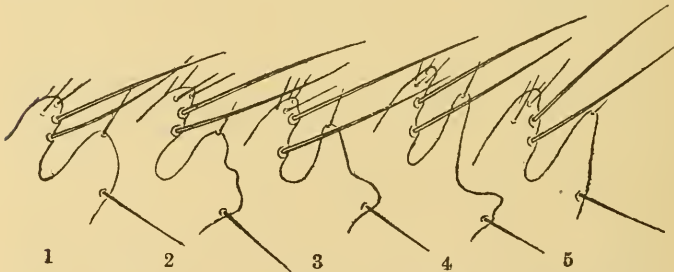
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|---|---|
| <p><i>a.</i> With sucking mouth-parts.</p> <ul style="list-style-type: none"> Anoplura Cimicidae Polycetenidae Siphonaptera Hippoboscidae Nycteribiidae Streblidae | <p><i>b.</i> With biting mouth-parts.</p> <ul style="list-style-type: none"> Mallophaga Hemimeridae Platypsyllidae |
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There are some other insects which may be called semi-parasitic, such as certain Staphylinids found on mammals in South America, and the blind Silphid beetle *Leptinus testaceus* of Europe, frequently observed in the burrows of mice. These I mention only in passing.

The skin of the host covered with pelt or feathers offers opportunities of life more uniform as to temperature and moisture than that enjoyed by the insect struggling against changing atmospheric conditions. True parasites are not much affected by climate, the conditions remaining more or less uniform whether the host is sub-tropical or sub-arctic in its distribution, or dwells in a moist or a dry climate. Insects that are free are much more affected by climatic conditions. Again, the forces of evolution are much less active in, and affect the parasite far less than, the host. Evolution in the case of the parasite is retarded by the uniformity of conditions. It is for this reason that parasites not infrequently illustrate the phylogenetic connection of the

hosts better than do the hosts themselves, just as certain caterpillars have indicated a relationship of their food-plants once considered to belong to widely different orders.

It must not, however, be concluded that the species of Epizoa are constant. They too are liable to variation, especially those which, like the fleas, do not spend all their life on the host. We find among them many instances of conspicuous variation, individual as well as geographical. The flea of the hedgehog, for instance, is different in the western Mediterranean countries from the form found in Central Europe and Great Britain. The rodent flea, *Ctenophthalmus agyrtes* (very common in Great Britain on voles and mice), has developed into a number of geographical races on the Continent, and even the Scottish and British specimens, taken as a whole, show some distinctions. Text-figs. 1-5 represent a portion of male genital organs of five fleas representing *Ctenophthalmus agyrtes*, in various parts of Europe: *agyrtoides* Wahlgr. (1911) from Scandinavia, *eurous* Jord. and Roths. (1912) from Hungary and Russia, *agyrtes* Hiller



FIGS. 1-5. Portion of δ -genitalia of *Ctenophthalmus agyrtes* and its geographical representatives: 1. *agyrtoides*; 2. *agyrtes*; 3. *eurous*; 4. *provincialis*; 5. *baeticus*.

(1896) from Central Europe, Northern France and the British Isles, *provincialis* Roths. (1910) from the French Alps and Southern France, and *baeticus* Roths. (1910) from Portugal. In America, North of Mexico, we know a number of species which also consist of four or five geographical varieties, and the same can be said of certain species inhabiting other continents. So far as our knowledge goes at present, this geographical variation of the fleas is not dependent on differ-

ences in the host or hosts, but must, at least in the main, be attributed to those factors, whatever they may be, which are the cause of the modification into geographical races of non-parasitic insects and other members of the animal world.

Epizoid life is, on the whole, one of ease and affluence, attended by the results which we are wont to denominate as degeneration. The females of certain sluggish or sedentary fleas, such as species of *Vermipsylla* and the renowned Jigger, *Dermatophilus penetrans*, swell up to a great extent, resembling big lice or ticks in shape, the resemblance being enhanced by their sluggish habits. A reduction in the mouth-parts of Epizoids is of common occurrence. The palpi are absent in the *Anoplura* or true Lice, and reduced in the *Mallophaga*, or biting Lice, and the labial palpi of the fleas, which form the outer sheath of the proboscis in this order of insects, are very much reduced in those species which anchor themselves to their host and thus lead a stationary life.

