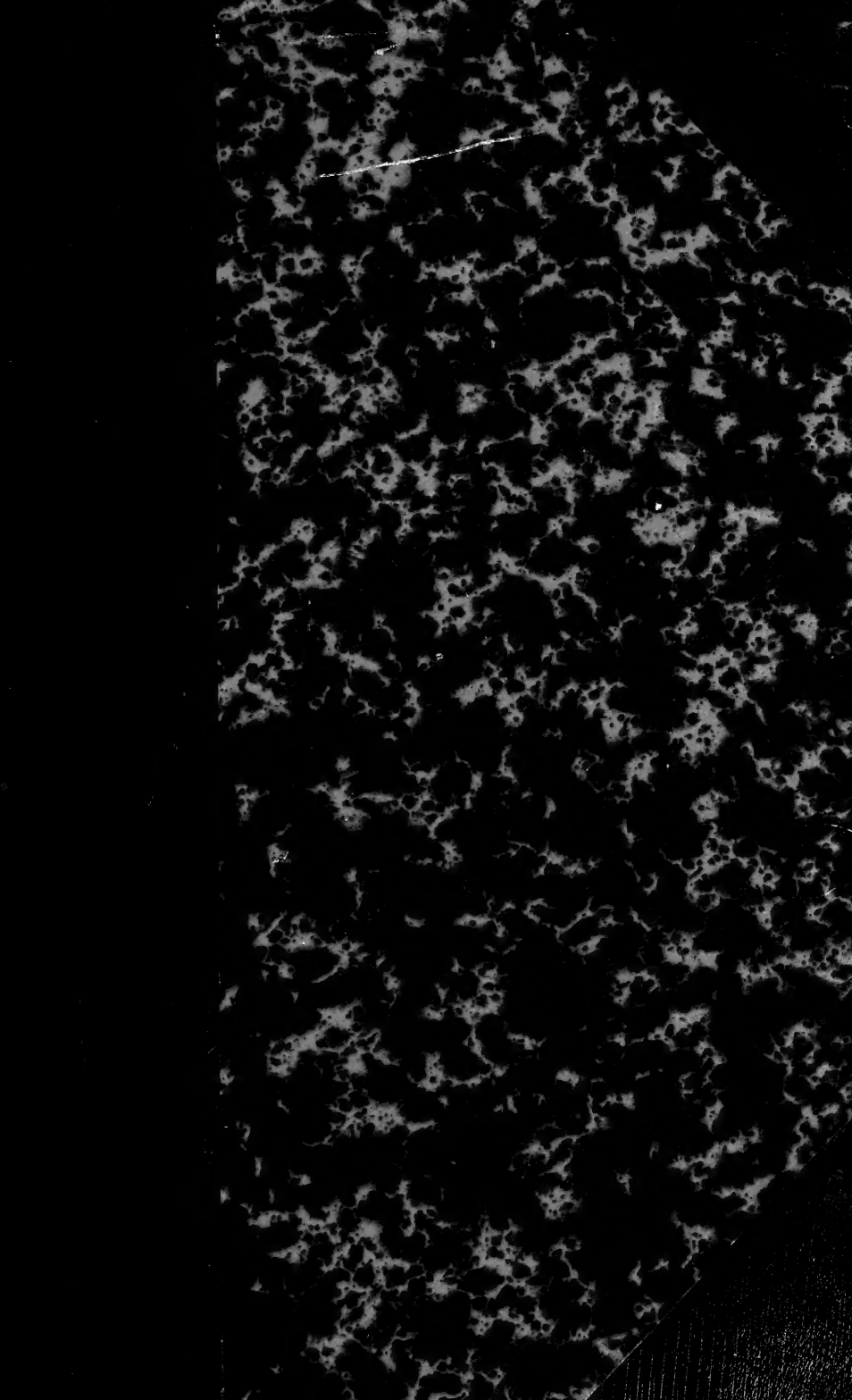

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THE AMERICAN
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ENTOMOLOGICAL SOCIETY

Review and Exchange
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THE SOUTH LONDON
Entomological & Natural History Society,

(ESTABLISHED 1872)

HIBERNIA CHAMBERS, LONDON BRIDGE, S.E.

OFFICERS & COUNCIL.

1899.

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S. EDWARDS, F.L.S., F.Z.S., F.E.S., &c. (*General Sec.*),
Kidbrook Lodge, Blackheath, S.E.

H. J. TURNER, F.E.S. (*Report Sec.*),
13, Drakefell Road, St. Catherine's Park, S E.

THE SOUTH LONDON

Entomological and Natural History Society,

HIBERNIA CHAMBERS, LONDON BRIDGE, S.E.

The Society has for its object the diffusion of Biological Science, by means of Papers and Discussions, and the formation of Typical Collections. There is a Library for the use of Members. Meetings of the Members are held on the 2nd and 4th Thursday evenings in each month, from Eight to Ten p.m., at the above address. The Society's Rooms are easy of access from all parts of London, and the Council cordially invite the co-operation of all Naturalists, especially those who are willing to further the objects of the Society by reading Papers and exhibiting Specimens.

SUBSCRIPTION.

Seven Shillings and Sixpence per Annum, with an Entrance Fee of Two Shillings and Sixpence.

All Communications to be addressed to the Hon. Gen. Secretary,

STANLEY EDWARDS, F.L.S., &c.,

Kidbrook Lodge, Blackheath, S.E.

LIST OF MEMBERS.

Chief subjects of Study :—*h*, Hymenoptera; *o*, Orthoptera; *he*, Hemiptera; *n*, Neuroptera; *c*, Coleoptera; *d*, Diptera; *l*, Lepidoptera; *ool*, Oology; *orn*, Ornithology; *r*, Reptilia; *m*, Mollusca; *cr*, Crustacea; *b*, Botany; *mi*, Microscopy; *e*, signifies Exotic forms.

YEAR OF ELECTION.

1886 ADKIN, B. W., Brandon House, Morden Hill, Lewisham, S.E. *l, orn.*

1882 ADKIN, R., F.E.S., Wellfield, 4, Lingard's Road, Lewisham, S.E. *l.*

1895 ASHBY, SIDNEY R., 8, Canterbury Terrace, Maida Vale, N.W. *l.*

1895 ASHDOWN, W. J., Belmont Road, Leatherhead. *l. c.*

1888 ATMORE, E. A., F.E.S., 48, High Street, King's Lynn, Norfolk. *l.*

1887 BARCLAY, F. H., F.G.S., F.E.S., The Warren, Cromer, and Knotts Green, Leyton, Essex. *l, orn, palæontology.*

1884 BARKER, H. W., F.E.S., 147, Gordon Road, Peckham, S.E. *l.*

1896 BARNETT, THOS. L., 81, Royal Hill, Greenwich, S.E. *l.*

1887 BARREN, H. E., 46, Lyndhurst Road, Peckham, S.E. *l.*

1889 BARRETT, C. G., F.E.S., 39, Linden Grove, Nunhead, S.E. *l, m.*

1896 BARTLETT, A. H., M.A., 86, Vanbrugh Park, Blackheath, S.E.

1889 BEAUMONT, A., F.E.S., The Red Cottage, Pond Road, Blackheath, S.E. *l, c, orn.*

1888 BENNETT, W. H., F.E.S., 15, Wellington Place, Hastings. *h, c.*

1877 BILLUPS, T. R., F.E.S., 20, Swiss Villas, Coplestone Road, Peckham, S.E. *h, o, c, d, he.*

1897 BISHOP, E. B., 10, Pewley Hill, Guildford. *l.*

1898 BLISS, M. F., University School, Hastings. *l.*

1893 BOND-SMITH, W., Potton, near Sandy, Beds. *l.*

1898 BOUSKELL, F., F.E.S., Sandown Road, Knighton, Leicester. *l.*

1896 BOWEN, F. A., 11, Buckland Crescent, Hampstead, N.W. *l.*

1895 BOWMAN, K., 18, Victoria Road, Clapham Common, S.W. *l.*

1887 BRIGGS, C. A., F.E.S., Rock House, Lynmouth, N. Devon. *l, m, n, o, British fishes.*

YEAR OF ELECTION.

1887 BRIGGS, T. H., M.A., F.E.S., Rock House, Lynmouth, N. Devon. *l.*

1891 BRIGGS, H. MEAD, 8, High Street, Canterbury. *l, orn.*

1890 BRIGHT, P., F.E.S., Aston Lodge, Surrey Road, Bournemouth. *l.*

1890 BRISTOWE, B. A., F.E.S., Durlstone, Champion Hill, S.E. *l.*

1893 BRISTOWE, L. W., Durlstone, Champion Hill, S.E. *l.*

1895 BROOKS, W., Grange Hall, Rotherham. *l.*

1898 BROOME, E. G., Christchurch, Oxford. *l.*

1890 BROWN, E. W., Capt., 2nd Royal West Kent Regiment, Dublin, Ireland. *l.*

1897 BROWNE, H. B., B.A., Sherrington House, St. Phillip's Road, Norwich.

1897 BURR, MALCOLM B., F.Z.S., F.E.S., Bellagio, East Grinstead.

1890 BUTLER, W. E., Hayling House, Oxford Road, Reading. *l, c.*

1888 CANSDALE, W. D., F.E.S., Sunny Bank, South Norwood, S.E. *l.*

1889 CANT, A., F.E.S., 10, Chandos Street, Cavendish Square, W. *l.*

1886 CARPENTER, J. H., F.E.S., "Shirley," St. James's Road, Sutton, Surrey. *l.*

1877 CARRINGTON, J. T., 110, Strand, W.C. *l, cr.*

1872 CHAMPION, G. C., F.Z.S., F.E.S., Heatherside, Horsell, Woking, Surrey. *c.*

1872 CHANEY, W. C., 32, Stroud Road, Woodside, S. Norwood, S.E. (*Hon. member*). *h, l, c.*

1897 CHAPMAN, T. A., M.D., F.E.S., *Vice-President*, Betula, Reigate, Surrey. *l.*

1898 CHATTERTON, F. J. S., F.E.S., 78, Clissold Road, Stoke Newington, N. *l.*

1888 CHITTENDEN, D., 49, Albany Road, Camberwell, S.E. *l.*

1896 CLARK, F., Paddington Infirmary, W. *mi.*

1887 CLARK, J. A., F.E.S., L.D.S., M.P.S., 57, Weston Park, Crouch End, N.

1898 CLARKE, H. SHORTRIDGE, F.E S., 40, Athol Street, Douglas, Isle of Man. *l.*

1879 CLODE, W. (*Life member*).

1884 COOK, A. E., 31, Lower Road, Rotherhithe, S.E. *l, orn, r.*

1885 CROKER, A. J., F.E.S., 90, Albert Road, Walthamstow. *l.*

Year of Election.

1898 Crow, E. J., 26, Tindal Street, North Brixton. *l.*

1888 Dawson, W. G., Plumstead Common, Plumstead, Kent (*Life member*). *l.*

1889 Dennis, A. W., 48, Mansfield Street, Kingsland Road, N.E. *l.*

1884 Dobson, H. T., F.E.S., Ivy House, Acacia Grove, New Malden, Surrey. *l, orn.*

1898 Donisthorpe, H. St. J., F.Z.S., F.E.S., 73, West Cromwell Road, South Kensington, S.W. *c.*

1898 Downing, John W., F.E.S., 45, Trevelyan Road, Tooting Graveney, S.W. *l.*

1897 Drury, W. F., F.R.H.S., Rocquaine, West Hill Park, Woking, Surrey. *l.*

1886 Edwards, S., F.L.S., F.Z.S., F.E.S., *Hon. Sec.*, Kidbrook Lodge, Blackheath, S.E. *l, e l.*

1886 Enock, F., F.L.S., F.E.S., 13, Tufnell Park Road, Holloway, N. *d, mi.*

1889 Farrant, M., jun., 137, St. Thomas, Exeter. *l.*

1888 Fenton, F. E., F.R.C.S., M.R.C.P., F.I.Inst., Langstone, Ealing, W.

1872 Ficklin, A., Norbiton, Surrey. *l.*

1891 Filer, F. E., F.E.S. 58, Southwark Bridge Road, S.E. *l.*

1887 Fletcher, W. H. B., M.A., F.E.S., Fairlawn House, Worthing, Sussex (*Life member*). *l.*

1889 Ford, A., Rose Mount, Hannington Road, Boscombe, Hants. *l, c.*

1891 Forrester, A. C., 99, Endlesham Road, Balham, S.W. *l.*

1886 Fremlin, H. S., M.R.C.S., L.R.C.P., F.E.S., Government Lymph Laboratories, Chelsea Bridge, S.W. *l, mi.*

1895 Furneaux, W., F.R.G.S., "Penlee," Ommaney Road, New Cross, S.E. *l, pond life, gen. zool.*

1884 Gibb, L., 148, St. James Street, Montreal, Canada (*Life member*). *l.*

1889 Greene, Rev. J. G., M.A., F.E.S., Rostrevor, Clifton, Bristol. *l.*

1895 Griffiths, G. C., F.Z.S., F.E.S., 43, Caledonia Place, Clifton, Bristol. *l, e, l.*

YEAR OF ELECTION.

1893 HALL, A., 16, Park Hill Rise, Croydon, Surrey. *l, e l, ool.*

1888 HALL, A. E., F.E.S., Norbury, Pitsmoor, Sheffield. *l.*

1884 HALL, T. W., F.E.S., *Hon. Treasurer*, Stanhope, The Crescent, Croydon, Surrey; and 61, West Smithfield, E.C. *l.*

1891 HAMM, A. H., 52, St. Mary's Road, Oxford. *l.*

1892 HARRISON, A., F.C.S., F.L.S., F.E.S., F.R.M.S., *President*, Thames Sugar Refinery, Silvertown, E., and 72, Windsor Road, Forest Gate, E.

1884 HELPS, J. A., Newstead Lodge, 91, Wood Vale, Forest Hill, S.E. *l.*

1888 HILLMAN, T. S., F.E.S., Eastgate Street, Lewes, Sussex. *l.*

1898 HILLSWORTH, E. H. R., 4, Bradley Cottages, Cowley Road, Wanstead, N.E. *l.*

1889 HINCHLIFF, Miss K. M., Worlington House, Instow, N. Devon. *l, e l.*

1888 HOPKINS, H. E., 153, Camden Grove North, Peckham, S.E. *l.*

1889 HORNE, A., F.E.S., Ugie Bank, Aberdeen. *l.*

1886 JÄGER, J., St. Quentin's Avenue, Notting Hill, W. *l.*

1887 JENNER, J. H. A., F.E.S., Eastgate House, Lewes, Sussex. *l, c, d, m, b.*

1884 JOBSON, H., 1, Rock Villas, Maynard Road, Walthamstow. *l.*

1886 KANE, W. F. DE V., M.A., F.E.S., M.R.I.A., Drumreaske House, Monaghan, Ireland. *l, mi, marine invertebrata.*

1898 KAYE W. J., F.E.S., Worcester Court, Worcester Park, Surrey. *l.*

1884 KENWARD, J., High Elms, Chinbrook RoadGrove Park, S.E. *l.*

1888 KNIGHT, E., 2, Lichfield Grove, Church End, Finchley, N.

1894 LAMB, H., Acacia Place, Upper Faut, Maidstone. *b, orn.*

1898 LEMANN, F. C., F.E.S., Blackfriars House, Plymouth. *l.*

1884 LEVETT, C., 107, Brockley Road, S.E. *l.*

1898 LITTLE, W. W., 17, Belgrave Street, King's Cross, N. *l.*

1872 LUBBOCK, The Right Hon. Sir JOHN, Bart., M.P., D.C.L., F.R.S., F.L.S., F.G.S., F.E.S., &c., High Elms, Down, near Farnborough, Kent (*Hon. member*). *h, b.*

1896 LUCAS, W. J., B.A., F.E.S., 12, Caversham Road, Kingston-on-Thames. *l, o, n, m.*

YEAR OF ELECTION.

1890 McARTHUR, H., 35, Averill Street, Fulham, W. *l.*

1872 M'LACHLAN, R., F.R.S., F.L.S., F.Z.S., F.E.S., Westview, Clarendon Road, Lewisham, S.E. (*Hon. member*). *n.*

1892 MAIN, H., 45, The Village, Old Charlton, S.E. *l.*

1886 MANGER, W. T., F.E.S., 100, Manor Road, New Cross, S.E. *l, c. cr.*

1889 MANSBRIDGE, W., F.E.S., Colegate, Horsham, Sussex. *l.*

1885 MERA, A. W., 79, Capel Road, Forest Gate, E. *l.*

1881 MILES, W. H., F.E.S., The New Club, Calcutta, India. *mi, b.*

1888 MITCHELL, A. T., 5, Clayton Terrace, Gunnersbury, W.

1896 MONINGTON, H. W., 8, Weswell Road, Streatham Common, S.W. *b.*

1896 MONTGOMERY, ARTHUR M., 32, The Grove, Ealing, W. *l.*

1896 MONTGOMERY, EDMUND M., 32, The Grove, Ealing, W. *l.*

1880 MONTIERO, Senor A. A. DE C., F.E.S., 70, Rua do Alecrinar, Lisbon.

1889 MOORE, H., 12, Lower Road, Rotherhithe, S.E. *l, h, d, e l, e h, e d, mi.*

1887 MORRIS, C. H., School Hill, Lewes, Sussex. *l, c, m.*

1887 NEVINSON, E. B., 7, Staple Inn, W.C. *l, stalk-eyed crustacea.*

1889 NICHOLSON, W. E., F.E.S., School Hill, Lewes, Sussex. *l.*

1872 OLDHAM, C., 2, Warwick Villas, Chelmsford Road, South Woodford, Essex. *l.*

1891 PALMER, J. F., Ewell Road, Surbiton Hill, Surbiton.

1892 PANNELL, C., East Street, Haslemere. *Conchology.*

1898 PARKIN, E., 3, Birley Street, Battersea, S.W. *l.*

1884 PEARCE, A. E., 12, Marius Road, Upper Tooting, S.W. *b.*

1883 PEARCE, W. A., 88, Croxted Road, West Dulwich, S.E. *l, b.*

1880 PERKINS, V. R., F.E.S., Burlinghame, Wotton-under-Edge, Gloucestershire. *l, h, d.*

1888 PERKS, F. P., 41, St. Martin's Lane, Charing Cross, W.C *zoology, mi, pond life.*

1889 PERRY, Rev. J. F., Oxford Road, Banbury. *l, c.*

1897 PREST, E. E. B.

1887 PORRITT, G. T., F.L.S., F.E.S., Crossland Hall, Huddersfield. *l.*

1896 POTTER, A. T., Whangarei, Auckland, New Zealand.

1888 REID, W., F.E.S., Pitcaple, Aberdeen. *l, continental l.*

YEAR OF ELECTION.