While some Ectoparasites, like the *Hippoboscidae* and *Streblidae*, have well-developed wings and have retained the power of flight, these organs are entirely lost in other Epizoid insects. We find remnants of wings or of wing-cases in the *Cimicidae*, *Polyctenidae*, and *Platyphylidae* and modified halteres in the *Nycteribiidae*, but in the *Hemimeridae*, *Siphonaptera*, *Mallophaga* and *Anoplura* all remnants of wings are lost. This convergent development is easy to understand in Epizoids. Wings would be a hindrance and a danger to insects moving among fur or feathers. For that reason, the winged *Pupipara* break off the wings, or, at any rate, lose them when they select their host, and in this state they resemble more a bed-bug than a fly, which resemblance is, of course, quite incidental, due to convergence without mimetic meaning.

One of the most remarkable reductions among Epizoids is that of the eyes. Epizoid species are derived from insects with compound eyes. The faceted eye, however, is preserved only in the *Cimicidae* and *Hippoboscidae*. In the *Mallophaga* and *Anoplura* the eyes are reduced or absent; in the *Nycteribiidae* absent or vestigial; in the *Polyctenidae*, *Hemimeridae* and *Platyphylidae* absent; in *Siphonaptera* the eye is single, never faceted, and in most cases reduced or absent.

This apparent irregularity in the development of the eye among Ectoparasites is, no doubt, explained by some difference in habits, although much still remains a mystery to us.

Is the absence of eyesight in these insects due to parasitism? Only to a certain extent, I think. We know that the insects which in the imago state are totally or partially blind are found among those which live in caves, deep under stones, or in other places where there is little or no light. The Ectoparasitic insects whose eye-sight is lost or reduced are those living on hosts that frequent similar dark places. Although not invariably true, the parasites of mammals which conceal themselves or dwell in burrows, hollow trees, caves, etc., are blind. Most of the fleas, for instance, which live on burrowing mammals are blind, while the bird-fleas have the eyes well developed. Bat parasites have no eyes or only remnants of them, with the exception of the *Cimicidae*. This exception is instructive. The *Cimicidae* or bed-bugs, some of which feed on bats (text-fig. 6) are closely allied to the *Polyctenidae* (text-fig. 7), likewise found on bats, but



FIG. 6. Head of *Loxaspis villosus* Stål (1865).
 ,, 7. ,, ,, *Polyctenes molossus* Gigl. (1864).

totally blind. The *Cimicidae* are usually found where bats sleep, only visiting their hosts in order to take nourishment, as they are temporary parasites. The *Polyctenidae*, on the other hand, live in the fur of bats, not leaving the host. They are more intensely parasitic and exist in almost uniformly dark surroundings. Is it the intensity of parasitism or the darkness which has caused the loss of eyes in *Poly-*

ctenidae? A comparison with other groups of ectoparasites will enable us to answer the question. Among the *Siphonaptera* the very intensely parasitic *Echidnophaga* and *Dermatophilus penetrans* have NOT lost the eye; they fasten themselves on the naked or comparatively bare parts of the skin of the host, in birds, for instance, around the eyes and ears, and on the wattles of fowls, in mammals on the ears and feet. The ♀ of *Dermatophilus penetrans* burrows into the bare skin,

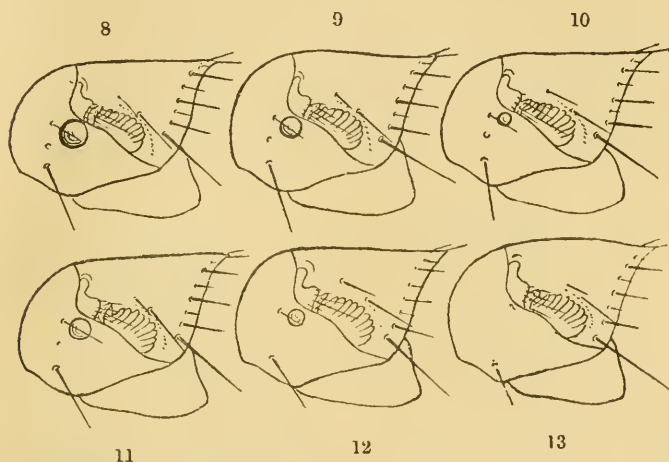


FIG. 8. Head of *Xenopsylla eridos* Roths. (1904).
 ,, 9. ,, ,, ,, *niloticus* Roths. (1908).
 ,, 10. ,, ,, ,, *niloticus* Roths. (1908).
 ,, 11. ,, ,, ,, *brasiliensis* Baker (1905).
 ,, 12. ,, ,, ,, *tortus* Roths. (1908).
 ,, 13. ,, ,, *Rooseveltdiella georychi* Fox (1913).

but even that habit is not accompanied by the loss of the eyes. The nearest allied species, *D. caecata*, however, has a reduced eye: and this species swells up in such a curious way in the ♀, that the abdomen almost completely envelopes the head and thorax. In both species the ♂♂ do not burrow into the skin. Again, among the *Anoplura*, the human lice are at least as intensely parasitic as the Polyteteniids, but they have nevertheless preserved the eyes, while other species of lice, living in the fur of burrowing mammals, have the eyes much reduced or absent. All this appears to show that the

degree of parasitism is of less importance in connection with the reduction of the eye than the absence of light, in the imagines of Epizoid insects. The absence of light leads to the reduction of the eyes, whether the insects are parasitic or not. Our illustrations (text-figs. 8-13) represent two series of three fleas each, showing a gradual reduction of the eye in closely related species.

The reduction or loss of the power of flight and of the eyesight are clearly cases coming under the term of loss of organs by disuse. But not every instance of reduction of organs among Epizoa is attributable to the same cause. In the *Mallophaga*, for instance, the foreleg is often much shortened, being modified into a sort of hand employed while feeding (text-fig. 14). In a similar way, the forelegs of *Polyctenidae*,

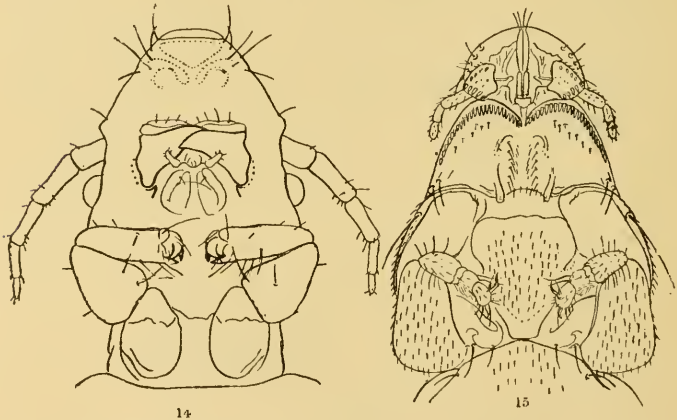


FIG. 14. Underside of head and prothorax of *Esthiopterum diomedae* Fabr. (1775).
 ,, 15. Underside of head and prothorax of *Eoctenes nycteridis* Horv. (1910).

widely removed from the *Mallophaga* in classification, are so short that they are entirely concealed under the prothorax. They are strongly built, particularly the femora, and certainly not without functions (text-fig. 15). It is possible that the Polyctenids use them while feeding for keeping the hairs of the host away from the proboscis. This convergent development between *Mallophaga* with biting mouth-parts, living on birds and mammals, and Polyctenids with sucking mouth-

parts living exclusively on bats is remarkable, and yet similar instances of convergence are not rare among non-parasitic insects, as for example the modification of the fore-tibia into an instrument for digging, the hind-legs into organs for jumping, etc. Such modifications are in fact adaptations suited for a similar kind of life and acquired by the various insects independently of one another.