1887 RICE, D. J., 13, Great Ormond Street, W.C. *orn.*

1887 ROBINSON, A., B.A., F.E.S., 1, Mitre Court, Temple, E.C. *l.*

1894 ROBINSON, LEIGH, Lady Bridge House, King's Lynn. *l.*

1888 ROBSON, H., 135, Louisville Road, Upper Tooting, S.W. *l, b.*

1890 ROWNTREE, J. H., Westwood, Scarborough. *l.*

1887 ROUTLEDGE, G. B., F.E.S., Tarn Lodge, Heads Nook, Carlisle. *l.*

1898 RUSSELL, A., F.E S., The Limes, Southend, Catford, S.E. *l.*

1895 RYE, B. G., F.E S., 212, Upper Richmond Road, Putney, S.W. *l c.*

1886 SALWEY, R. E., F.E.S.

1897 SANDISON, JOHN, 2, Francis Grove, Wimbledon, Surrey. *l.*

1888 SAUZÉ, H. A., *Hon. Librarian*, 4, Mount Villas, Sydenham Hill Road, S.E. *l.*

1898 SICH, ALF., F.E.S., "Brentwood," 65, Barrowgate Road, Chiswick.

1890 SMITH, WILLIAM, 13, St. Merren Street, Paisley. *l.*

1890 SMITH, WALTER, 1, Arundel Villas, Hampton Road, Twickenham. *l.*

1882 SOUTH, R., F.E.S., 100, Ritherdon Road, Upper Tooting, S.W. *l.*

1873 STANDEN, R., F.L.S., F.E.S., Thorpe Hall, Colchester (*Life member*). *l.*

1872 STEP, E., F.L.S., Portscatho, R.S.O., Cornwall, *b, m, orn.*

1872 STEVENS, S., F.L.S., F.E.S., Loanda, Beulah Hill, Norwood, S.E. *l.*

1894 TARBAT, Rev. J. E., M.A., Holmlea, Weybridge. *l.*

1895 THORNHILL, W. B., Castle Cosey, Castle Bellingham, near Drogheda, Ireland. *l.*

1895 TOLHURST, J., "Glenbrook," Beckenham, Kent. *l.*

1894 TRENERRY, E. H., 3, North Road, Clapham Park, S.W. *l.*

1895 TUNALEY, HY., F.E.S., 30, Fairmount Road, Brixton Hill, S.W. *l.*

1887 TURNER, H. J., F.E.S., *Hon. Report Secretary*, 13, Drakefell Road, St. Catherine's Park, S.E. *l, orn.*

1886 TUTT, J. W., F.E.S., *Vice-President*, Rayleigh Villa, Westcombe Hill, Blackheath, S.E. *l.*

1887 VERRALL, G. H., F.E.S., Sussex Lodge, Newmarket. *d.*

1889 VINE, A. C., 45, Temple Street, Brighton, Sussex. *l.*

YEAR OF ELECTION.

1889 WAINWRIGHT, C. J., F.E.S., 2, Handsworth Wood Road, Handsworth, near Birmingham. *l.*

1880 WALKER, J. J., R.N., F.L.S., F.E.S., 23, Ranelagh Road, Marine Town, Sheerness. *l, c.*

1888 WALLER, R., 2, Grand Parade, Upper Richmond Road, Putney, S.W. *l.*

1886 WALSINGHAM, The Right Hon. Lord, M.A., LL.D., F.R.S., F.L.S., F.Z.S., F.E.S., &c., Merton Hall, Thetford, Norfolk (*Hon. member*). *l, orn.*

1897 WALTERS, B. H., 48, Finsbury Pavement. *orn.*

1888 WARNE, N. D., 8, Bedford Square, W. *l.*

1888 WARNE, W. F., 8, Bedford Square, W. *l.*

1887 WATERHOUSE, E. A., 23, Spencer Road, Putney, S.W.

1896 WATERS, A. H., B.A., 48, Devonshire Road, Cambridge. *l. m.*

1888 WEBB, S., 22, Waterloo Crescent, Dover. *l.*

1872 WEST, W., *Hon. Curator*, 8, Morden Hill, Lewisham Road, S.E. *l, c.*

1878 WEST, W., L.D.S., Cyprus Villa, Lewin Road, Streatham Common, S.W. *l, mi.*

1887 WHIFFEN, W. H., 49, Granville Park, Lewisham, S.E. *l.*

1891 WILLIAMS, H., 6, Langthorne Terrace, Ashburnham Road, Southend-on-Sea. *l.*

1888 WINKLEY, M. H., 9, Glen Eldon Road, Coventry Park, Streatham, S.W. *l.*

1893 WOLFE, J. J., Skibbereen, co. Cork, Ireland. *l.*

1899 WOOD, Rev. FRANCIS HENRY, M.A., Brabourne Cottage, Bromley Park, Kent. *l.*

1895 WOOD, H. L., The Old Grammar School House, Ashford, Kent. *l.*

1886 WRIGHT, W. H., Secretary's Department, Somerset House, Strand, W.C. *l.*

Members will greatly oblige by informing the Hon. Sec. of any errors, additions, or alterations in the above Addresses and descriptions.

REPORT OF THE COUNCIL, 1898.

THE Council of the South London Entomological and Natural History Society, in presenting the Twenty-Sixth Annual Report, is gratified to inform the Members of the continued success which attends the work of the Society.

During the year 15 Members have been admitted into the Society, a larger number than in any one year since 1891; but against this satisfactory increase 6 resignations have to be placed, and we have lost one Member by death, and 10 have been written off for non-payment of subscriptions, leaving the present membership at 167, consisting of 4 honorary, 5 life, 158 ordinary. The finances of the Society continue to maintain a satisfactory position.

The following gentlemen contributed papers or gave lantern demonstrations during the year:—Mr. LUCAS, three; Mr. TUTT, two; Mr. R. ADKIN, one; Mr. A. H. JONES, one; Mr. E. SAUNDERS, one; Mr. SOUTH, one; Mr. F. CLARK, one; Rev. J. W. HORSLEY, one; and Prof. A. RADCLIFFE-GROTE, one. The Council notices with pleasure that no less than six of these were devoted to orders other than Lepidoptera.

An exhibition of varieties held at the Meeting on November 10th proved highly successful. The opportunity thus offered for the comparison of well-marked local forms was taken advantage of by several Members with most interesting results. An exhibition, by means of the Society's lantern, of a series of slides illustrative of the Geology of the South-east of England, with explanatory notes, provided by the South-east Union of Scientific Societies, was also very interesting

The Ordinary Meetings have been well attended with the exception of those held in the summer months, when on one occasion the number of Members present fell as low as

seventeen; but with the advance of autumn the numbers rose again, reaching at one Meeting the satisfactory total of fifty-one.

Owing to the redecoration of the Society's rooms, and the introduction of the electric light, the Meetings fixed for July 28th and August 11th and 25th were cancelled; but any little inconvenience that the Members may have thus been put to has been amply compensated for by the greatly improved condition of the rooms and their lighting.

Three Field Meetings, held during the summer months, attracted somewhat better attendances than those held during immediately preceding years. They were as follows:

May 21st, when Major Ficklin and Mr. Lucas conducted a considerable party of Members over Oxshott Heath and through the adjacent pine woods to the Black Pond, numerous interesting species of various orders being obtained or noted by the way.

June 11th was devoted to an investigation of the portion of the North Downs adjacent to the town of Reigate, Messrs. R. Adkin and H. J. Turner being in charge of the party; and although the limited time at their disposal did not admit of any very great area being covered, it is satisfactory to know that the observations made were sufficiently encouraging to induce some of the Members present to subsequently revisit the same locality.

July 9th was also spent on the chalk, but on this occasion the hills running off from the Medway Valley were selected. On arriving at Chatham the party was met by several Members of the Rochester Naturalists' Society, including Mr. J. J. Walker, R.N., who took charge of and conducted the party over a particularly interesting country, and called attention to numerous objects of interest that were met with by the way.

Two parts of "Proceedings" have been issued in accordance with the plan commenced in 1897, and although not quite so bulky as on some previous occasions will be found to be quite equal in other respects.

The collections of the Society remain under the able care of Mr. West (Greenwich), who has had an unusually busy

year. The donations include, among others of less importance, the following :

From Mr. LUCAS, types of the rare grasshopper *Mecastethus grossus*, and numerous species of Dragon-flies.

From Mr. ASHDOWN, twenty species of British Longicorn beetles, and several species of Dragon-flies.

From Mr. DRURY, a large store box of British Micro-Lepidoptera, which has rendered the type collection much more complete.

From Mr. TURNER, a few specimens of Dragon-flies not previously in the collection.

From Mr. WEST, a drawer containing 125 species of Hemiptera Heteroptera.

The Library has been well looked after by Mr. SAUZÉ, the Hon. Librarian.

The following is a list of the additions to the Library during the year :

"The Entomologist," from Mr. SOUTH, F.E.S.

"The Entomologists' Monthly Magazine," from Mr. M'LACHLAN, F.R.S., &c.

"The *Z*oologist," from Mr. NEWMAN.

"The South-eastern Naturalist," 1897, from the SOCIETY.

"The Bulletin of the Texas Academy of Science," by EXCHANGE.

"Knowledge," from the PUBLISHERS.

"Notes on Early Man," "Notes on Hydrozoa," and "Notes on Polyzoa," by JOSEPH SMITH, F.L.S., from the AUTHOR.

"Address to the Entomological Society of London," by ROLAND TRIMEN, F.R.S., from Mr. TURNER.

"Address to the City of London Entomological Society," by Mr. J. W. Tutt, F.E.S., from the AUTHOR.

"Entomologists' Record," odd numbers from Mr. TUTT.

"Transactions of the City of London Entomological Society," from the SOCIETY.

"Journal of the City of London Science Society," from the SOCIETY.

"Science" for April, 1898, from Mr. T. D. A. COCKERELL.

"Text-book of Entomology," by Packard, from Mr. STANLEY EDWARDS, F.L.S.

"Science-Gossip" for July, 1898, from the PUBLISHERS.

"Reports of Department of Geology, Indiana, U.S.A.," eight volumes, from Prof. BLATCHLEY, in exchange.

"Report of South-east Union of Scientific Societies," from the UNION.

"Specialisation of the Lepidopterous Wing," by Prof. Grote, from the AUTHOR.

"Report of the Fruit-Growers' Association of Ontario" for 1898, from Mr. L. GIBB.

The donations of photographs of Members have necessitated an additional Album. This has been kindly presented by the Hon. Treasurer, Mr. T. W. Hall.

In conclusion, the Council desire to express their thanks to all those gentlemen who have, by means of papers, lectures, conducting Field Meetings, donations to the Library, collections, &c., assisting in the production of the "Proceedings," and in various other ways, conduced to the continued prosperity of the Society.

THE SOUTH LONDON ENTOMOLOGICAL AND NATURAL HISTORY SOCIETY.

BALANCE SHEET FOR THE YEAR 1898.

GENERAL FUND.

Receipts.	£	s.	d.	*Expenditure.*	£	s.	d.
To Balance in Hand	3	11	10	By Rent (1 year)	25	0	0
,, Subscriptions received, 97 at 7/6 ... £36 7 6				,, Attendance (1 year)	2	10	0
,, ,, ,, 5 ,, 6/– ... 1 10 0				,, Printing	1	5	0
,, ,, ,, 14 ,, 5/– ... 3 10 0				,, Postage, Stationery, and Sundries ...	4	9	9
,, ,, ,, 23 ,, 2/6 ... 2 17 6				,, Insurance of Library and Collections (Fire)	0	8	3
	44	5	0		33	13	0
,, Entrance Fees, 15 at 2/6	1	17	6	,, Entrance Fees carried to Suspense a/c	1	17	6
,, Arrears of Subscriptions received	6	7	0	,, Subscription to South-east Union	0	5	0
,, Subscriptions paid in advance	1	7	6	,, Balance in Hand	21	13	4
	£57	8	10		£57	8	10

SUSPENSE ACCOUNT.

Receipts.	£	s.	d.	*Expenditure.*	£	s.	d.
To Balance in Hand	8	0	0	By Balance in Hand	9	17	6
,, Entrance Fees from General Fund...	1	17	6				
	£9	17	6		£9	17	6

LIBRARY FUND.

Receipts.	£	s.	d.	*Expenditure.*	£	s.	d.
To Balance in Hand	0	10	5	By Binding Books	0	17	6
„ Library Fines	0	4	4	„ January "Knowledge"	0	0	4½
„ Debit Balance	0	7	3½	„ Librarian's Postages	0	4	2
	£1	2	0½		£1	2	0½

PUBLICATION FUND.

Receipts.	£	s.	d.	*Expenditure.*	£	s.	d.
To Balance in Hand	0	12	0	By Printing	40	12	6
„ Donations	25	16	6	„ Receipt Book	0	0	6
„ Sale of "Proceedings"	0	8	0				
„ Debit Balance	13	16	6				
	£40	13	0		£40	13	0

ASSETS AND LIABILITIES.

Assets.	£	s.	d.	*Liabilities.*	£	s.	d.
To Balance, General Fund	21	13	4	Debit Balance Publication Fund	13	16	6
„ „ Suspense Account	9	17	6	Debit Balance Library Fund	0	7	3½
„ Arrears of Subscriptions, £13 13s., valued at say	3	0	0	Balance in Hand	20	7	0½
	£34	10	10		£34	10	10

Examined, compared with Books and Vouchers, and found to be correct, *January 17th*, 1899.

ROBT. ADKIN,
A. M. MONTGOMERY, } *Auditors.*

PAST PRESIDENTS.

1872 ... J. R. Wellman.
1873 ... ,,
1874 ... ,,
1875 ... A. B. Farn, F.E.S..
1876 ... ,,
1877 ... J. P. Barrett.
1878 ... J. T. Williams.
1879 ... R. Standen, F.E.S.
1880 ... A. Ficklin.
1881 ... V. R. Perkins, F.E.S.
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1883 ... J. R. Wellman.
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1885 ... R. South, F.E.S.
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1898 ... J. W. Tutt, F.E.S.

The Lasiocampids.

By J. W. Tutt, F.E.S. *Read February 24th*, 1898.

The choice of the Lasiocampid moths, as the basis of a short paper, was determined by the fact that I have recently been attempting to get some general information with regard to this group. I cannot say that I have succeeded very well, and I offer the few facts and suggestions following rather as a basis for discussion than because they have any inherent value *per se*.

The Lasiocampid moths form a very restricted group in Britain, containing only the following species:—*Trichiura crataegi*, *Poecilocampa populi*, *Eriogaster lanestris*, *Lasiocampa quercûs* and *L. trifolii*, *Macrothylacia rubi*, *Clisiocampa* (*Malacosoma*) *neustria* and *C. castrensis*, *Cosmotriche potatoria*, *Epicnaptera ilicifolia*, and *Eutricha* (*Gastropacha*) *quercifolia*.

In Staudinger's "Catalog der Lep.," 1871, we find that there are, besides the above, twenty-seven other Palæarctic species. These are (using Staudinger's antiquated generic groupings) *Chondrostega pastrana*; *Bombyx ilicis*, *franconica*, *alpicola*, *neogena*, *loti*, *vandalicia*, *catax*, *rimicola*, *eversmanni*, *fasciatella*; *Crateronyx taraxaci*, *balcanica*, *dumi*, *philopalus*; *Lasiocampa albomaculata*, *pruni*, *populifolia*, *tremulifolia*, *suberifolia*, *lunigera*, *pini*, *bufo*, *lineosa*, *otus*, *femorata*; *Megasoma repanda*.

It will be remembered that I made some remarks on the nature of genera in a paper * read before your Society in April last. In this paper I discussed the theory of natural genera and what I then termed "genera of convenience," and illustrated my remarks by the British Vanessid butterflies, a group almost every species of which occurring in Britain belongs to a separate, well-defined genus when the Vanessids of the world are taken into consideration. I then pointed out that each genus should represent an evolutionary group, and not just so many heterogeneous or homogeneous units as the mind could readily remember.

This is called to my mind because, in working out this family, I observe that most of our Lasiocampid moths are lumped into one genus, *Bombyx*, a name belonging by right to *Bombyx mori*, the common silkworm moth of Asia and Southern Europe, and therefore representative of the Bombycid moths, a group in some respects intermediate between the Sphingids and Lasiocampids. Thus one reads of *Bombyx castrensis*, *Bombyx rubi*, *Bombyx quercûs*, *Bombyx quercifolia*, and so on; and Staudinger gives the following hetero-

* 'Some Considerations of Natural Genera and Incidental References to the Nature of Species,' "Proc. South Lond. Soc.," 1897, p. 20.

geneous mixture as constituting his genus *Bombyx*, viz. *cratægi*, *populi*, *castrensis*, *neustria*, *lanestris*, *trifolii*, *quercûs*, and *rubi*, besides ten others that are not British; in fact, the whole of our British species fall into only two genera, those just mentioned in *Bombyx*, and *potatoria*, *quercifolia*, and *ilicifolia*, with eleven species not British in *Lasiocampa*.

With Kirby's list * we obtained the first rational generic grouping of the Lasiocampid moths. Here we see how truly it may be said that our British species are to a great extent individuals of separate well-marked and well-defined genera, each of which has its own group of near allies, in some instances extending to several species. Thus *Trichiura* contains—besides *cratægi*—*khasiana* from the Khasia Hills, *aliaria* from Pebas, *obscura* from Australia, and ? *albiplaga* from the Cape. *Pœcilocampa* has—besides *populi*—*subpurpurea* from Tokei, and *habitus* from Vera Cruz. *Clisiocampa* contains—besides *castrensis* and *neustria*—*testacea* from Japan, *indica* from the East Indies, *californica* from California, *fragilis* from Nevada, *constricta* from San Francisco, *strigosa* from Yosemite Valley, *erosa* from Oregon, *thoracica* from California, *incurva* from Arizona, *disstria* and *americana* from North America generally, and ? *bilineata* from Senegambia. At the same time Kirby separates the European species *franconica*, *intermedia*, and *apicola* (*alpicola*), and the Mon Pin species *flavomarginata*, from *Clisiocampa*, under the name *Malacosoma*, a separation that we think unnatural, and therefore unnecessary. *Gastropacha* (*Eutricha*) contains—besides *quercifolia*—*populifolia* from Central Europe, *angustipennis* from North China, *undulifera* from North India, *divaricata*, *sinuata*, and *torrida* from Darjiling, *modulata* from Bhamo, *phidonia* from Surinam, *? gerstæckeri* and *knoblauchi* from Chinchoxo.