Some of the chief activities in the life of the Epizoa and the attendant morphological peculiarities aim at the circumvention of the hostility of the hosts. Beak, tooth, and claw are ever ready to destroy the unwelcome guests. As among insects generally protective resemblance, nauseousness, stings, shamming death, swiftness of flight, etc., are means of avoiding an untimely death, so we find also among Epizoa devices which give the parasite a chance of surviving the severest persecution. These morphological devices may be discussed under two headings: (1) Means of holding on to the host, and (2) means of moving about on the host into a position of safety.

The Ectoparasite is enabled to keep his foothold, so to speak, by bristles, tarsal claws, or the proboscis, or a combination of them.

It is one of the characteristics common to Epizoid insects that they have a covering of hairs and bristles, either over the whole body or on certain exposed portions of it. The bristles and hairs serve various purposes. The function of those bristles which are directed away from the body or legs is to rest on the hairs of the host when the parasite is not moving. The parasite by this means can hang in the pelt without slipping out, as a broken-off many-branched twig remains hanging in a bush. These supporting bristles are directed backwards, or at least their tips point backwards, so as not to impede a forward movement of the parasite. Some Epizoa can only move forward in the pelt (*Siphonaptera*), not backwards. Some *Mallophaga* resemble *Polyctenidae* in possessing single long bristles on the tibiae (cf. text-figs. 26-29).

The claws at the end of the tarsi appear to be organs which are easily modified. The claws of the fore-tarsi are often different from those of the other tarsi in Ectoparasites, as is

also frequently the case in other insects. We have not noticed any special sexual adaptation of the claws in Epizoa, but the tarsi have often a different covering of bristles in the sexes.

There is a *single* claw in some mammalian *Mallophaga* and in the *Anoplura* (text-figs. 16 and 17). This claw is so constructed that the insect can take a firm hold of a hair of the host. It is singular that this kind of claw should be found only in those two groups, which are usually placed far apart in the system. If there is really no relationship between the *Anoplura* and mammalian *Mallophaga*, the close agreement in the claws is certainly most remarkable.

All the other Epizoa insects have double claws of the

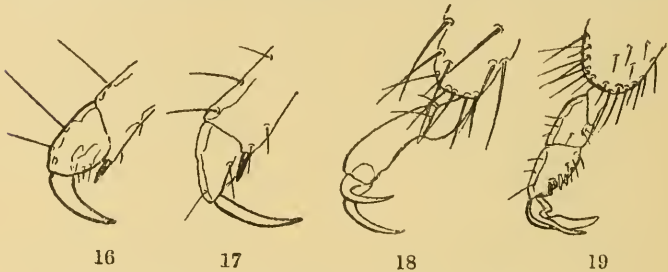


Fig. 16. Tarsus of *Pediculus humanus* L. (1758).
 ,, 17. ,, ,, *Trichodectes caprae* Gwilt (1843).
 ,, 18. ,, ,, *Ancistronea vagelli* Fabr. (1787).
 ,, 19. ,, ,, *Adroctenes horvathi* Jord. (1911).

sickle-shaped type usually found in insects (text-figs. 18 and 19). In some groups (the majority of fleas) the claws have a large basal tooth, in other cases they are quite simple, many intergradations occurring. Asymmetrical claws are found in some genera of *Polyctenidae* (text-fig. 19) and of *Cimicidae*, the inner or posterior claw (*i. e.* posterior if the leg is stretched out at right angles to the body) being smaller than the outer one. In this point the three groups of Ectoparasites mentioned agree with the Rutelid beetles and the ♂♂ of the Agaristid genus *Chelonomorpha*, while in the butterfly sub-family *Acracinae* the opposite development has taken place, the inner claw being the larger one. Among the Pupipara also some slight asymmetry in the claws is found; here, as in the *Cimicidae* and *Polyctenidae*, the inner claw being the shorter one. It appears, therefore, probable that

the single claw of *Anoplura* and some mammalian *Mallophaga* corresponds to the outer (= anterior) claw of other insects.