If only our British insects were looked at, one would say at once that *quercifolia* and *ilicifolia* must fall into the same genus; but no, with the fauna of the world before us we find that *ilicifolia* is the centre of its own group, the genus *Phyllodesma* (*Epicnaptera*), which contains—besides *ilicifolia*—*suberifolia* from South-west Europe and North Africa, *americana* from North America, *ferruginea* from Michigan, *californica*, *roseata*, and *alascensis* from California, *? modesta* and *thyatira* from Panama, and *tremulifolia* from Central Europe.

I have, I trust, quoted sufficient instances to bear out my point, viz. that almost every individual species of our British Lasiocampids is the representative of a special genus when we take into consideration the faunas of the world.

But not only are many of our British species representatives of different genera, they are also isolated examples of different tribes. No one, for example, comparing in all their stages say *Trichiura cratægi* with *Lasiocampa quercûs*, and these again with *Gastropacha* (*Eutricha*) *quercifolia*, could suppose for a moment that these belonged to the same tribe; whilst at the same time the comparison

* "Catalogue of Lepidoptera Heterocera," Vol. I., 1892.

of *C. potatoria*, *G. quercifolia*, and *E. ilicifolia* can leave no doubt that these do so. The characters of the egg and imago, apart from the intermediate stages, are sufficient to prove this, and the pupæ show an equally close alliance. The larvæ are so exceedingly specialised in almost all the Lasiocampids that the alliances, unless the species are very closely related indeed, are often much obscured in this stage, there being no very great similarity among the larvæ except in very closely related species, and, even in these, protective secondary developments often obscure somewhat similar structural peculiarities.

At present it seems to me that as tribal arrangements our genera fall into the following:

I. *Pœcilocampa.*
II. *Trichiura.*
III. *Eriogaster.*
IV. *Lasiocampa.*
V. *Malacosoma* (*Clisiocampa*) and *Macrothylacia.*
VI. *Cosmotriche*, *Gastropacha*, and *Phyllodesma.*

To attempt to divide our few British species of Lasiocampid moths not only into at least nine different genera, but into no less than six tribes, will, I doubt not, be considered sheer nonsense by the purely British collector, who thinks about the regularity of his cabinet drawers the moment one speaks of classification, as if it matters where moths are placed in a cabinet so long as one knows where to find them when one wishes to examine them.

Before leaving this part of my subject I would call attention to a paper* by Dr. Dyar, recently published. In this the family is called the *Lachneidæ*, and he says, "The oldest plural term for the family is Hübner's *Lachneides*, and must form the family name, as shown by Grote." I have long since come to the conclusion that synonymy is of the devil. I cannot attempt to explain what Dyar means, I can only hope that it is all right.

To complete this part of the paper I add a comparison between Kirby's and Dyar's conclusions so far as relates to our British species:

Kirby, "Cat. Lep. Het.," 1892.	Dyar, "Can. Ent.," 1898.
Trichiura cratægi.	*Trichiura cratægi.*
Lasiocampa quercûs.	*Lasiocampa quercûs.*
„ *trifolii.*	„ *trifolii.*
Macrothylacia rubi.	*Macrothylacia rubi.*
Pœcilocampa populi.	*Pœcilocampa populi.*

* 'A Generic Revision of the Lachneidæ (Lasiocampidæ),' "Canadian Entomologist," XXX., p. 2, *et seq.*

Kirby, "Cat. Lep. Het.," 1892.	Dyar, "Can. Ent.," 1898.
*Clisiocampa** *neustria.*	*Malacosoma** *neustria.*
„ *castrensis.*	„ *castrensis.*
Eriogaster lanestris.	*Eriogaster lanestris.*
Philudoria† *potatoria.*	*Cosmotriche*† *potatoria.*
Phyllodesma‡ *ilicifolia.*	*Epicnaptera*‡ *ilicifolia.*
Gastropacha§ *quercifolia.*	*Eutricha*§ *quercifolia.*

The lists give no suggestion of what is the possible line of evolution of these moths. So far as our British genera are concerned, they may be assumed to have originated from a hypothetical base, which has given off *Pœcilocampa* and *Trichiura* on the one side, and *Cosmotriche*, *Epicnaptera*, and *Eutricha* on the other, and has reached perhaps its highest point of specialisation in *Lasiocampa*. The following tree (Fig. 1) will perhaps illustrate the relationships of these.

Having now considered the relationship of our Lasiocampid moths to each other, we may attempt to discover their relationship with the groups to which they are most nearly allied. Here we find that almost all recent authorities are more or less agreed. By the special consideration of each of the early stages it has been shown that the Lasiocampids belong to the Sphingo-Micropterygid stirps, a section of the moths that has the Cochlidids and Anthrocerids among its most generalised, and the Sphingids and Saturniids among its most specialised members. To this group Dyar refers the Pterophorids, and Chapman the Nepticulids, and Micropterygids.

If I had to illustrate in a rough and ready manner the relationship of the chief families belonging to this stirps, I should do it as follows (see Fig. 2): the Bombycides proper should have appeared just above the Lasiocampides.

The whole of this stirps is characterised by the possession of a flat egg, with the micropylar axis horizontal, almost always longer than the transverse and vertical axes, the three axes being usually of different lengths.

The flat scale-like egg of the Cochlidids falls rather badly into this section; it is much more like those of the Tortricids than any other

* Kirby gives *Clisiocampa*, Curt. (1828), for *neustria* and *castrensis*, and *Malacosoma*, Hb. (1822 ?), for *alpicola* (*apicola*), *franconica*, and *intermedia*. Dyar unites them into one genus under the older name *Malacosoma*.

† *Philudoria* is one of Kirby's own names (1892). He uses *Cosmotriche*, Hb. (1822 ?), for *lunigera* and its allies. For this latter group Dyar follows Aurivillius, and uses *Selenephera*, Ramb. This seems to be the same as *Selenophora*, Ramb. (1866), which Kirby gives as a synonym of *Dendrolimus*, Germ.

‡ Kirby uses *Phyllodesma*, Hb. (1822 ?), and gives *Epicnaptera*, Ramb. (1866), as a synonym. Dyar drops *Phyllodesma* altogether.

§ Kirby uses *Gastropacha*, Ochs. (1810), for *quercifolia*, and gives *Eutricha*, Hb. (1810 ?), as a synonym. Dyar employs the latter, rejecting *Gastropacha*, because "it is a synonym of *Lasiocampa*, being proposed in the same sense to include all the species of the family."

groups. The smooth, shining yellow egg of the Anthrocerids, with one pole transparent, the characteristic green, almost smooth egg of the Sphingids, and the shiny, almost rhomboidal Lasiocampid egg, with its opalescent markings, will be known to all of you. If, however, we

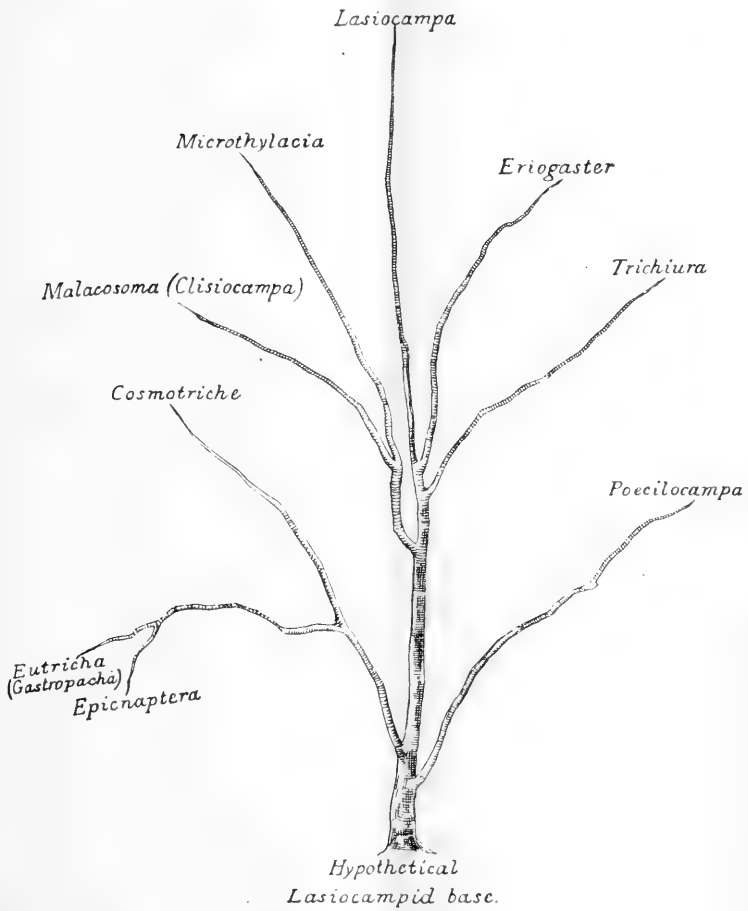


Fig. 1.—Tree illustrating phylogeny of Lasiocampid genera.

examine the Lasiocampid egg carefully under a high power, we shall observe that it is usually covered with an exceedingly fine polygonal reticulation, an exceedingly minute black knob being placed at each of the angular points, and only just distinguishable under a two-thirds lens.

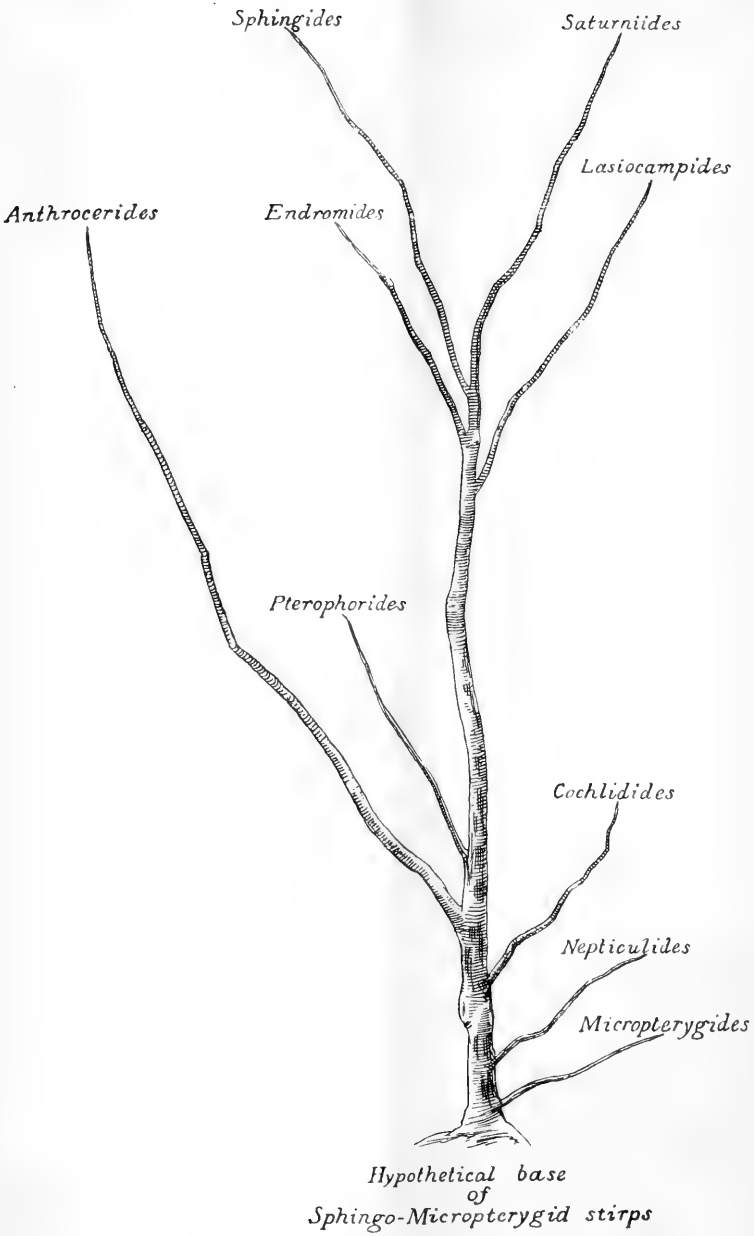


Fig. 2.—Tree illustrating the phylogeny of superfamilies of the Sphingo-Micropterygid stirps.

The egg-laying of our British Lasiocampids is exceedingly variable for so small a number of species, and some of the modes adopted are striking and peculiar. The egg-laying of *Malacosoma neustria*, *M. castrensis*, and *Eriogaster lanestris* is remarkable. These species lay their eggs in the form of a necklace round and round a twig, the eggs of the first being embedded in a stiff liquid glue, the last covered with a thick covering of long silky hairs, mouse-coloured in tint to the naked eye, but seen to be formed of black and white fibres under a microscope. The eggs of *T. cratægi* and *P. populi* are both laid in linear series side by side on a branch, whilst those of *M. rubi* are attached to almost anything in the near neighbourhood of their food. The eggs of *L. trifolii* are slightly attached to stems of grass or other plants, and so also are those of *C. potatoria*. It is reported that *L. quercûs* sprinkles its eggs loosely, but I am not so sure that this is absolutely true. It will, I know, like *C. potatoria*, lay them freely in one's hand whilst one is holding the moth, but I have somewhere read that the *callunæ* form has been seen attaching its eggs to a heather twig. Chapman notes the eggs of *Eutricha quercifolia* as laid in small groups (half-a-dozen or more) on twigs, and placed more or less on each other. I know nothing of how the eggs of *E. ilicifolia* are laid, and should be glad of information.

To return to the mode of egg-laying adopted by *Malacosoma neustria*, *M. castrensis*, and *Eriogaster lanestris*, it will be observed that their peculiar mode of attachment gives them the appearance of being upright rather than flat eggs, *i. e.* their micropylar axis appears to be vertical, and not horizontal, to the surface on which they are laid. This is due to the fact that they are not really attached to the twig round which they are placed, but are actually laid on each other.

The Lasiocampid larvæ are exceedingly beautiful creatures, densely hairy, usually with the primary tubercles very ill-developed and much obscured by the secondary hairs, which form a thick coating spread over the whole of the skin. These latter hairs are, however, developed particularly in those directions that increase the resemblance of the larvæ to their food-plants in the group that includes *Eutricha quercifolia*, as well as in that containing *Trichiura cratægi*. The larva of *L. quercûs*, too, in spite of its striking intersegmental and lateral tints, is very inconspicuous when stretched at length on a twig of hawthorn, maple, or sloe.

Another characteristic of the larvæ of this group is the gregarious habit which in some of the species is very remarkable. *M. neustria* and *castrensis* are well-known examples, and in America the allies of the former species have earned the popular name of tent caterpillars. But they are probably outdone by *E. lanestris*, which sometimes forms a huge web extending over a considerable area, and into which the larvæ retire when not feeding or sunning themselves.

Bacot says that the larvæ fall broadly into two groups:—(1) Containing *quercûs*, *castrensis*, *neustria*, &c., of which he considers

castrensis the more generalised form. (2) Containing *quercifolia ilicifolia*, and *potatoria*, of which he considers *potatoria* the most generalised example. In the larvæ of the first group—*quercûs*, *trifolii*, *rubi*, &c.—the secondary hairs are developed into a fur of loose hairs, which readily rub off, and by their mechanical properties produce urtication if they enter the skin. I have myself suffered greatly from the effects of the hairs of *L. quercûs* entering the skin of my hand. A bad case, in which a boy's eye was injured owing to the hairs of a larva of *M. rubi* entering, was discussed about a year ago at the Entomological Society of London.

The difference in the cocoons made by the larvæ of the Lasiocampid moths is very striking. *E. lanestris*, *L. trifolii*, and *L. quercûs* make the hard egg-shaped cocoons from which the name "Eggar" has been derived, and which has most probably been carried on from the Cochlidids, which make very similar ones. It is well known that these cocoons are coloured by a fluid which is poured upon the silk from the alimentary canal, and supposed to be a chlorophyll product, and that they are hardened by a deposit of lime secreted in the Malpighian tubules, and poured out from the anus upon the silk when it has been woven. Starvation just previous to spinning, by not supplying the larva with the requisite chlorophyll stain, results in the formation of a pale-coloured cocoon. Some of the cocoons of *E. lanestris* are dark coffee-coloured, and they vary through different grades of intensity to white. Some of the cocoons of *L. quercûs* are pale brown; others, especially of *callunæ*, are frequently almost black. In fact, I consider the general darker coloration of the cocoon of *callunæ* to be due to the differences in the food-plant, since the colouring matter is a direct derivative of the chlorophyll in the food, the chlorophyll of some plants being notably darker than others.

The cocoons of *Malacosoma neustria* and *M. castrensis*, with their pale yellow or sulphur-coloured particles of aragonite mixed with the silk, are very different from those above described. Like the above, though, it often happens that these cocoons lose their characteristic colour, and are quite white. This form of cocoon is not unlike that of *C. potatoria*, which is, however, more parchment-like; and this again, except in colour, is not very dissimilar from that of *E. quercifolia*, whilst it is very similar to that of *E. ilicifolia*. The cocoons of *P. populi* and *T. cratægi* are mixed with pieces of extraneous matter, and as they are usually spun up in a crack in the bark, or even under the surface of the ground, they bear considerable resemblance to the cocoons of some Notodonts and Noctuids. The cocoon of *M. rubi* is a very strongly modified form of the *neustria* cocoon, forming a long tubular structure sometimes three or four inches long, inside which the pupa moves up and down to take advantage of the sun.

The pupa is of the Obtect type. It has the fifth and sixth abdominal segments free in both sexes, but it has a very generalised

character in the retention of the dorsal head-piece, and on dehiscence the head-coverings remain in one piece. It is of little use for me to describe the Lasiocampid pupa, since its general features must be known to all entomologists. It is of stout and robust form, usually rounded at both ends, and rarely gradually terminating in an anal point, although this character is distinct enough in *Malacosoma*. Ventrally the most noticeable point is the presence of the labial palpi. The third pair of legs is always covered by the wings. The covering of hairs—short bristly points—that thickly studs certain parts of the pupal skin, often, owing possibly to the movement of the pupa in the cocoon, becomes covered with a thick coating of felt-like material, which gives the pupa a very strange appearance. This peculiarity is particularly well marked in pupæ of *E. quercifolia* and *E. ilicifolia*. It is necessary here, perhaps, to point out that many people ally the Notodonts with the Lasiocampids, because of the considerable resemblance that exists between their pupæ ; and even so good a student as Bacot insists that the resemblance is really more than a superficial one, and denotes an actual relationship. The cremaster of the Lasiocampid pupa is very striking. There are no curved hooks, but a thick brush of short, stiff, bristly hairs, like a cocoa-nut mat. In a few species the bristles are wanting, and the cremastral area is quite smooth.

The imagines of the British species are known to all of you better perhaps than to me. You are all aware of the marked sexual dimorphism that exists in every species, and know that certain species, such as *Pœcilocampa populi*, *Cosmotriche potatoria*, *Malacosoma neustria*, and *Eutricha quercifolia*, sometimes abound at light. You know also the amazing power that the females of *Macrothylacia rubi*, *Lasiocampa quercûs*, and *L. trifolii* have of attracting males from a great distance, and have seen, or at least heard of, them crawling in dozens over a box in which a female has been confined.

You all know, too, that only on one occasion (or at most two) has the imago of *M. castrensis* been seen wild in this country, and that no one knows its habits in a state of nature ; nor have I ever heard of more than one or two entomologists who have seen wild in the hedges an imago of *Eriogaster lanestris*. This is very remarkable, and shows that we have not yet learned everything ; and were it not for the fact that *P. populi* and *M. neustria* come to light, how few of these would be seen in the imago state !

Probably the most interesting of all our British species is *Lasiocampa quercûs*. This interest has arisen from the difficulty that has occurred as to whether one of its forms or offshoots—*callunæ*—has or has not undergone sufficient differentiation to enable it to be called a distinct species from, or a local race of, *L. quercûs*.

Many entomologists will know that I have recently, in my Presidential Address to the members of the City of London Entomological Society, pointed out, among many other things, how "isolation by diverse habits" may aid in the differentiation of species

from a common stock. It is evident that, in the case under review, *L. quercûs* and *L. callunæ* have gone far towards the necessary point, although in my opinion they have not yet reached it by becoming thoroughly differentiated. In Scotland, on the moors of North England, Wales, Ireland, and the south of England, the perfect insect emerges in June (or thereabouts), lays its eggs, the larvæ hatch out, and feed up to about the third skin before hybernation; they subsequently feed up slowly the next summer, pupate in July or August, go over the winter in the pupal stage, and finally emerge in the following June as imagines, having taken two years to complete their metamorphoses; but among these two-year *callunæ* there are occasional individuals that emerge from the cocoon in the August of the same year in which the larvæ have pupated, and thus only take one year instead of two for their ecdyses. Throughout France, and reaching well up into England as far as Yorkshire, in the low-lying parts of the country, imagines of *L. quercûs* emerge in July and August, lay their eggs, larvæ from which hybernate comparatively small, but feed up quickly in the spring, pupate in May and June, and emerge in July and August of the same year. These are the normal habits of *L. quercûs;* but among the many that do this an occasional individual remains in cocoon the whole winter, and does not emerge until the next summer, thus taking on the habits of *callunæ*. Thus in one brood it is possible to get part with the habits of one and part with the habits of the other. In the cold season of 1888 almost all larvæ of *L. quercûs* collected in Kent continued to feed throughout the cold summer until August, then pupated, and went over the winter in this stage, adopting the *callunæ* habit at once under unfavourable conditions. It appears to me that in the south the percentage of individuals that go over is a small one, but gradually increases as we go north (or reach a higher altitude), until, when we reach the Highlands of Scotland (or the hill-moorlands), the individuals have a fixed habit, requiring two years to come to maturity. In the warm parts of South France all are *L. quercûs*, and have the *quercûs* habit. In the mountains of France and Piedmont I have found the larvæ at considerable elevations, and here the *callunæ* habit again prevails.

An attempt to discuss the peculiarities of each separate species would occupy far too much time. I will only add a few notes on three of the other species.

Malacosoma castrensis is an exceedingly local species. It was reported from Devonshire many years ago, and although it does not appear to have been found there of recent years, there is no proof that the species does not still occur there. On the Continent it occurs all over Central Europe, swarming in some districts on weedy waste places, often found high on the mountains, in pine woods, and various localities of different situation and aspect. In Britain it is supposed to be confined to the coast of Suffolk, Essex, and Kent, and probably ninety-nine hundredths of the specimens bred and

captured come from two comparatively restricted localities. Does our knowledge represent the real distribution of this species? I am very much inclined to doubt it.

Lasiocampa trifolii is another species widely distributed on the Continent. I have found the larva on the Basses Alpes, and in the Forest of Fontainebleau; yet, with the exception of the well-known New Forest locality, it is supposed to be a coast species in Britain, formerly abounding on the Lancashire and Devonshire coasts, less abundantly on the coasts of Kent and Sussex. It is little wonder that the species is recorded as being less abundant on the Lancashire and Devonshire coasts than formerly. I was recently looking through the "Intelligencers," and in the good old days this species must have been collected in tens of thousands in its restricted haunts. One reads, "Two of us got above 400 last night, as many as we could carry; we hope to go again in a day or so;" and so on over and over again. I do not know who obtained most victims, the Liverpool or Plymouth collectors. It is difficult to judge when both took so many, evidently all on which they could lay their hands Still I am not inclined to think that this had anything to do with making *L. trifolii* so local with us, nor do I understand why this species—like *M. castrensis*—is with us to a great extent a coast insect. Can any one suggest an explanation? Is it that the coasts are less populated, wilder, and less disturbed? Still our hills must contain some undisturbed spots not unsuitable. I should like to have opinions on the point.

The third insect is *Epicnaptera ilicifolia*. Every British lepidopterist knows what a *rara avis* this is with us, that with the exception of the solitary specimen caught May 17th, 1896, by Freer no other record has been made for years. Yet the species cannot be extinct among us, as this capture shows. Overlooked, not worked for, or some similar judgment must be passed on our inability to find it. On the Continent it is not rare in some places, but at the same time not so common as it is sometimes reported to be. The pabulum of its larva makes a search for the latter difficult; the cocoon is spun among the leaves, and not at all conspicuous, and the imago is so like a dead leaf that one might very well look at it without detecting it.

I should have liked to speak about the variation of this interesting family—the almost polymorphic character of *L. trifolii*, *M. castrensis*, and *M. neustria*, the South European races of *L. quercûs*, the wonderful development of the family in Asia and Africa, and other interesting matters, but these may form perhaps, at some time, an excuse for another paper.

British Species of Lepidoptera occurring in Japan.

By Richard South. (*Read April 14th*, 1898.)

"When an Englishman travels by the nearest sea route from Great Britain to Northern Japan he passes by countries very unlike his own, both in aspect and natural productions. The sunny isles of the Mediterranean, the sands and date palms of Egypt, the arid rocks of Aden, the cocoa groves of Ceylon, the tiger-haunted jungles of Malacca and Singapore, the fertile plains and volcanic peaks of Luzon, the forest-clad mountains of Formosa, and the bare hills of China pass successively in review; till, after a circuitous voyage of thirteen thousand miles, he finds himself at Hakodate in Japan. He is now separated from his starting-point by the whole width of Europe and Northern Asia, by an almost endless succession of plains and mountains, arid deserts or icy plateaux; yet when he visits the interior of the country he sees so many familiar natural objects that he can hardly help fancying he is close to his home. He finds the woods and fields tenanted by tits, hedge-sparrows, wrens, wagtails, larks, redbreasts, thrushes, buntings, and house-sparrows; some absolutely identical with our own feathered friends, others so closely resembling them that it requires a practical ornithologist to tell the difference. If he is fond of insects he notices many butterflies and a host of beetles, which, though on close examination they are found to be distinct from ours, are yet of the same general aspect, and seem just what might be expected in any part of Europe. There are also, of course, many birds and insects which are quite new and peculiar, but these are by no means so numerous or conspicuous as to remove the general impression of a wonderful resemblance between the productions of such remote islands as Britain and Yesso."

Thus wrote Wallace in "Island Life" some eighteen years ago, and to-day his remarks, especially so far as they concern insects, apply with even greater force, as our knowledge of the insect fauna of Japan is now more complete. Entomologists have ascertained that not only do a large number of European genera of Lepidoptera occur in the islands, but that very many species are exactly identical with those found in Britain; whilst others are but so slightly different that they can only be regarded as geographical races or varieties.

Our present knowledge of Japanese Lepidoptera is largely due to the active labours of the late Mr. Henry Pryer, who resided for several years in Japan, and to Mr. John Henry Leech, who, in addition to a vast amount of material obtained by himself in the country, acquired

the collections formed by Mr. Pryer. The former published a "Catalogue of the Lepidoptera of Japan," but his most important work is "Rhopalocera Nihonica," in which all the species of butterflies are figured, and the text is in English and Japanese. In Mr. Leech's papers "On the Lepidoptera of Japan and Corea," published in the "Proceedings of the Zoological Society of London" (1887–9), and in his "Butterflies from China, Japan, and Corea" (with excellent coloured plates), the subject is more fully treated. So far, however, there is no special handbook of the Heterocera of the islands, but as there appears to be a desire for such a work it is probable that one will be produced in the very near future.

As will be seen by looking at a map of the world, the Japanese islands are situated between the parallels of 30 and 46 north latitude, whereas our own islands are between the 50th and 60th parallels, so that the most northern part of the Japanese kingdom is, roughly speaking, four degrees further south than Cornwall, while its most southerly extension is twenty degrees nearer the equator. The four principal islands are Nipon, or central; Yesso, northern; and Shikoku and Kiushiu, southern. The nearest point to the continent of Asia is in Kiushiu, but this is over 100 miles from Corea, and the next nearest is in Yesso, somewhere about 200 miles from the Manchurian coast. These distances are only given as approximate. The climate of Japan, more particularly in the north, is not very dissimilar to that of England: the difference between the heat of summer and the cold of winter is more marked, I believe, in the main island; but the mean annual temperature of the northerly portion is similar to that of England, *i. e.* 50 degrees Fahr., whilst in the south the mean ranges from 55 to 60 degrees. I understand that in Yesso snow lies on the ground for at least four months in the year. It may also be mentioned that the climate is influenced by the Japan current, a warm ocean stream which is the Eastern equivalent of the Western Gulf Stream.

The country is largely agricultural, and rice especially is grown wherever the nature of the ground admits of cultivation. Mr. Leech, referring to his collecting experience at Nagasaki, in the island of Kiushiu, says that he "found insect life very abundant wherever a piece of accessible uncultivated ground was to be met with. This is only the case on hill-sides too steep for cultivation. It is wonderful to see the way in which the hills are cut into steps, supported by huge banks and walls, and kept constantly irrigated by small streams of water, especially in the south. Where a good piece of forest occurs it is usually impenetrable on account of the dense undergrowth of bamboo, grasses, and ferns, filled with nauseous plants, emitting an effluvium that resembles putrid flesh. This sort of collecting ground occurs nearly all over the main and southern islands of Japan, and when combined with a mixture of tropical sunshine and tropical rains renders an entomologist's pursuit both arduous and unpleasant" ("Proc. Zool. Soc. Lond.," 1887, p. 399).

Turning now to the zoological region in which Japan is embraced, it may be convenient to glance at the zoo-geographical realm defined by Heilprin ("Distribution of Animals") as the Holarctic, which comprises the Palæarctic and Nearctic regions of Wallace and others, but with certain modifications to which further reference will be made. The southern limits of this realm, at least in the Eastern Hemisphere, with which we are only concerned at present, are formed from the Bay of Biscay to the Caspian by the Pyrenees, Alps, Balkans, and Caucasus; thence by the northern line of Persia and Afghanistan, the Himalayas and the Nanling mountains in China. This constitutes the Eurasiatic division or region, and is divided into four sub-regions as follows:

Boreal.—Includes the whole of Europe and Asia, north of an imaginary line running from the Norwegian coast at about the 66th parallel, and terminating on the East Asiatic coast at the 50th parallel or thereabouts. The line of demarcation represents the northern limit of cereals, and reindeer do not usually travel southwards beyond it.

European.—Defined northwards by the Boreal limits, southward by the Alpine ranges, and eastward by the Caucasus and the Caspian.

Central Asian.—Lies between the European and Manchurian sub-regions, and has its northern boundary limited by the Boreal line.

Manchurian.—Includes Japan, Corea, Manchuria as far north as the Amur, Northern China, with a westerly extension along the northern face of the Himalayas.

A considerable tract of the Palæarctic region, as defined by Wallace, is treated by Heilprin as a transition area, wherein occur genera and species belonging to the Eurasiatic, to the Ethiopian, and to the Oriental regions. This he styles the Mediterranean or Tyrrhenian region, and it embraces the peninsular portion of Southern Europe, North Africa, Asia Minor, Persia, Afghanistan, Beloochistan, and the northern half of Arabia.

The composition of the fauna of the Manchurian sub-region, to which, as already stated, Japan belongs, is in some respects comparable to that of the Mediterranean transition tract just referred to. It comprises genera pertaining to the Oriental regions, as well as those proper to the Holarctic, the latter predominating in the more northern portions, whilst the former are in greatest force in the southern parts. There are in addition a few genera which seem to be peculiar to the area.

Somewhere about one-third of the genera of macro-Lepidoptera occurring in Japan are European, or generally referred to as such. Rather over 160 are well-known British genera. Twenty-two species of Rhopalocera are common to Britain and Japan, while four other British species are represented in Japan by very near allies. Eight Sphinges are identical, or almost identical, in the two countries, and three others are replaced in Japan by closely allied species. Among the

Bombyces there are upwards of thirty species in Japan, the Japanese specimens of which are almost exactly similar to British examples of those species, and several others are represented by forms or by species very closely allied to them. Not less than ninety British species of Noctuæ occur in Japan, and the majority of these are exactly identical, whilst others are but little modified, and nine other Japanese species represent British ones. Of the Geometræ, eighty British species occur in Japan, and nearly all these are identical with the home productions.

In addition to those already mentioned, the following two papers, also by Mr. Leech, will be found useful to entomologists interested in the Asiatic distribution of British species of Lepidoptera:

"On Lepidoptera Heterocera from China, Japan, and Corea" ("Ann. and Mag. Nat. Hist." [6], xix. and xx.).

"Lepidoptera Heterocera from Northern China, Japan, and Corea" ("Trans. Ent. Soc. Lond.," 1898, pt. iii.).

Notes on Collecting British Hemiptera.

By Edward Saunders, F.L.S., F.E.S. *Read April 28th*, 1898.

It is with great pleasure that I comply with your Secretary's request to supply some remarks on Hemiptera. The order is a favourite of mine, and one which I think is particularly well suited for the study of those who, like myself, have only a very limited time to devote to entomology. In this country it is not a very extensive order, and nearly all the species are obtainable after business hours. As a rule the specific characters are pretty well defined, and are structural, so that any one with a good eye can soon learn to distinguish the species apart. These features of the order make it a very good one for beginners to try their powers upon.

The number of species in Coleoptera, Lepidoptera, Diptera, and Hymenoptera may well frighten some from taking them up; but in this country we have only about 750 species of Hemiptera, and of these the Heteroptera number about 440, so that no one need be alarmed at their multitude. As it is with this latter section of the order that I am most familiar, I will, with your permission, restrict myself to it.

Before going into methods of collecting, &c., it will be well to say a few words as to how a member of this order, or, in plain language, a "bug," may be recognised when met with. In the first place, its mouth parts are arranged for sucking, and have no external biting jaws, as in the members of the Coleoptera, Orthoptera, Neuroptera, or Hymenoptera. This character alone will almost serve to distinguish a bug (at least, one of the Heteroptera), as none that I know of is likely to be confounded with a butterfly or moth. And if any of the more delicate *Capsidæ* could be mistaken for *Diptera* (which is difficult to imagine), the existence of a pair of posterior wings of membranous texture would reveal their affinities at once. As a rule, they are more liable to be confounded with Coleoptera; but, besides the essential mouth characters, the wing-cases or upper wings, at any rate in developed forms, are not of one substance throughout, but become membranous towards the apex, the "membrane," as it is called, being clearly divided from the basal or coriaceous portion. On this account the wing-cases in this order are called by some hemi-elytra. These membranes cross at the apex when the wing-cases are folded, and in this respect the latter differ essentially from those of the *Coleoptera*, in which the suture is straight to the apex. Here, however, it must not be forgotten that I am speaking of developed forms only. Hemiptera in the imago state often assume two distinct forms—the fully developed or "macropterous," where the elytra have

a fully developed membrane, and the under or posterior wings are complete; and the undeveloped or "brachypterous," where the membrane is abbreviated or absent, and the posterior wings incomplete or rudimentary. The form of the pronotum also varies correlatively with this development, being wider, as a rule, posteriorly in macropterous examples. Some species are rarely met with in the macropterous state, and the brachypterous representatives of some bear considerable superficial resemblance to some of the brachelytrous Coleoptera. In such cases the suctorial mouth may be relied upon to distinguish the Hemipteron.

I think, however, that after a very short training a bug will offer attractions to the eye (and nose too, in many cases), which will at once indicate the order it belongs to. May I also remind you that all bugs are not flat? Many are very convex, and many are delicate creatures, which one can hardly secure without damaging their slender legs and antennæ.

It is frequently difficult to distinguish the larval and nymph forms of a bug from the brachypterous imago. If, however, the wing-cases are examined, they will be found in the early stages to be enclosed in a membranous sac, and not free, as they are in the imago; also the claws in the larva are as a rule imperfect, and the whole integument is of a softer nature.

A collector of Hemiptera need not burden himself with any large amount of impedimenta; a bag net, a canvas water-net, a white umbrella, a sheet of white mackintosh, a killing bottle, and a digger are about all his necessary weapons.

As the frame for a net I prefer an ordinary steel folding landing-net ring, with a universal screw, such as is obtainable at a fishing-tackle maker's shop. On this should be fitted a bag of coarse unbleached linen. It is well to avoid jute fabrics, as they certainly do not bear the same amount of hard work as those made of flax. Round the mouth of the bag a wide hem of some very strong material should be attached, into which the ring of the net can run. The material I use for this purpose is what is called "webbing." A very few days' hard sweeping in hedges, &c., will wear through any hem made of brown holland or ordinary linen, as it must be borne in mind that this hem bears the full brunt of the work. The ring should be screwed into an iron or steel ferrule (avoid a brass one, as it soon wears out), which should be fixed on to a strong oak stick, so that the whole apparatus is fairly heavy and capable of brushing well into bushes, &c. One sees people occasionally sweeping with a cane-ringed net, or one with a thin wire ring; but with a light implement of this sort only very superficial work is possible. Some collectors prefer the large open nets which have the stick passing right through the ring. There is one advantage in these, viz. that they can be used both for sweeping and beating, so that both a net and an umbrella need not be carried; but, on the other hand, the circle is so large that frequently there is a difficulty in sweeping under hedges with

one, and on the whole I prefer the two implements, as each does its own work better than the combination.