The second organ by which Epizoa with sucking mouth-parts fasten themselves to the host is the proboscis. A permanent fixture is achieved by driving the proboscis deep into the skin, as is done by ticks. This tick-like fixing is found among the fleas in certain species, either in both sexes or, as is usually the case, only in the female. The rabbit-flea, and the species of *Echidnophaga* may be mentioned as examples. The mandibles and upper lip of these fleas are very strongly developed, the mandibles having densely and deeply serrated edges, by means of which these fleas are anchored. It is interesting to note that in some stationary fleas which have large claws the proboscis is relatively small (*Malacopsylla*); while in stationary fleas anchored by the strongly developed mouth-parts the tarsal claws have become reduced, being in some species so slender and weak as to be of no use as a means of fixation (*e. g.* in the Jigger).

It is also possible that some other portion of the mouth-parts serves the purpose of fixing in other Epizoa. The so-called mentum of the beaver-beetle, *Platypsyllus castoris*, for instance, is divided into three lobes posteriorly projecting towards the throat; and the gular plate of some *Mallophaga* is similarly divided posteriorly into two or three projecting lobes (*Ancistrana*, *Pseudomenopon*); (*cf.* text-figs. 20 and 21).

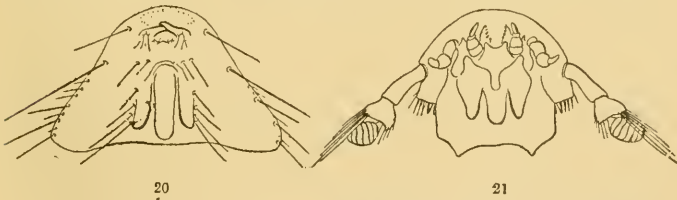


FIG. 20. Underside of head of *Pseudomenopon tridens* N. (1838).
 ,, 21. ,, ,, ,, *Platypsyllus castoris* Rits. (1869).

The permanently fixed Epizoa are exposed to the danger of being torn off or squashed by the host. There is generally some special provision against this danger. Either the skin of the parasite is so very tough that the scratching and biting of the host can do no damage of serious consequence to the

body though the legs may be injured, or the body is provided with strongly chitinised projecting lateral excrescences, as, for instance, in the genus *Hectopsylla* (*Siphonaptera*), or with specially thickened pleural sclerites as in certain *Mallophaga*.

The non-stationary Epizoa have, instead, the advantage of being able to run away, and they usually manage to find a place on the body of the host where claw, tooth or beak cannot well reach them. The majority of Epizoid insects have acquired great agility, and many of them glide through the fur of the host as quickly as a seal travels through water or a corncrake through grass. Such rapid locomotion is only possible in consequence of special adaptations.

The Epizoa are all flat, and only the females of certain stationary species swell up to a considerable extent. The fleas are compressed, *i. e.* flat from the side, while all the other Epizoid insects are depressed, *i. e.* flat in a dorso-ventral sense. The head is rounded or conical, and sometimes as flat and thin as the blade of a knife. In *Mallophaga*, some Fleas, *Pupipara*, and others, it is the whole anterior portion of the head corresponding to the clypeus which is smoothly rounded. Stationary fleas, however, like the rabbit-flea and the Jigger, have the frons angulate. In the *Polyctenidae* the upper lip is very much enlarged and semi-circular in shape, forming the anterior portion of the head into a kind of shield (text-fig. 7). This shield is horizontal and very much resembles the clypeus of certain *Mallophaga*. Now, among the *Siphonaptera* we also find species in which there is such a shield, but here it is homologous with the clypeus and not with the labrum, and is placed in a vertical direction. This occurs in *Stephanocircus* and some allied genera. The head of the *Nycteribiidae* has not this rounded shape and is not carried in the usual manner, but tucked away in a groove on the upper side of the thorax.