The umbrella if possible should have whalebone ribs; but as it is difficult now-a-days to get such antiquated structures, it is of no use insisting on that point. Anyhow, the frame should be as strong as possible, as if when beating, the stick misses a bough and comes down on the umbrella, the effect on a weak structure is likely to be disastrous. The cover should be of white linen or holland. One great advantage which an umbrella has over a wide-mouthed net is that it can be held by the ferrule end over one's head under higher branches than can be beaten into a net, which has to be held horizontally. An ordinary Coleoptera bottle, with a tube through the cork, is, I think, the best for collecting purposes; this should have a piece of cyanide of about the size of two peas at the bottom, these should be well wedged down with blotting-paper, over which should be placed a cone of white note-paper, so arranged as to come well up the sides of the bottle, in order that the insects may not touch the damp blotting-paper. The least damp will spoil some of the more delicate species, causing the membrane to curl up at the apex, which completely disfigures the specimens. An ordinary fern trowel makes an excellent digger, and is very useful for removing bark, digging at the roots of grass, &c.

The features of the country he is in should be carefully considered by the collector, and his collecting should be guided by their peculiarities. Where extensive commons occur, probably there rarities may be sought with success. Where pinewoods are a feature of the neighbourhood, good species may be expected from beating them. Where large *sphagnum* bogs exist they should be specially worked, and so on. It should be remembered that the insects peculiar to certain species of plants will not always be found on them, especially if only introduced into gardens, &c. As a rule, sandy districts are very good for Hemiptera; and sandy commons, such as Chobham Common, and what is called West End Common, Chobham, in which large boggy tracts occur, are perhaps as prolific in their yield of species as any localities that can be selected; they provide dry sandy spots, marshes, sphagnum bogs, and actual water, with the very variable vegetation which belongs to each. In summer, *i. e.* June and July, a wooded inland locality, such as the New Forest, is as hopeful as any; but in August and September preference may probably be given to some seaside locality with good sand-hills, such as Deal or Lowestoft, or some inland sandy common.

The various seasons of the year of course require different methods of collecting. Beating and sweeping are probably in the summer the most productive; but there is little to be done in this way until June, as the larvæ do not begin to feed till the leaves come out, and some time must elapse before the perfect insects are to be found. There are, however, a good many species that hybernate. These may be found in the early spring, or, indeed, at any time during the

winter, by shaking moss, dead leaves, &c., over mackintosh. So that there is no time when the Hemipterist need fold his hands and feel that he has nothing to do.

As we are now at the end of April, it may be well at once to consider the methods of collecting suitable to May. Beating and sweeping are not likely yet to produce much; but still a few species that live through the winter may be found by these methods, and young larvæ of many species will occur, and offer a good opportunity for anyone interested in breeding to try and rear them. I believe this may easily be done by anyone who has time enough to change their food constantly in the same way as is done by those who rear Lepidoptera. Old lichen-covered branches of larches, &c, may be beaten with advantage for the very small species of *Myrmedobia*, &c, several of which are rare; moss, dead leaves, *sphagnum*, rubbish, &c., will all yield their peculiar species if shaken over a white sheet or mackintosh. *Sphagnum* has only a few hemipterous inhabitants, such as *Salda cocksi*, *Plociomerus luridus*, *Hebrus ruficeps*, &c.; but a sunny day in May is a very good occasion to search for them.

Under heather and low spreading plants various species may be found. Habitats of this kind should never be passed over, even in summer; but until the middle or end of June they afford excellent chances of getting a good bag. Many water-bugs may be got in May. The species of *Corixa* require very careful collecting, as they bear such a close general resemblance to each other that the rarer species are very liable to be overlooked. On the other hand, the same species is apparently very liable to vary in colour according to the nature of the water it lives in; specimens from some of the pools in peaty localities, especially in the north, being very much darker, and their markings consequently more obscure than those taken in clear ponds. The black spot or marking at the apex of the posterior metatarsus, which is a character assigned to a certain group of this genus, should be carefully looked for before dismissing a specimen as useless; this character is best seen from the under side, as the long hairs of the margin often interfere with a good dorsal view.

Towards the middle of June it is well to try beating in order to ascertain the condition the Hemiptera are in, as of course an early season will develop them more rapidly than a late one. It is of very little use collecting specimens until they are fully mature, as the legs and antennæ of immature examples shrivel in the most aggravating way, and this in the Hemiptera is of very great importance, many of the species being distinguished by the comparative lengths of the antennal joints. It is often difficult to recognise the immaturity of a specimen in the net; but a day or two after setting it will reveal itself plainly enough, and a collector is lucky if he can revisit the locality a few days later when mature examples can be found.

The most productive trees are oak, ash, hazel, alder, willow and sallow, poplar and firs. Oaks and sallows are *par excellence* the homes of many species, and it is really astonishing to see the

amount of life which two or three sharp raps with a stick will dislodge from a single branch of oak. The most effective way to beat is not to thrash away indiscriminately at the leaves, but to strike the branch itself sharply once or twice, holding the umbrella close up under it, then immediately to bring the umbrella down on to the ground and commence operations. Turn the umbrella so as to keep the sunshine out of it, as otherwise the bugs will take flight. An "umbrellaful" towards the end of June will probably consist of many species, but by far the largest number of specimens will belong to the genus *Psallus*, of which *P. varians* and *P. variabilis* are the most abundant. So soon as a desired specimen is seen in the umbrella the tube of the bottle should be placed over it or just below it, so as to touch its hind tarsi, when, as a rule, it will at once fall backwards down the tube.

It would be impossible to give a list of all the species to be found on each kind of tree, but I may mention that one of the rarities to be looked for on oak is *Psallus albicinctus*, a small reddish species with darker atoms on the thorax, closely resembling a small dark *P. varians;* also that specimens of *Orthotylus* from this tree should be carefully examined, as there are four or five species which cannot possibly be identified in the umbrella. Ash gives a few specialities, such as *Loxops coccineus* and *Psallus lepidus* in both its forms. These at first sight look quite distinct, but the best authorities consider them as forms of one species. Hazel is fairly productive, and from it may be beaten the lovely *Malacocoris chlorizans*, as well as *Pantilius* and *Nabis brevipennis*, *Phylus*, *Psallus salicellus*, &c. Willows, sallows, and alders, in July and August, produce many species, and are always worth beating. *Calocoris striatus*, *Plesiocoris rugicollis*, *Lygus limbatus* (hitherto only known as British from specimens taken off sallow on Wimbledon Common), *Pilophorus clavatus*, *Plagionathus roseri*, *P. bohemanni*, *Psallus fallenii*, *P. alnicola*, *P. sanguineus*, the rare *P. albicinctus*, and several species of *Orthotylus*, are all to be found on these plants; and besides these there are yet several species found on the Continent which are quite likely to occur with us, such as *Orthotylus virens*, *Psallus intermedius*, *P. æthiops*, *P. scholtzi*, and *Cyphodema rubicunda*. A few species occur on poplar, especially on *Populus alba*, such as *Phytocoris populi*, *Psallus rottermundi*, &c. Fir trees in our islands seem to possess few species compared to the numbers which frequent them on the Continent. Still there are a good many to be found, and I always beat firs in hope that some of these Continental species may yet turn up. Such species as *Phytocoris intricatus*, *Hadrodema nigriceps*, *Allœotomus gothicus*, and *Phylus limitatus* are all quite possibilities. Spruce firs yield the best results, but several interesting species—such as *Atractotomus magnicornis*, *Pilophorus cinnamopterus*, *Elatophilus nigricornis*, and *Plesiodema pinetellum*—occur on Scotch firs, the latter two so far having only been found with us in Scotland.

When we descend to low-growing plants the field is very extensive,

and the best advice is to sweep everything, giving special attention to any plants that are aromatic and strong-smelling, as these often harbour special species which occur nowhere else. From the sedges and such like plants along the sides of and in ditches and marshes good results may always be expected, and aromatic plants that spread on the ground, such as *Ononis* and *Erodium*, require special working; their spreading stems should be lifted up, and the ground under them carefully examined. Some Hemiptera, such as *Odontoscelis*, *Sciocoris*, *Pseudophlœus*, &c., are very sluggish, and resemble the ground very closely in colour, so that plenty of time should be allowed for them to move. On sand-hills by the sea, as at Deal, Camber, &c., very good results may be obtained in this way. I generally take the precaution to sweep the plants first and examine the contents of my net, and then to lift their branches and grub about underneath them.

The common broom, *Sarothamnus scoparius*, is a very productive plant, and harbours several species peculiar to itself. Three species of *Orthotylus* may be found on it—*O. concolor*, *O. chloropterus*, and *O. adenocarpi*—all very similar, but distinguishable apart in the umbrella when the eye has caught their characters. *O. chloropterus* is slightly the largest, and has a very dark membrane; *O. adenocarpi* is slightly paler in colour, and of a yellower green, with the membrane paler; *O. concolor* is smaller and of a decidedly paler, bluish green, with pale, almost diaphanous membrane. With these *Heterocordylus tibialis* almost always occurs in more or less abundance, and much more rarely *H. genistæ*. Old broom bushes sometimes yield *Anthocoris sarothamni*, and the very beautiful but rare *Dictyonota fuliginosa*, but often as I have hunted for this last, it has never been my good fortune to find it.

Searching at the roots of grass, sedges, &c., in marshy places is most profitable, and many rare species are likely to reward one's labour. *Drymus piceus*, *Cyrtorrhinus pygmæus* and *flaveolus*, *Nabis lineatus*, and many others are to be found in such localities; and similar work in dry spots will often produce such things as *Plagiognathus saltitans* and *pulicarius*, *Conostethus roseus*, and, if near ants' nests, *Systellonotus triguttatus*, the female of which, when running, so closely resembles a common garden ant (*Lasius niger*) that it requires careful scrutiny to establish its identity.

Salt marshes are the favourite resorts of several species of *Salda* and of a few *Capsidæ;* the former are to be found running and jumping on the ground. The *Capsidæ* attack such plants as *Atriplex*, *Salsola*, &c., and are best obtained by sweeping or searching under their stems, &c. *Salda* is not by any means exclusively a salt marsh genus, as several of our rarer species are found on the margins of inland streams, lakes, &c., and on marshy ground on commons; whilst one species—*S. orthochila*—is found on quite dry sandy spots.

Other hopeful localities are the trunks of trees and old palings. Hemiptera may often be found sitting quietly on these, either in the

crevices of the bark or amongst the lichens, the colour of which some very closely resemble. In fact, there are very few localities where Hemiptera may not be found. Any one who has access to old barns or church roofs, or such like localities where bats nest, should not fail to try and get the rare *Cimex pipistrelli*, which is parasitic on the bat. Martins' nests also sometimes contain *C. hirundinis*. Many years ago I found the latter in some numbers on the window of a house in this neighbourhood, which had a martin's nest just over it. The lady of the house took me up to the room in great concern, as she was horrified at finding what she feared were ordinary house bugs, and was much amused and consoled at my delight in capturing them, and was only too anxious for me to repeat my visits till all danger was over! Still these experiences are rare, and I have never since seen the creature alive.

Hemiptera should not be left long in the cyanide bottle, but should be set if possible the same day as they are captured, as if they get over-damp their legs are apt to fall off, and their membranes to curl up at the apex. The best way to set them, in my opinion, is to mount them across narrow strips of card. These need only be very short, so that the insect almost touches the pin. By this method almost the whole of the under side can be examined. Another way is to put them somewhat sideways on a longitudinal strip; this answers as well as the other, and it is a mere matter of taste as to which looks best. Some prefer to pin everything, but unless silver pins are used the risk of destruction by verdigris is very great. The ordinary method of carding is objectionable, as it hides the under side; but if in the mind of any entomologist this is of less importance than the look of the specimen, then I would strongly advise that the legs be left free, and not gummed down, as the claws afford valuable characters, and it is impossible to examine them if clogged with tragacanth. Ordinary liquid glue is, I find, as good as anything for mounting purposes. The cards (of whatever shape they are) should be pinned with fairly long pins, and raised within a quarter of an inch of the head, so that a strong lens can be brought to bear on the insect. Care should be taken not to leave newly-set specimens in any place where *Psoci* can get to them, as these little wretches will eat away the slender apical joints of the antennæ, &c., and utterly spoil the specimens.

A good collection of British Hemiptera Heteroptera should fill about ten to twelve single-sided boxes, such as those sold by Janson. These to my mind are particularly well suited for a student's collection, as, being shallow, the insects if pinned high are brought up close to the eye, and can be examined with a glass with unusual facility.

The chief characters which have been used to distinguish the various families, genera, &c., apart, lie in the *antennæ*, the *rostrum*, the form of the head and thorax, the component parts of the elytra, the joints of the tarsi, the claws, and the position of the insertion of the legs, *i. e.* of the coxal cavities.

It is impossible here to attempt any sketch of a classification, but

the student of this order should carefully study the characteristics of each family; these are well defined, and by no means difficult to appreciate (I have given tables of them in my "Hemiptera Heteroptera of the British Isles"), but the characters assigned to the genera are often very difficult to seize, especially those employed in the *Capsidæ*: the species, however, when the genus has been rightly determined, are, as a rule, comparatively easy to distinguish; and on the whole I think even a beginner may take up the order with a fair prospect of soon making himself reasonably well acquainted with it. I am of course speaking of the order as it is represented in this country. The number even of *Palæarctic* species is very great, and that of the species of the world must be quite appalling. I hope I have said enough to show that the Hemiptera afford plenty of scope for study, and that they will amply repay any amount of attention given to them. Allow me to conclude by saying that I shall always be happy to help anyone in the determination of his captures, or to show my collection to any of your members who may at any time find themselves in the neighbourhood of Woking, and call upon me at "St. Ann's."

Notes on some South European Lepidoptera, with remarks on Thais and Euchloë.

By A. H. Jones, F.E.S. *Read May 12th*, 1898.

You are all no doubt well acquainted with the limits and extent of the Mediterranean flora. That it spreads all along the Riviera—up the valley of the Rhone—to a spot a little north of Avignon, along the coast of Spain to Gibraltar, and the African coast to Tangiers, including the islands of Corsica and Sardinia. Within this area we find similar lepidopterous life, the butterflies found on the African coast and the south of Spain having a close affinity to those occurring on the Riviera, the difference often being merely a question of size, as in *Charaxes jasius*, and of colour, as in *Thais rumina*, and var. *medesicaste*.

I will refer firstly to the Riviera and its surroundings, and then to the adjoining mountains—the Maritime Alps and the Basses Alps.

The entomologist who is familiar with the profusion of butterfly life in the Swiss Alps will be disappointed on his first arrival in the Riviera if his object be to obtain a number of specimens. He will not find as he wanders among the olive trees—be the day ever so fine—much beyond a few white butterflies and an occasional Geometer. The localities have to be found out, the attractive flowers discovered, before he will meet with the butterflies which he has come so far to capture.

When stopping at Beaulieu, near Nice, in May a few years ago, I spent several days, working most diligently with but very poor results, when at last I discovered a ravine with a profusion of flowers; and in this locality, of very limited extent, I found butterflies and day-flying Geometers in abundance. One of the best localities of this description on the Riviera is probably at Carqueyranne, a few miles south of Hyères; it is of some extent, spreading over many acres, and is an ideal spot for the collector.

It is in this locality only that I have seen an abundance of butterfly life on the Riviera. That beautiful species, *Euchloë euphenoides*, is quite plentiful, accompanied by an occasional *E. cardamines*; *Gonopteryx cleopatra* is, of course, common; *Limenitis camilla* is sometimes seen, and numberless "blues" and "skippers" are found among the wild thyme in the open places.

The road from Hyères to Carqueyranne affords very good collecting. It leads through extensive woods of fir and arbutus, which on a hot day give forth a most delicious perfume. In these woods during May little is to be seen beyond *Gonopteryx cleopatra*, but on reaching

the coast several species are found, *Melitœa cinxia* being particularly common. The road then follows the coast-line for a few miles, and is a good locality for that very early and southern species, *Thestor ballus*.

Any one stopping at Hyères should not fail to visit the Iles d'Or. Porquerolles, about five miles long, is the largest, and I would therefore suggest it as being the best to visit from an entomological point of view. I spent one day on this island, and was greatly charmed with my visit, especially with the view over the Mediterranean from the elevated cliffs on the south side. The arbutus is the principal shrub, and I am told *Charaxes jasius* is common there; but I only met with ten species in all, *Gonopteryx cleopatra*, *Pieris daplidice*, and *Euchloë belia* being the principal butterflies.

I have referred to the Mediterranean flora spreading up the Rhone valley beyond Avignon. Not far from Avignon is Pont du Gard, celebrated for the magnificent Roman aqueduct. The flora in the neighbourhood is very similar to that found at Carqueyrannes, and we naturally come across the same species of butterflies; for instance, *Euchloë euphenoides* and *Melanargia syllius*, both of which, however, strictly belong to the Mediterranean fauna. This is another ideal collecting ground, and deserves more than a passing visit.

Roughly estimated, there are about one hundred species of Rhopalocera to be found on the Riviera, yet in the Maritime Alps and the Basses Alps there are probably nearly double that number, nearly two thirds of the whole of the species of butterflies occurring in Europe. This difference is accounted for by the various elevations, viz. from almost the sea level to the region of perpetual snow.

My acquaintance with the Maritime Alps is confined to one visit in the month of May to St. Martin Lantosque (3117 feet above the level of the sea). This place is reached by diligence from Nice, being about thirty-seven miles distant by road and twenty miles in a "bee line." As the diligence starts at night both in going and returning little opportunity is afforded for seeing the intervening country, but there appeared to be an absence of trees.

St. Martin Lantosque is a great summer resort for the inhabitants of Nice, and consequently is well supplied with hotels. The hotel in which I stayed was so unique in character that I must be excused for referring to it. It was constructed on the edge of a ravine. The dining-room was at the top of the house, and by reversing the order of things you went downstairs to bed, the inferior rooms being near the bottom of the ravine.

From a botanical point of view this district is one of the richest in the Maritime Alps, and many rare plants are found here. It also has the reputation of being very rich entomologically; but the date of my visit—the middle of May—was much too early. Had I arrived there two months later I should probably have made many interesting captures. As it was, I only observed *Lycæna baton*, the "blue" so

common at Hyères, that ubiquitous butterfly, *Vanessa antiopa*, *Lycæna semiargus*, and a few other species.

At about 500 feet above the village the mountains were almost covered with snow. The numbers of plants with flowers of varying beauty and colour, which but a few days before must have been completely enveloped in snow, was a sight not easily forgotten.

When Messrs. Lemann, Nicholson, and myself contemplated a visit to Digne, in the Basses Alps, it was surprising what little information we could glean with regard to that district. Fortunately we obtained through a Paris bookseller a copy of a paper written by a Monsieur Donzel, and read so long ago as in 1850, before the Société Linnéene de Lyon. From this we obtained some very useful information as to the various localities, and the species to be looked for. We were only able to visit a few of the places indicated, as many were far off, and excursions to them would have involved more time than we had at our disposal. We, however, found plenty of occupation in the immediate neighbourhood of Digne ; for whichever direction we took we always discovered some good collecting ground. We made several excursions to an elevated plateau known as Les Dourbes, about seven miles distant, very exposed, and about 1000 feet higher than Digne, a different description of species was met with than in the warmer and more sheltered localities at a lower elevation. Les Dourbes is the great locality for *Euchloë tagis*, var. *bellezina*, to which further reference will be made later on.

The hills in the immediate vicinity of Digne do not exceed an elevation of 3000 feet above the level of the sea. They are mostly covered with young oak trees, among which a considerable amount of butterfly-life exists, two species, viz. *Thecla spini* and *T. ilicis*, var. *cerri*, being particularly common in the month of June. In the valleys between the hills, if flowering plants can be found such as the lavender, many butterflies and day-flying moths may be met with.

The most attractive butterfly of the Basses Alps is *Papilio alexanor*, a grand species which is somewhat common in the month of July. It has a wide range over the mountains of Southern Europe, and is found eastward as far as Persia. I took a beautiful series in the month of June, but they were then by no means common. It is a strong flier, and can only be captured when at rest. Its favourite flower is the thistle. Many of the butterflies in the Digne district are what may be termed as of a "large form." The *Parnassius apollo*, for example, are much larger than those found in the Swiss Alps.

Digne has a very interesting and varied flora, which accounts for its rich insect fauna. Monsieur Honnorat, to whom Monsieur Donzel refers in his paper, says that without going out of the department you can gather 3500 species of plants, although in the neighbourhood of Paris, within a radius of twenty leagues, you can scarcely come across 2000.

There is probably no group of butterflies which affords such a

fascination to British entomologists visiting the south of Europe as the genus *Thais*, the pattern on the wings, the general appearance and habits, being so unlike any species occurring in our own country. My first wish (and I believe it to be a general one) was to see a *Thais* on the wing. I remember meeting a collector at Hyères who had been searching all day for that beautiful species, *T. medesicaste;* and although there was an abundance of other species to which he might have directed his attention, his sole object appeared to be the capture of that particular butterfly. The genus *Thais* chiefly belongs to the Mediterranean, Asia Minor, and North African faunas. There are three species occurring in Europe; one is found along the shores of the Black Sea, commonly in Armenia, and as far westward as Gallipoli in Turkey; the remaining two are more especially attached to the shores of the Mediterranean.

All the species of the genus *Thais* select the warmest situations in which to undergo their transformations, and the butterflies are only to be seen on the wing during the brightest sunshine; the merest cloud influences them, and they disappear like magic into the grass, reappearing instantly on the return of sunshine. They seem to be more sensitive to the effects of light and shade than the Erebiæ. The larvæ are cylindrical, rather short, and covered with spine-like protuberances. They are somewhat sluggish, and all three species feed on *Aristolochia*. The full-grown larva being found during the daytime at the roots of the plants suggests its being a night feeder. The pupa is attached by the tail, and by a silken band round the body, like other Papilionidæ.

I will now briefly refer to the species. In Europe *Thais cerisyi* appears only to be found in Greece and Turkey and the adjoining islands. It is more plentiful in Asia Minor, is common in Armenia, and extends as far as the Caucasus, where it assumes a different form —var. *caucasica*. The series exhibited were nearly all bred from pupæ received from Armenia, and probably refer to the var. *deyrollei*, peculiar to Asia Minor There seems to be very little, if any, difference between these and the type which occurs in Turkey. The larvæ feed on *Aristolochia hastata*.

Thais polyxena is the commonest of the genus, and is more generally distributed, and extends farther north than any of the other species, occurring in Central Europe and as far eastward as South Russia. Although the species occurs as far north as Brünn, it is curious that it should be absent from Switzerland. Dr. Frey mentions, however, that it was once captured a long time ago in Canton Tessin. It is recorded as occurring in abundance on April 19th, 1857, in the vineyards of the Italian market town Orta, which is not so very far distant from Canton Tessin. On the Riviera (and in Italy, according to German authors) another form of this species occurs. It is a shade smaller, the scroll on the outer margins of both wings is less deeply dentate, and other differences present themselves, making a well-defined variety—var. *cassandra*.

This butterfly is greatly influenced in the time of its emergence according to seasons. In the first week of May, 1888, I found it abundantly and in fine condition at Hyères, whereas in 1894, an early season, by May 6th not one was to be seen, and I was almost too late for the larvæ, which were then full-fed. I am told the butterfly was out this year on March 15th at Hyères.

Var. *cassandra* is not at all uncommon at Hyères, but it is extremely local. I once came upon a colony in a swampy piece of ground near the river Gapeau, on the north side of Hyères, where it was very abundant. I imagine wherever the food-plant, *Aristolochia rotunda*, occurs plentifully the butterfly is to be found. This form of *T. polyxena* occurred in some numbers in a friend's garden on the outskirts of Hyères, the food-plant being common in the vicinity. It was here I found the larvæ from which the series now exhibited was bred. My friend Mr. Raine, who has frequently reared *cassandra*, tells me that he had never bred any ichneumons from the pupæ; my experience, however, was the reverse, for I bred more ichneumons than butterflies. Var. *ochracea* is not at all scarce, and is merely a form in which the ochreous ground-colour is darker.

Thais rumina, the third and last species, occurs in Southern Spain and Portugal, and is not uncommon at Gibraltar. North of the Pyrenees, along the Riviera and as far north as Digne, in the Basses Alps, we find the variety *medesicaste*. The markings in this form and the type are practically identical, the difference appearing to be merely a question of intensity of colour, the ground-colour in the type being deeper ochreous, and the red blotches much brighter.

Medesicaste was fairly common at Hyères in the beginning of May, 1890. This year three specimens were taken there on March 17th. At Digne (which is about 2000 feet above the sea level), probably its northern limit, the species was not uncommon during the first week in June, 1890. At the same time I found larvæ in all stages on their food-plant, *Aristolochia pistalochia*, the young ones on the under sides of the leaves and in the tubes of the curious flowers, the full-grown larvæ lying concealed at the roots. It is rather a curious fact that bred specimens of *medesicaste* are so much larger and finer than captured ones. I can only account for the circumstance in this way: the food-plant grows on hill-sides much exposed to the sun, and in dry seasons probably becomes parched up, and the larvæ, being sluggish, suffer in a corresponding degree; whereas by rearing the larvæ one collects all the succulent plants one can find in shady places. I visited Digne again in 1894, but *medesicaste* was extremely scarce. Local collectors told me that they believed the species had suffered from the effects of the drought of the previous summer.

Var. *canteneri* of Staudinger is a variety occurring in Spain and Northern Africa, and differs from the type in having the ground-colour very dark ochre. Var. *honoratii* is a very beautiful variety, in which the red blotches are confluent. It is only recorded from Digne, and seems to be somewhat rare, to judge from the high prices local collec-

tors place upon it. The best chance of obtaining this remarkable aberration is to collect the larvæ and rear the butterflies. A friend who accompanied me to Digne bred three beautiful specimens.

Aristolochia pistalochia and *rotunda* are, to all appearance, very closely allied; yet *medesicaste* will only eat the former and *cassandra* the latter plant. There are thirteen species of *Aristolochia* occurring in Europe, though not a single one is indigenous to Great Britain.

Aristolochia clematitis (birthwort) is found in old gardens, but it is not a native. The geographical distribution of *pistalochia* and *rotunda* corresponds with that of the respective butterflies. *A. clematitis* (given by German authors as the food-plant of *T. polyxena* type) has a range as far north as Central Europe, where the butterfly is found.

The genus *Euchloë*, of which there are eight well-defined species occurring in Europe, is another very interesting group of butterflies. The first three species—*belemia*, *belia*, and *tagis*—are somewhat allied to the Pieridæ in appearance, markings, and flight, yet in structure they are very different, the wings being far more pointed and the antennæ much shorter. Their flight, like *Pieris callidice* and *P. daplidice*, is rapid, and, like the Pieridæ, each has a second brood. Specimens of the second brood are larger than those of the first, the reverse being the case, I believe, with butterflies in Northern Europe. The remaining five species may be termed the "orange tips." Their flight is by no means so rapid as that of the three preceding species. They rest frequently on flowers, and allow themselves to be easily captured.

Before referring to the genus *Euchloë* I wish to make a few remarks with regard to three species of Pieridæ. *Pieris callidice* is quite an Alpine species, and is of wide distribution, occurring from the Pyrenees to Turkestan, where it assumes a larger form known as *chrysidice*. The markings, however, are precisely the same. *Callidice* is found at Gavarnie, in the Pyrenees, on the Jura Mountains, Basses Alps, nearly all over the Swiss Alps, and in the Tyrol, but is not found in Scandinavia.

I have met with occasional specimens in the Saas Valley and other parts of Switzerland, but only on one occasion commonly. On June 15th, 1885, this "mountain white" was flying in considerable numbers over the Rhone Glacier moraine at 5761 feet above the level of the sea. Being very quick on the wing, its capture was not easy, as to keep one's eye on the butterfly and the broken ground was a difficult matter. The caterpillar feeds on mountain Cruciferæ.

Pieris daplidice.—So much has been written about this species that I scarcely like to refer to it. I have met with it in several localities round the Lake of Geneva, and last year at Martigny, in the Rhone Valley, but never in any numbers in Switzerland. It is not an uncommon species at Hyères, but in my experience is not so abundant as *E. belia*. *P. daplidice* would appear to be rather commoner about sixty miles north of the Mediterranean.

In the beginning of May, 1894, I found the species quite abundant at Digne in lucerne fields on the Barcelonette road. I have not taken it farther north than Coblentz. I am told that it is rare in Belgium, but it does not appear to be so scarce there as in England, as every Belgian entomologist will tell you that he has taken the butterfly at some time or other.

Mr. Raine informs me that at Hyères *daplidice* is on the wing at the end of February, occurs throughout the summer months, and is found in the autumn, suggesting that there is a succession of broods in the south. He has frequently reared the first and second broods, the larvæ feeding on wild mignonette.

Pieris chloridice is a very pretty species belonging to the fauna of South-eastern Europe, not occurring farther westward than Turkey. It appears to be more common in Asia Minor. My series was taken in Armenia.

I now return to the genus *Euchloë*. *E. belemia* is purely a southern species, occurring in the south of Spain along the North African coast, certainly as far eastward as Palestine, as I have received specimens from that locality. How far north it extends into Spain and Portugal cannot be ascertained from any published records, but we are certain of the fact that it does not occur north of the Pyrenees. The variety *glauce* is the second brood ; it is somewhat larger, the black apical markings are duller, but the distinctive difference is on the under side of the hind wings, on which the green assumes a yellowish tint, and the white "tiger-like" stripes become enlarged and are devoid of silver.

Euchloë belia is another southern species, although extending much farther north than the preceding. It is one of the commonest butterflies on the Riviera, and occurs in Palestine and along the north coast of Africa. It is reported, according to Dr. Frey, to have been once taken at Sion, in Switzerland, is met with at Lyons, is recorded as occurring near Paris, and I have seen a specimen sold at Stevens' as having been taken in England. I think it quite possible that a strong flier like *belia* could certainly migrate to the centre, if not to the north of Europe, and possibly to the south of England. This species is interesting in having two distinct forms—var. *ausonia*, the second brood, and var. *simplonia*, the mountain variety. The black apical markings are lighter in *ausonia*, and the ground-colour of the under side of the hind wings is more yellow than in the type. As in *belemia*, specimens of the second brood are larger than those of the first. It is an early species, the first brood emerging in the south of France at the end of February. In 1894, curiously enough, I found both broods out together. *Belia* was getting over, and var. *ausonia* was just coming out. Mr. Raine tells me that *belia* only occurs in March, April, and May ; the second brood, *ausonia*, appears at the end of May, and the butterfly is not seen again until the following spring. He further states that he bred specimens which had been four years in the pupal state. I can only recollect one other species of butterfly,

viz. *Papilio hospiton*, the "Corsican swallow-tail," the pupæ of which lie over.

Simplonia is the mountain form of *belia;* it approaches nearer to var. *ausonia*, and is rather larger than the type. It occurs throughout the Basses Alps, the Pyrenees, and most places in Switzerland at a certain elevation. I have taken it in several localities from June to August at about 4000 feet, but not commonly.

E. tagis is quite a Spanish and Portuguese species. It closely resembles *belia*, but is a trifle smaller. There is, however, a considerable difference in the under side of the hind wings. I am not aware how far north into Spain and Portugal it occurs; at all events, we find north of the Pyrenees a smaller form known as var. *bellezina*. This variety does not occur on the Riviera, as recorded by some authors, and I have never taken it anywhere in France except on Les Dourbes, near Digne, at about 3000 feet. This would almost point to the fact that *bellezina* is a mountain form of *E. tagis*, as *simplonia* is of *E. belia*. It would be interesting to know whether this variety represents the species in the mountains south of the Pyrenees.

Var. *insularis* of Staudinger is described as the Corsican and Sardinian form of the butterfly. I fail, however, to see sufficient difference to separate it from *bellezina*. I have met with *insularis* on the sea level in Corsica, which is rather against the mountain theory; but it must be borne in mind that nearly the whole of Corsica is more or less mountainous.

Euchloë cardamines is the most widely distributed species of the genus. It occurs throughout Europe, Asia Minor, Syria, and extends into Northern and Western Asia. It is also found up to a considerable elevation in the Alps; it is recorded from St. Moritz, in the Engadine, at over 5000 feet, and I have taken it at Zermatt and several other localities at a similar elevation. The English specimens differ, as you all know, in having the discoidal spot on the margin of the orange blotch, whereas in Continental specimens the orange spreads considerably beyond it. A specimen I captured at Zermatt has the orange very considerably suffused over the wing.

A second brood of *cardamines* is occasionally recorded as occurring in England. I find mentioned in the "Entomologist" for August, 1892, the occurrence of several specimens being seen at Wisley, in Surrey; and again on August 2nd of that year a male specimen was seen near Thame, in Oxfordshire; yet in the south of France, with all its increased amount of heat, I am told a second brood is never seen. Mr. Raine has bred the butterfly from a larva found on *Biscutella didyma*. *Euchloë gruneri* and *E. damone* are Eastern species, not being found farther west than Greece. Both are single-brooded. *Euchloë euphenoides*, known in France as "la gloire de Provence," is a southern and very beautiful species. I have taken it as far north as Digne, although rather sparingly, and at Pont du Gard, near Nîmes; but it seems more plentiful on the Mediterranean coast—near Carqueyranne, for instance. It is, however, an extremely local butterfly.

Gynandromorphous specimens occur occasionally. One of the most remarkable aberrations of a butterfly I have ever seen was a male specimen of *E. euphenoides* captured by Mr. Raine at Hyères. It was devoid of orange on both wings, and the ground-colour was quite a different tone of yellow. The specimen is in the Raine Collection at the Natural History Museum, Newcastle-on-Tyne, and is well worth an inspection by any one interested in "varieties." The caterpillar feeds chiefly on *Biscutella didyma*, and the butterflies delight to rest on its flowers. It is never double-brooded. *Euchloë eupheno* is often confounded with this species; it is an African butterfly, and is probably only a form of *euphenoides*.

Euchloë pyrothoë is quite an Eastern species, and is recorded from the mountains of Orenburg, on the confines of Persia.

Zegris eupheme is a South Russian species, and occurs in the Crimea; the variety *meridionalis* occurs in Southern Spain.

Leucophasia sinapis is a very generally distributed species in Europe. I have never been abroad without meeting with one of the broods; I have found it throughout Switzerland, at Digne, the Riviera, and in Corsica. The Continental specimens, especially from the south, appear to be rather larger than British examples.

Leucophasia duponcheli is a well-defined species, and seems to have rather a limited area of distribution. I have taken it at Digne, and at about 1500 feet in the mountains at the back of Nice.

The second brood of this butterfly, var. *æstiva*, closely resembles the second brood of *L. sinapis*. I find the best way to separate the species which occur together is to examine the antennæ. In *sinapis* the under side of the club is white, and in *duponcheli* brown.

I have referred very briefly to the last species in this paper, which specially refers to the genus *Thais* and *Euchloë*.

The Scientific Aspects of Entomology.

By J. W. Tutt, F.E.S. *Read October 13th*, 1898.

In bringing forward for discussion such a subject as that conveyed by the title of this paper, one recognises that many details connected with the points one must necessarily touch upon will present themselves under various aspects to different individuals. At the same time one may safely assume that among a body of men all deeply interested in the study of entomology, or kindred subjects, there will be no great difference of opinion as to broad principles; and here one may notice that, whatever one has to say about entomology must necessarily present a broad collateral parallelism with botany, conchology, and other studies that have their origin in field rather than in laboratory work, so that any remarks made about the one subject will largely find an echo in the sister sciences, and any broad principles touched upon will probably be found as applicable to them as to the particular subject under consideration.

Science comprises the knowledge of facts, the classification of facts, and the deduction of principles from the facts thus classified. The pursuit of insects, the thousand and one details of work done by entomologists in the field, is but the alphabet of their study; it does not constitute science. It is only when a man classifies the facts thus obtained from his practical experience, and is able to deduce generalisations from the details that he has observed, that his work becomes scientific, and that his results may be called science. The observations of the field naturalist, and the careful description of species, are the groundwork on which the science of entomology is built, but they are not the superstructure itself, and should not be mistaken for it. The formation of this foundation is an absolutely necessary and useful work, and the individuals who engage in it are doing a very useful service; but to the science of entomology, to the solution of the problems of animal life and its origin, it bears just about the same relationship that the organ-blower bears to the music, compared with the musician who plays the instrument.