Such stowing away of projecting organs is a common device. The proboscis of the *Cimicidae* and *Polyctenidae* lies in a groove on the under side, and that of the *Siphonaptera* in between the fore coxae. The antennae of fleas (text-figs. 8-13), *Pupipara* and certain *Mallophaga* are tucked away in a groove. The antennae are nearly always short, and, in those cases where there are many segments, most of

them are united to form a knob. In the *Platytypyllidae* and *Siphonaptera* the antennae recall those of Clavicorn beetles (text-figs. 14-19, 21).

The incisions between the segments of the body and leg-joints are points of danger; the hairs of the host might slip into the sutures and the parasites thus become entangled. This danger is overcome on the one hand by the presence of bristles which overbridge the incisions, and on the other by the segments being closely applied to one another or telescoped. Such "parrying" bristles fending off the hairs of the host are most conspicuous at those joints where the greatest flexibility obtains between parts of the insects; for instance, at the joint between head and thorax, prothorax and mesothorax in those cases where the former is separated, and at the juncture of femur and tibia. Some species of fleas and *Polyctenidae* may be mentioned as illustrations.

The bristles which lie flat on the body, as do the majority of the thoracic and abdominal bristles in fleas, not only

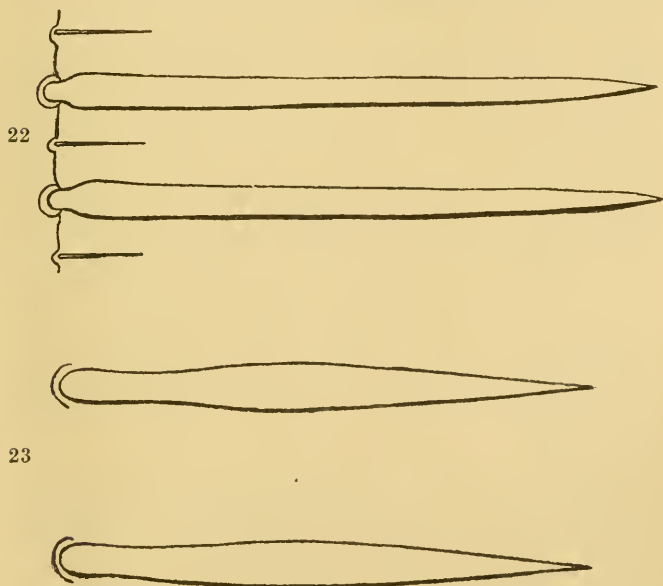


FIG. 22. Abdominal bristles of *Xiphiopsylla hippia* Roths. (1913).
 ,, 23. ,, ,, ,, *Polyplax enormis* K. and P. (1915).

protect the joints, but also strengthen the body and render the insect slippery, so that it can withstand pressure more successfully and glide more easily through the fur. As a rule these bristles are of the usual tapering kind, but bristles of other shapes also obtain. Bristles resembling the blade of a straight sword are, for instance, found in some fleas (*Xiphopsylla*) and some Anoplura (*Polyplax*, *Hoploplura*) (text-figs. 22, 23). Short, thick, peculiarly dentate bristles occur in *Cimicidae* and appear among Ectoparasites to be confined to that family.

The combs, which are a very conspicuous feature of many Ectoparasites, have a similar function to the bristles. They are strongly developed in most *Siphonaptera*, all *Polyctenidae* (text-fig. 15), in *Nycteribiidae*, and *Platyphylidae*, and similar structures may often be observed among *Mallophaga*. These combs in most groups consist of peculiarly modified bristles, but in the fleas they usually appear to be exaggerated serrations of the edges of segments. Most of the *Nycteribiidae* have one or two combs on the underside of the abdomen and a semi-circular one dorsally on each side of the thorax. In the *Polyctenidae* combs are found on the head, thorax, and the elytra, or on one of them, and sometimes also on the antennae. *Platyphylus* has a comb on the head, while in fleas, combs are found on head, thorax and abdomen, some fleas, however, being without combs altogether. Some bat-fleas and the large mole-flea may serve as examples of many-combed species, while the "bubonic plague" flea, *Xenopsylla cheopis*, belongs to a combless genus. The human flea is allied to the rabbit-flea and the hedgehog-flea. The two latter species have a comb on the genal portion of the head and pronotum, while in the human flea the pronotal comb is entirely lost and the genal one at most represented by one tooth.