If a man will take some small group of insects containing but few recognised species, study them in detail *ab ovo*, compare them one with another, and deduce *bonâ fide* conclusions from his observations —that man is scientific. If he will take a larger group of insects and study some one structure in detail, and deduce some general conclusions from his observations—that man is scientific. If he will collect a small group of insects over the whole range of their geographical distribution, point out to us why each individual species is confined within certain limits, why their localities are isolated and consist of small tracts of a few hundred square yards, scattered here and

there over thousands of square miles—that man is scientific, and doing scientific work.

It is quite clear, from the enormous ground covered by our subject, that to do good work a man must specialise in some particular branch. This may, according to the taste of the individual, be the systematic, the biological, or the philosophical; for it appears to us that all the side branches ultimately resolve themselves into one or other of these main stems. The first two branches have had an existence as long as the science of entomology itself; the last is naturally the product of our modern methods, and is only possible to men of special intellectual capacity, who have had excellent preliminary training, and are able at once to make observations and to draw logical deductions from the facts observed.

We can go back for at least one hundred and fifty years, and find systematic entomologists sharply and distinctly separated from the biologists. The ignorance of the old entomologists who worked out the biology of our insects is profound so far as relates to their knowledge of the names and affinities of insects. None of their insects bore names, and their work is not always, therefore, of that special value that it otherwise might be. But if Réaumur, Swammerdam, and the other pioneers in insect biology were not systematists, very certain indeed it is that the early systematists were not biologists; and this distinction lasted more or less until the last quarter of a century. True it is that in the meantime some systematists had begun to add notes on the life-histories of certain of the species, but such notes were generally intended to help the field collector to name his captures in their early stages, and had no real scientific value; and, of course, books of this kind are published up to the present day.

During the last fifty years, however, the distinction between the biologist and the systematist has to a certain extent broken down. This may be in part due to the improvement in the general education of a large part of those who give their attention to the study of entomology; it may be also in part due to the great improvement and to the more general diffusion of scientific methods of work, and it may be due to the fact that it is now more generally recognised that a knowledge of the other branches of the science leads to a better comprehension of the special branch to which the student is attached. This is proved to have been so in the case of those who have been most successful in the study of the more philosophical branches of entomology, almost all the most eminent thinkers having had a preliminary training as systematists and biologists.

No longer, then, do those who study the biological problems relating to insects form, as it were, a group of scientific men quite apart from the systematists, nor are the latter absolutely ignorant of the broad facts of the anatomy and physiology of the insects they study. The time, too, has to a great extent gone by when the philosophical student was looked upon with contempt by the biologist and systematist, and *vice versâ*. The number and abundance of species,

the ease with which many may be reared in large numbers, the rapidity with which the broods follow each other, and the consequent ability to obtain results rapidly, have tended to throw on the study of insects the greater part of the practical work by which the experimenting biologist has attempted to fathom some of the mysteries surrounding the phenomena of life. It frequently happens, therefore, that the biologist appeals to the systematist for material, and often becomes more or less interested in systematic work himself; on the other hand, men who commence as systematists often find themselves branching off into biological or philosophical studies. Darwin commenced as an ardent coleopterist; Wallace was a systematic lepidopterist; and the published systematic work of Bates and Trimen must be well known to all of you. Poulton, too, commenced by collecting and arranging Lepidoptera, and is at the present time superintending the rearrangement of the "Hope" entomological collections in the University of Oxford. Chapman, who has revolutionised our ideas of the classification of the Lepidoptera, and perhaps done more than any other entomologist towards bringing entomology into line as an exact science, is a well-known systematist in more than one order. Such examples might be multiplied exceedingly, and I have no hesitation in stating that some work in systematic entomology is of the greatest advantage to those students who take up the biological or philosophical sides of the subject; and I would urge that, without some knowledge of field work—often a very exact and thorough knowledge—ultimate success in the working out of many philosophical problems is almost impossible. There can be little doubt, then, that some close attention to systematic work, and some exact knowledge gained by actual observation in the field, make the very best basis on which to climb to success in the other branches of the subject.

Sooner or later the systematic entomologist, especially if he does his own collecting, finds himself drifting more or less into the biological side of his subject. He, perhaps, has bred specimens for his collection, and has thus become interested in the phenomena presented by their metamorphoses, and, instead of being satisfied with the mere killing and setting of the specimens for his collection, he commences probably to collate the facts that he observes, and attempts to draw conclusions therefrom. This naturally leads up to the more subtle problems relating to the conditions of life, to the modifications of the various forms, and ultimately he is led to attempt to explain the origin of the various forms or species themselves; for it may be taken for granted that when once the inquisitiveness of a really intellectual man has been aroused, he will follow up his investigations to their ultimate end. It is the strong side of the human intellect to want to know the how and why of everything; and hence, so far as one seeks knowledge for its own sake, this must be considered as the highest branch of this and all parallel subjects.

I will now deal with a few of the various branches of entomological

science to which the attention of scientific entomologists has been directed of late years, and first as to the subject of "Classification." The matter of classification naturally deals with the relationship that insects bear (1) to each other and (2) to all other animals. The animal kingdom is primarily divided into two great sections (1) the Protozoa (or one-celled animals); (2) the Metazoa (or many-celled animals). In the latter the cells are generally built up into tissues, and the tissues arranged in three fundamental layers—the ectoderm (outer layer), the mesoderm (middle layer), the endoderm (inner layer). The vast assemblage of animals included in the Metazoa are subdivided into several main groups or phyla, of which the chief are the Porifera (sponges), the Cœlenterata (sea-anemones, jelly-fishes, &c.), Vermes (worms), the Echinodermata (sea-urchins, star-fishes, &c.), Mollusca (snails, mussels, &c.), the Arthropoda (crustaceans, insects, &c.), and the Vertebrata (ascidians and fishes to man). The insects belong to that phylum termed Arthropoda, so that the nearest allies to insects, *i. e.*, those belonging to the same phylum, include the Arachnida (spiders), Crustacea (lobsters, crabs, &c.), and the extinct Trilobites.

It is generally conceded by all naturalists that insects stand at the head of the Arthropoda. Their bodies are complicated in structure, and their organs more specialised in the adult stage than those of any other class belonging to this particular phylum. There can be no doubt that the power of flight has led to the great success of insects in the struggle for existence, and that their ability to move rapidly has been the basis of their success in escaping from their numberless enemies, and the proximate cause of their numerical superiority in genera and species. For a similar reason probably—viz. the power of moving through the water rapidly—fishes owe their success over animals that lead an aquatic life.

The Arthropods as a whole are characterised by the body being made up of segments bearing jointed appendages. The segments, too, are more or less clearly divisible into a cephalothorax and abdomen, by which characters they are separated from the Annelid worms. In their internal organs, however, the general character and arrangement of the organs, the position and general shape of the alimentary canal, of the nervous and circulatory systems, agree broadly with those of the Annelid worms, so much so that many naturalists trace the descent of the Arthropods from the worms; others, however, prefer the much safer theory that the two have descended from a common ancestor which possessed the main characters now common to both these groups. As a matter of fact the Arthropod phylum contains within itself such important subdivisions that it is possible it comprises the elements of at least three or four other phyla. Many eminent entomologists have discussed the origin of insects within the Arthropod phylum.

We have no further time at our disposal than to state that by their structure, metamorphoses, and embryology, the Myriapoda and

Insecta stand apart from the Arachnida and all other Arthropods; whilst two singular animals—the *Peripatus* and *Scolopendrella*—appear to connect the insects with the Annelids. The peculiar structure of these animals suggests them as stranded surviving remnants of a multitude of extinct forms, leading up from ancestors, at least closely allied to the Annelid worms, to insects.

The relation of insects to each other has formed the basis of much exact and detailed study; and it is probably the amount of detailed observation made that has led to so much diversity of opinion among specialists, one considering certain characters of importance that are not supposed to be of much value by others. Generally speaking, however, the nature of the metamorphosis has formed the broad basis on which most systems of classification have been founded; and so long as one recognises that the character of the metamorphosis represents the degree of specialisation of the various classes of Insecta, the arrangement based thereon must be considered a fairly safe one. On this basis we have two main divisions, the first comprising two classes whose species are without wings and ametabolous, *i. e.* not presenting any of the ordinary phenomena of metamorphosis.

The second includes the winged forms; but since the degree of metamorphosis which the latter undergo varies considerably, this section is subdivided into the heterometabolous and holometabolous groups,—the former including those orders that have a more or less incomplete, the latter those orders that have a complete metamorphosis. These may be tabulated thus:

- Insecta
  - Synaptera ... ...
    1. Thysanura.
    2. Colembola.
  - Pterygota
    - Heterometabola
      1. Orthoptera.
      2. Dermaptera.
      3. Platyptera.
      4. Ephemeridæ.
      5. Odonata.
      6. Thysanoptera.
      7. Hemiptera.
    - Holometabola ...
      1. Trichoptera.
      2. Lepidoptera.
      3. Diptera.
      4. Hymenoptera.
      5. Coleoptera.

Since, however, as we have stated, this system of classification is based on the phenomena presented by metamorphosis, and we propose dealing later with this subject, we may leave the consideration of the relationship existing between the heterometabola and holometabola until later in the paper.

It would be impossible even to give the barest outline or indication of the biological work that has been done in relation to insects. When we consider the various stages through which insects pass, the complexity of almost every tissue and organ, and remember that every tissue and every organ has been, perhaps, the life-study of

some specialist, one may get a fair conception of the work already accomplished in this branch of our science. Not that these men have studied their subject as entomologists *per se*, but rather as biologists in the broadest sense. It has been recognised for at least a century and a half that a knowledge of the structure and functions of the organs of insects afforded a valuable basis for the further study of analogous organs in the higher animals. The broad principles of insect anatomy and physiology were worked out in the last and early part of the present century by Swammerdam, Réaumur, Lyonet, Latreille, Cuvier, Kirby and Spence, Burmeister, and more recently by Westwood, Huxley, Graber, Brauer, and a host of eminent biologists, and their work can of course be consulted in the ordinary way. Much yet remains, however, to be done even in this direction, especially in matters of detail.

There is no need, therefore, apart from the impossibility, to deal with this branch of entomological science, or even, indeed, one branch of it in detail; and our remarks, put into the form of a survey of a few of the leading facts, must be exceedingly brief.

In all insects the skin consists of a layer of epithelial cells called the hypodermis, which secretes the cuticle, the latter being of varying thickness, flexibility, and durability in different insects. The cuticle becomes hardened by the presence of a substance called chitin, whilst the joints or portions of the cuticle, where movement is possible, remain thin and flexible. This outer covering, then, whilst not interfering with the freedom of movement, forms a more or less solid crust, and is a permanent protection to the soft organs within; at the same time it makes a solid base for the attachment of the muscles. Chitin is a most remarkable substance, practically insoluble under chemical reagents, is rapidly deposited at the end of embryonic life, and quickly hardens on exposure to air. There are numerous pores or canals passing through the cuticle; some of these carry off the secretions from the dermal cells; through others hairs or setæ pass, whilst others are even supposed to have some functional purpose in the aëration of the tissues directly beneath the chitinous covering.

The segments themselves are simply thickenings of a continuous cylinder of skin, and are not independent individual rings or segments. The segmentation of the skeleton, too, is correlated with the serial arrangement of many of the organs, *e.g.* the ganglia of the nervous system, the ostia of the dorsal vessel, the outer openings of the respiratory tubes, &c. In the unjointed worms the body forms a single but flexible lever. In the earthworm the body-wall is divided into a number of somewhat hardened segments joined by flexible intersegmental membranes, so that each section can be moved independently. So similar, in the main, is the structure of many insects, especially the larval forms, that one might well suppose that this metameric structure of worms and insects has been inherited from a common ancestor. The peculiar segmented con-

dition of insects gives them a great freedom of movement, and we may safely assume that the need of a greater freedom of movement has led to their segmentation. The crawling movement of an unsegmented worm-like body would tend to lateral movement, and such lateral strain, acting intermittently or alternately from side to side, would tend to keep certain parts of the body flexible, whilst the more prominent portions to which the muscles were attached would require to be specially protected from injury. This necessity has been met by deposits of chitin, and thus has probably arisen the separation of the more prominent indurated portions of the body-wall from the flexible intersegmental areas, and, as a result, segmentation, as we understand it, has probably taken place.

We have already stated that the overwhelming superiority in numbers of insects over all other terrestrial animals is probably due to the fact that their wings enable them to escape from many animals that would otherwise prey on them. True, many insects have no wings at all, and others only have them in their adult or imaginal state, yet the possession of wings is the important structural feature by which insects differ from all other Arthropoda, and it is well known among entomologists that it is in the wingless larval and pupal stages that the greatest amount of destruction of insect life takes place.

The wings of insects are thin, broad, leaf-like folds of the integument, which are, in reality, outgrowths of the lateral parts of the mesothorax and metathorax respectively. They are moved by powerful muscles, which occupy the greater part of the thoracic cavity. The size of the mesothorax and metathorax depends largely upon the size of the wings they carry. In certain Orthoptera the hind wings are larger than the front pair, and we then find the metathorax larger than the mesothorax. In the Odonata, or dragon-flies, in which there is little difference in the size of the two pairs of wings, there is little difference in size between the meso- and metathorax, whilst in the Diptera, which have only rudimentary hind wings (called halteres), the metathorax is correspondingly decreased in size.

The wings of insects are simple, very thin, chitinous lamellæ, consisting of an upper and lower layer united round the edges, so that in reality each wing forms a closed sac. Between these two thin layers is a fine network of hollow chitinous tubes called nervures. These latter are somewhat complicated in structure, each consisting of a central hollow tracheal vessel encircled by a blood-vessel. The latter in turn is surrounded by the hypodermis of the wing, upon which the outer chitinous wall (consisting of two layers) is spread. The structure of the wings of insects themselves still leaves much room for original study.

I will now invite your attention for a few minutes to the way in which the wings of insects are formed, and for this purpose we will consider them in relation to the Diptera and Lepidoptera, in

which orders the mode of development of the wings has been somewhat fully observed. The wings in certain Lepidoptera, and probably in many other insects, begin to form in the embryo before the larva or grub hatches from the egg. They first appear as folds or outgrowths of the hypodermis, and lie in pouches on either side of the body. In those insects that have no distinct pupal period, as the grasshoppers, the wings begin to appear externally in the third stage of larval life, *i. e.* after moulting has taken place twice; in the holometabolic insects, as the Diptera and Lepidoptera, the wings are not seen externally until the pupal state is reached.

Herold was the pioneer of these studies on wing-structure, and in 1815 he described the "primitive wings or wing germs" in the caterpillar of the cabbage white butterfly (*Pieris brassicæ*) after the third moult. This observer informs us that the primitive wing germs appear on the inside of the meso- and metathorax, and may be recognised by their attachment to the hypodermis, and by their regular symmetrical form, whilst fine tracheæ were observed attached to the wing germs. At the same time Herold discovered the mode of origin of the nervures of the wing, and traced out the mode in which the scales were formed. Earlier observers, Malpighi, Réaumur, Swammerdam, and Lyonet, had observed these wing rudiments in the larva just before pupation under the old larval skin, and although they were observed to be situated in the "fat body" of the larva, without being attached to it or being a constituent part of it, and that they were fastened to the skin in a deep fold which the skin makes at the point of attachment, yet their true nature was scarcely understood. We might here observe that in all those butterflies with prominently developed pupal wings, the wings are specially well developed in the last larval instar. They are particularly noticeable in the full-grown larva of *Euchloë cardamines* and *Anthocaris belia.*

Whilst Weismann was conducting his researches into the embryology of insects (particularly the Diptera, *Musca vomitoria* and *Sarcophaga carnaria*) he observed that the larvæ of these flies had developed wings previous to pupation, and also that the legs, imaginal mouth appendages, &c., were also undergoing development. He then discovered that these various structures—wings, legs, &c.—were developed from minute masses of microscopic cells which he called "imaginal discs." Six of these "imaginal discs" were observed on the venter of the three thoracic segments, and four lateral discs, one on either side of the meso- and metathorax. The former gave rise to the legs, the latter to the wings of the imago. The "imaginal discs" of the wings were afterwards found to be present in newly hatched larvæ. They appear to be from the first in connection with the hypodermis, and are attached to minute tracheæ, forming minute folds of the peritoneal membrane of these tracheæ. These tracheal enlargements increase in size until at last they become differentiated into a mass that corresponds with the

upper part of the thoracic segment, whilst a tongue-shaped rudiment becomes developed into the wing.

It is, however, at the time just previous to pupation, and at the actual time of pupation, that the great development of the embryonic wing takes place. Previous to this the wings have been folded into a lateral cavity; but at this stage the sheath of the rudimentary wings is drawn back, blood is forced in, and the wings are thus everted from the cavities in which they have hitherto been confined. This seems to be one of the many important changes that take place in the larva during the quiescent period preceding pupation. At the actual change into the pupa, however, the imaginal buds extend rapidly along their edges, and the pupal wing is developed as a closed sac, the future growth of the wing taking place during the pupal stage of the insect.

Before entering into a somewhat full consideration of the further development of the wing, and the scales with which some wings are covered, it may be well to notice here that the general principle of wing-development just outlined has been shown to be correct, not only for Lepidoptera and Diptera, but also for the Hymenoptera, Trichoptera, Coleoptera, and Neuroptera. In the ant-lion (*Myrmeleon formicarius*) Pancritius found no rudiments of the wings in larvæ a year old, but they were detected in the second year of larval life, and are said not to differ much histologically or in shape from those of Lepidoptera. In the Coleoptera and Hymenoptera the imaginal buds appear rather late in larval life, yet their structure is like that of those in Lepidoptera.

During the pupal period the wing becomes much corrugated and folded, and scales are developed on the wing surface. How then, it may be asked, does the small, thick, corrugated, sac-like wing, which in the nymph or pupa (or even at the time of emergence of the imago) consists of a series of closely compressed folds, become the large, thin, flat, leaf-like structure which we see in the perfect insect?

In the pupal wing considerable growth and development take place in various ways. Among other structures, the inner surfaces of the upper and lower layers of the wing membrane give rise to a number of vertical prolongations, which finally meet each other in what is termed the ground membrane of the wing. These vertical fibres, then, stretching from one membrane to the other, prevent the two surfaces from separating widely from each other, and also maintain them at a fixed distance. When, therefore, the hæmolymph or blood is forced between the membranes of the wing by the insect, it does not cause the wing to swell out so as to form a balloon-shaped sac or bag; but the processes holding the two membranes of the wing closely together cause the blood to be spread equally and the folds to be gradually unrolled from the base outwards by the pressure exerted by the blood. When the wings have attained their full size the hæmolymph coagulates, the upper and lower layers are still more closely united, and the nervures are solidly buried between them.