The question why the combs are lost in many species will be difficult to answer. I may mention, however, one instance which throws a little light on points of this kind. Bat-fleas appear originally to have had a comb on the pronotum, metanotum and abdominal tergites 1-6, *i. e.* 8 dorsal combs. These are preserved in a number of species. In others some of the combs are lost or reduced to a few very short teeth.

We have also species in which the lost combs are replaced by what we call "false" combs in *Siphonaptera*. The abdominal combs of the North American *Myodopsylla palposus*, for instance, are represented by small teeth (text-fig. 24).

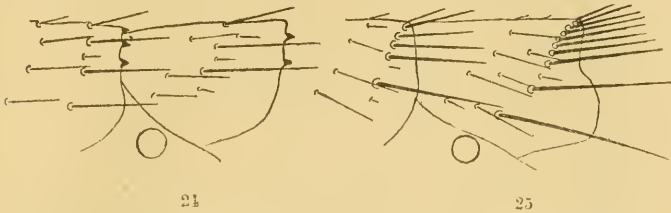


FIG. 24. Metanotum and first abdominal tergite of *Myodopsylla palposus* Roths. (1904).
 ,, 25. Metanotum and first abdominal tergite of *Myodopsylla insignis* Roths. (1903).

In an allied species (*M. insignis*) Nature has thought better of it and replaced the lost combs by combs developed from the row of long bristles which is present in all fleas at some distance from the apical margin of the segments (text-fig. 25). There is apparently a tendency towards the loss of organs after they have persisted, perhaps, a long time; if this loss is antagonistic to the welfare of the insect, the species is doomed to destruction unless another organ can undertake the function of the lost one. At any rate, this seems to be the explanation of the development of such false combs in species which we must assume from all we know of them and their allies to have possessed originally normal combs on the segments now provided with false ones.

Bat-parasites provide us further with an interesting case of the evolution on parallel lines which occurs in these different groups of Epizotic insects. The legs of *Polyctenidae* have so-called pseudojoints varying in number according to individuals, species or genera. The pseudojoints are pale rings where the chitin is less thick and hard, rendering the legs more flexible. Similar pseudojoints are found in *Nycteri- biidae*, and in the bat-infesting genus of bed-bugs, *Loxaspis* (text-figs. 26-30). The bat-fleas, however, although long-legged, have no pseudojoints. The occurrence of such a curious structure in parasites living on the same family of hosts, or even on the same individual, is certainly not

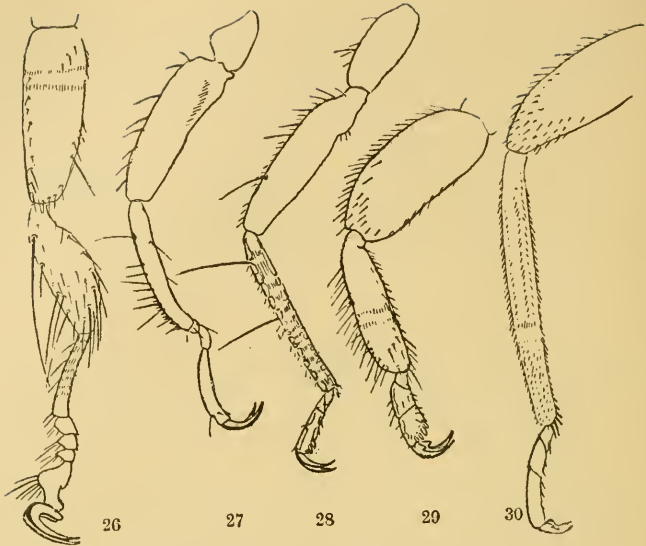


FIG. 26. Leg of *Listropodia blasii* Kolen. (1856).
 ,, 27. ,, *Colpocephalum truncatum* Piag. (1880).
 ,, 28. ,, *Hesperoctenes*.
 ,, 29. ,, *Adroctenes horvathi* Jord. (1910).
 ,, 30. ,, *Loxaspis mirandus* Roths. (1912).

accidental, but must be assumed to be due to the similarity of surroundings.

From the various examples of resemblances I have mentioned, it is evident that the medium in which a species exists exercises a most powerful influence on its evolution. If that is so in the case of Epizoic insects, we are not far wrong in assuming that the similarities, often slight in themselves, which sympatric insects (*i. e.* insects living in the same district) exhibit, are due in the first instance to similarity in the surrounding primary conditions of life.

It only remains for me to express my thanks to the Officers and Council for the assistance which they have given me during my term of office, and especially to the Vice-Presidents, on whom, through unfortunate necessity, so large a portion of my work has latterly devolved.

GENERAL INDEX.

The Arabic figures refer to the pages of the 'Transactions'; the Roman numerals to the pages of the 'Proceedings.'

The President's Address is not separately indexed.

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- Acraea*, on certain forms of the genus, lxxix, 289.
- Africa, Rhopalocera from, exhibited, xiv; observations on the attacks of birds on butterflies in British East, lxxiv; habits of *Pangonia varicolor*, observed in South, exhibited, xc; west of the Victoria Nyanza, notes on South-West Uganda and on late German East, cx.
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THE FELLOWSHIP AND FEES.

Fellows pay an Admission Fee of £2 2s. The Annual Contribution is £1 1s., due on the first day of January in each year, and payable in advance; or a Composition Fee of £15 15s. may be paid in lieu thereof, the whole payment for Life Fellowship, including the Admission Fee, being £17 17s. Fellows residing permanently outside the United Kingdom pay no Admission Fee.

All Fees should be paid to the Treasurer, Mr. A. H. Jones, Shrublands, Eltham, Kent, and not to the Secretaries.

Fellows desiring to pay their Annual Contribution through their bankers can obtain an official form of banker's order by applying to either the Treasurer or to the Resident Librarian.

Fellows whose Contributions for the current year have been paid are entitled to receive the publications of the Society free of charge. Further copies may be purchased at reduced prices by applying to the Resident Librarian.

Forms of application for Fellowship and copies of the Bye-laws and List of Fellows may be obtained from either of the Secretaries or from the Resident Librarian.

MEETINGS AND EXHIBITIONS.

Intending exhibitors are required to signify their names and the nature of their exhibits to the Chairman before the beginning of the meeting, in order that they may be called upon from the chair. Descriptive notes of all exhibits should be handed to the Secretaries at the same meeting for printing in the Proceedings. If the epidiascope is required a week's notice must be given; exhibits to be satisfactorily focussed by this instrument must not exceed 7 ins. square.

Fellows resident abroad, or who are otherwise unable to attend, are reminded that any specimens, notes, or observations they may send to the Secretaries will be considered by the Council, with a view to exhibition or reading at the meetings of the Society.

PAPERS AND ILLUSTRATIONS.

Fellows desiring to communicate papers to the Society must send the full titles of such papers either to the Secretaries at the Society's rooms, or to Commander J. J. Walker, M.A., R.N., Aorangi, Lonsdale-road, Summertown, Oxford, at least fourteen days prior to the date of the meeting at which it is proposed that such papers shall be read.

Authors proposing to illustrate their papers should communicate with the Secretaries before the drawings are executed. The Council recommend that the size of the work on plates should be limited to $6\frac{1}{4}$ ins. by 4 ins., and in no case will it be allowed to exceed $6\frac{1}{2}$ ins. by $4\frac{1}{4}$ ins.

Attention is called to the Instructions to Authors issued with Part I of each volume, which may also be obtained of the Resident Librarian. Inattention to these regulations may involve an author in considerable expense.







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