The application of the term Lepidoptera, or "scale-winged," to the order that includes the butterflies and moths has begotten the popular but erroneous idea that only these insects have scales. Scales are only modified hairs, and Semper has proved beyond question that their mode of origin is quite identical, whilst even in some larvæ the hairs become flattened and scale-like. True scales are characteristic of the Synaptera and Lepidoptera, yet they also occur in Trichoptera, in Psocidæ (*Amphentomum*), in many Coleoptera (*Curculionidæ*, *Cleridæ*, *Ptinidæ*, *Dermestidæ*, *Scarabæidæ*, *Cerambicidæ*, &c.), in the Culicidæ, and a few other Diptera. At the same time it may be well to notice that whilst many species in all these latter orders are without scales, not a single species of the Lepidoptera is known in the imaginal stage to be without them.

When the pupal wing is undergoing development certain large nucleated hypodermal cells in the wing may be observed to undergo a certain amount of elongation, the elongations projecting beyond the surface of the wing. The cells thus developed are placed at regular intervals on the surface of the wing, and the prolongations at last form regular rows on the surface. It is at this time that the hypodermis of the wing is thrown up into a series of regular ridges which run across the wing. Each of these ridges carries on its summit a row of the prolongations, or primitive scale-cells as they really are, whilst the furrow between two adjacent ridges represents the interval between two rows of scales. The scales always project from the tops of these ridges.

The scale-cell increases rapidly in size, flattens out, and finally assumes the outward shape of the mature scale. A layer of chitin is then secreted over its entire outer surface, so that the scale becomes a thin, flat, chitinous bag, filled with protoplasm, the chitin upon the upper surface being striated, the lower surface smooth. Many scales have two sets of striæ, a well-developed longitudinal set and a finer transverse set. These striations diffract the light, and give rise to the iridescent colours that many scales, particularly those of Lepidoptera, exhibit.

So long as the scales remain filled with protoplasm they are quite transparent; but the protoplasm afterwards becomes coarsely granular, and appears to give place to a secretion from the hæmolymph which contains the necessary material for the elaboration of pigment, the white coloration being quite different from the opaque whiteness noticeable in some air-filled scales. This secretion from the hæmolymph does not appear to enter the scales which will be finally white (due to air contents), but does in many species enter other scales without undergoing any further differentiation. These scales remain white, although under the influence of certain chemicals—ammonia, &c.—the white is readily changed to a cream or yellow tint, *e. g.*, the white of *Melanargia galathea*, of *Polyommatus corydon*, &c. This material has been designated "pigment-factor." by Riding. In those pigmented scales which do not remain white, the secretion

or pigment-factor soon becomes ochre-yellow in tint, and having remained in this stage from twenty-four to thirty hours, the mature colours begin to show themselves.

The scales of insects, which vary much in shape, are hollow and loosely attached to the surface of the body or wing by a short, slender pedicel which fits into a minute, close-fitting socket that perforates the wing membrane. Their surfaces have frequently an elaborate series of longitudinal ridges, marked with striæ, and with transverse striæ between them. The primary use of scales is undoubtedly to protect the body, but the secondary uses have become as important as, or perhaps more important than this. The two most important of the secondary uses to which the scales have been put are—(1) the formation of the colour patterns by which the insect is protected, either by the similarity these bear to the environment of the insect or by their startling nature, so that when suddenly exhibited to a would-be enemy the latter is sufficiently taken aback to give the insect a chance of escape; (2) by their modification into androconia or scent-glands in certain male insects, thus forming an important secondary sexual character, and increasing the chance of procreation in the species.

We may now consider very briefly the nature and uses of the colours of insects, and may at once state that these arise in one of three ways: (1) by interference, (2) by diffraction, (3) by the presence of pigment within the scales. The physical structure of the body-surface, wing-surface, or scale-surface may give rise to interference or diffraction colours, or both. We have seen that the body-surface, wing-surface, and scale-surface of insects is composed of chitin, and Schneider tells us that the latter consists of a number of irregular laminæ of exceeding thinness, and as these layers are superimposed upon each other, we have at once the layer of thin transparent plates necessary to produce interference colours. We have also seen that the chitinous surface of the body or wing or scales is frequently covered with exceedingly fine ridges and striæ. Kellogg says that there are some 500 striations to the millimetre on the scales of the imagines of *Micropteryx* (one species of which, of a metallic green colour, is abundant in the month of May in the flowers of buttercups), and as many as 1400 striæ to the millimetre on the scales, of the fine tropical butterflies belonging to the genus *Morpho*. The continually changing colours of many insects, as the position of the insects is made to vary, are due to diffraction.

The third way in which the colours of insects may be developed is due to pigment deposited in the cells of the cuticula or on the inner surface of the scales. Mayer has shown that when the protoplasm is withdrawn from the scales of Lepidoptera at the time of their formation a secretion of hæmolymph enters, and deposits on the inner surface of the scales a material which varies in different species and in different parts of the same wing, and has the power of absorbing certain rays of light and reflecting others, and thus giving us the

colour impression we observe. Colours produced in this way we call "pigmentary."

Mayer's demonstration that the pigmentary matter deposited in the scales of Lepidoptera is a derivative of the blood secreted at a time when the histogenesis of the tissues of the imago has been completed within the pupa, gives a hint as to the actual nature of pigments. They would appear to consist of the nitrogenous material or waste present in the blood left after the building up of the essential tissues of the insect, formed into definite secretions, which the insect is enabled, as pigment, to get rid of in a purposeful manner. It must not be forgotten that all the vital activities of the pupa are taking place in a multitude of ways in a closed cell; that no waste can be excreted, there being no outlets in the pupa for this purpose; and therefore the new combination of chemical elements which forms the tissues of the imago must balance to a nicety those that existed in the very different structures of the newly-formed pupa. It is well known that almost all newly emerged lepidopterous imagines void one or more drops of fluid with a uric base after emergence from the pupa. This must be the residue of the material not utilised by the vital functions accompanying the processes of histolysis and histogenesis.

Many years ago Meldola demonstrated that the yellow pigment of *Gonepteryx rhamni* was soluble in water, and that the aqueous solution had an acid reaction. Krukenborg discovered that in the blood of different beetles and lepidopterous pupæ there were various colouring matters constant in different species, and readily recognisable under the spectroscope, and specially noted the yellow-brown lymph of *Attacus pernyi* and the yellow-green lymph of *Saturnia pyri*. Hopkins has shown that the yellow pigment in certain Pierid butterflies is a derivative of uric acid; and Griffiths has demonstrated that the green pigment found in several species of *Papilio*, *Limenitis*, as also in various Sphingid, Geometrid, and Noctuid species, also consists of a derivative of the same product. This has been termed "lepidopteric" acid. We have already shown how these uric pigments must arise as the result of the vital activities of the pupa during the time that the imago is being developed.

It is impossible, in the time at our disposal, to enter any more fully into this phase of the subject. One thing appears quite certain, however—viz. that the nature of the pigmentary deposit is as characteristic for each individual species as are the shape and structure of the scale in which it may be deposited. With those who consider that the colours of insects originate within the insects themselves we are inclined to agree, since there can be no doubt that the nature of the pigmentary deposits and the scale-structure determine absolutely the colours of the insect. With those who ascribe the phenomena of colour variation to internal causes we should agree so far—and only so far—that a difference of physique, and consequent available energy, would necessitate a difference in the quality of, or a

difference in the relative quantities of the materials composing the pigment. Many ill-pigmented specimens of Lepidoptera, probably resulting from this cause, frequently come under one's notice. When, however, naturalists ascribe the origin and modification of pattern to these internal forces, we disagree most strongly; for, whilst the formative material of the patterns is undoubtedly the result of internal activities, the arrangement of the material is, in my opinion, and as I have elsewhere discussed at length, due to utility, and has been brought about and perfected by natural selection. This, of course, brings us to the threshold of the absorbingly interesting subjects of mimicry and protective resemblance—matters quite outside the possibility of consideration in so short a paper.

One other aspect of our subject, however, has been much studied of recent years, and can hardly be altogether passed over in silence. I refer to the phenomena attending the "metamorphosis of insects." Striking as are the changes of form through which the embryo passes before leaving the egg-shell, the changes that these insects, with a complete metamorphosis, subsequently undergo are almost equally remarkable. The cause of these changes is undoubtedly to enable them to lead a different mode of life, and to adapt them to the changed conditions that characterise the mode of life adopted at various stages of their existence.

The post-embryonic life of a winged insect, such as a fly, bee, &c., is divisible into three stages—the larva, pupa, and imago, the term metamorphosis being applied to the changes that take place during the post-embryonic stages of life. The larva of such an insect (fly, bee, butterfly, beetle) lives an entirely different life from that led by the pupa of the same animal, and this again differs from that led by the imago or perfect insect; so that the insect in its three forms leads to all intents and purposes three distinct lives, existing under entirely dissimilar surroundings, and necessitating entirely different habits. To enable it to do this the organs themselves have to undergo considerable modification. Certain structures useful in one stage may be useless in others, and hence disappear (*e. g.* the lepidopterous prolegs); others are modified entirely in character, owing to different requirements in the mode of use (*e. g.* the mouth parts); again, others arise, as it were, suddenly from structures previously in a very rudimentary state (*e. g.* antennæ and wings). The changes that take place at a metamorphosis occur not only in the external body and its appendages, but also in the internal organs, the changes extending sometimes not only to the shape and general external character of the organs, but also to a difference in function.

All insects do not undergo the same degree of metamorphosis. The differences between the larval, pupal, and imaginal condition of Hymenoptera, Coleoptera, Diptera, Lepidoptera, and Trichoptera are very marked; but to the early stages of the Heterometabola—Orthoptera, Hemiptera, Odonata, &c.—the term larva and pupa are scarcely applicable. Many naturalists use the term "larva" for the early

stages of the insects included in those orders characterised by their species having an incomplete metamorphosis, and the term "nymph" to the active pupal stage preceding the appearance of the imago. Many others, however, employ the term "nymph" to include all the early stages between the egg and the imago. The "nymph" in this sense, then, when applied to such insects as grasshoppers, &c., denotes the young which lead an active life up to the time of the final development of the perfect insect, that quit the egg in an advanced condition of development, having regard to their powers of locomotion, and that have at this time the mouth parts formed after the same type of construction as those of the adult insect. We have, then, so far seen that there are two distinct conditions of metamorphosis in insects—that represented by the Orthoptera and that represented by the Lepidoptera.

In the Synaptera (*i.e.* insects without wings), however, development is direct, the young differing neither in form, structure, nor habits from the adult. Hence such insects are said to be ametabolous; and since these insects show no tendency whatever to undergo any transformation, it is quite clear that metamorphosis is a phenomenon that has been induced in insects since the first winged forms appeared, and our knowledge of its details suggests that it has been intensified with the specialisation of the most highly developed orders of the class. As we have already said, the transformations of winged insects vary in degree, and they fall naturally into the two groups—the Heterometabola (with incomplete metamorphosis) and the Holometabola (with complete metamorphosis). In the former we have observed that the adults differ from the freshly hatched young chiefly in having wings; they have no inactive, resting, or pupal stage, and the wings are only acquired after successive moults. We have also seen that the orders belonging to this group comprise the Orthoptera, Dermaptera, Platyptera, Ephemeridæ, Odonata, Thysanoptera, and Hemiptera. To illustrate this mode of metamorphosis any common grasshopper will serve our purpose. Many of these have five moults, and six stages or instars, five of which belong to the nymph stage. In the first two stages there are no rudiments of the wings; these appear after the second moult. This development of rudimentary wings is accompanied by slight changes in colour and size, and similar changes occur at each moult, until, in the adult, the full mature colouring and completely formed wings are developed.

It is, however, in the phenomena presented hy the metamorphosis of the Holometabolic section of insects that most interest centres. In these the larva undergoes a definite number of moults or exuviations of the skin, generally constant for the same species, although female larvæ frequently have an instar more than those of the males. After each moult there is generally a considerable change, and hence in many larvæ each stadium (or period between two moults) is characterised by a particular form of armature or plumage.

The term "larva," then, is specially applicable to the young of the

holometabolous orders of insects. The word literally means a "mask," and was applied to the caterpillars of butterflies and moths by the old philosophers, because they considered that the larva masked the later stages; that, in fact, the larval skins enveloped the pupa, and this the imago, and that having shed its normal number of skins, the imago, always present within the larva and pupa, was liberated. To a certain extent this idea of the old naturalists was accepted until comparatively recently, but was completely overthrown by Weismann's discovery of the imaginal discs in the larva and the mode of their development. This discovery has, of course, completely changed our ideas of the nature of metamorphosis, and revolutionised our knowledge of the fundamental processes concerned in the change from larva to pupa, and from pupa to imago.

We have already referred to the periodical moults or sheddings of the skin that larvæ undergo. Previous to exuviation taking place the larva indulges in a prolonged rest; later the old skin splits in the region of the head, and gradually, and usually without any apparent effort on the part of the larva, the skin slips back over segment after segment until it is completely cast. With the exception of a series of almost imperceptible vermiform movements of the segments the larva appears to be taking no active part in the process, the skin slipping off as the larva advances much like a glove is slipped off the finger. There is a fluid circulating between the two skins just previous to the moult, and this acts as a lubricant during the process, and there is no doubt that the development of the hairs and other cutaneous structures beneath the old skin facilitates the change. When the larva has just completed a moult its skin is exceedingly soft and delicate, but the latter soon hardens. Not only is the integument shed with its hairs and setæ, but linings of all internal organs that have had an ectodermal origin (*e. g.* the tracheæ, mouth lining, and part of the alimentary canal) are cast with it. In the apodous larvæ of certain Hymenoptera, bees, &c., the delicate skin is not shed whole, but breaks away in shreds or fragments during the process of moulting. The old notion that the larva shed its skin because it was no longer large enough for the growing animal is not now accepted. There can be little doubt that moulting is really an excretory process, by means of which the accumulation of waste matters is periodically got rid of.

It is necessary now to return to the subject which we recently left, viz. that relating to the actual development of the imago of the Holometabolic insects. Herold was the first author who objected to the erroneous theory, held by Swammerdam and others, that the newly-hatched larva had in it at the time of birth all the parts of the larva, pupa, and imago, each of which became visible in turn at every subsequent moult. As we have before mentioned, however, it was not until the real nature of the internal changes was discovered and explained by Weismann that any radical difference of opinion as to the nature of metamorphosis was accepted by natu-

ralists. This biologist showed that a process of histolysis was set up in the larval tissues of certain Diptera, that these tissues were entirely destroyed, and that from the resulting elements of this histolysis the new organs were built up, the growing imaginal buds utilising the histolytic products of the larva for their own nutrition. Although his researches were confined to the *Muscidæ*, his observations and conclusions were soon found to have a much wider and more general application.

The imaginal discs of Weismann are, as we have already said, separate cellular masses or folds which give rise to the appendages, wings, and other parts of the imago. They arise from the hypodermis, are usually present in very young larvæ, sometimes even in the later embryonic stages. Such imaginal buds have been shown to exist for each part of the body, not only for the appendages and wings, but also for the different sections of the digestive canal and other internal organs. During the quiescent stage preceding pupation these discs commence to enlarge, whilst at the same time there is a destruction of the larval organs, the latter being due to the activity of the leucocytes or blood-corpuscles. This continues until most of the larval tissues are reduced to a creamy mass, the imaginal buds, however, remaining unchanged in character, but, on the other hand, utilising for their own growth the material that the histolytic process has produced. These two processes of histolysis and histogenesis go on side by side, and of course are not completed until the final formation of the imago within the pupal case. Some of these discs undergo their development in the early, others in the later, stages of the pupal period.

An explanation of the process of the development of the imaginal buds into the various imaginal organs would involve far too much detail to be included in this paper. We must, therefore, bring to a conclusion our remarks on metamorphosis, and will do so by summarising the principal points that relate to its origin. These may be stated as follows:—(1) The Synaptera or apterous insects have no metamorphosis, the winged insects only undergoing the changes already described. This would suggest that metamorphosis *per se* was not inherited from the primitive ancestor of all insects. (2) The earliest and most primitive orders of winged insects pass through a slight metamorphosis only; but as the adults of certain orders became more specially adapted to get their food whilst in the air, and in a manner totally different from that by which they obtain it during their larval existence, the metamorphosis became more complete. (3) The advantage accruing from metamorphosis in such orders as Lepidoptera, Hymenoptera, Diptera, and Coleoptera is evident from the vast number of species that have been developed and are now in existence. (4) The fossil remains of insects suggest that in the Palæozoic period ametabolous and heterometabolous insects alone were in existence. The holometabolous insects are much newer and are much richer in the number of species than

the older forms. (5) The great abundance of species in these orders shows that metamorphosis is a great advantage to insects in the struggle for existence. The period of exuviation is, in all Arthropods, a very critical one, and they are at that time more than usually helpless before the attacks of their enemies. The holometabolous insects, by their power of storing up surplus food (fat-body) in the larval stage, which they can use at leisure for their further development in the pupal stage, by their power of hiding within cocoons, &c., without the necessity of seeking food during this critical period, are able to undergo the necessary changes in their organisation with a minimum of exposure and risk.

Metamorphosis, then, appears to be an adaptive habit which certain insects have adopted in their struggle for existence against those enemies by which they are everywhere surrounded, and against those animals that compete against them for food. The habit of flying, by which they are able to escape from numberless enemies that have not this power, was probably one of the first factors in their development that led to their ultimate success. The additional ability to store up food in the early active (larval) stages of their existence, so as to allow them to adopt a hiding habit and quiescent external form at the most critical period of life, must, however, have been the proximate cause of that success which has culminated in their being numerically the most successful types of terrestrial life in existence, the number of species being almost incredible.

Gentlemen, I am afraid this is very bare and very meagre,—an attempt, perhaps, to cover too much ground in a limited time ; still I trust the time occupied will not have been altogether wasted. I trust that I have been able to show you that there are branches of entomology still rich in treasures for the worker, that there are views of entomology beyond the destruction of our fauna, and that material should be collected only for a definite scientific purpose and end, and not accumulated to kill time, or because it will have a money value some day.

Lazy Days by the Sea (chiefly concerning Lepidoptera).

By Robert Adkin, F.E.S. *Read October 27th*, 1898.

Whether it is the sudden release from the everyday cares of business routine that engenders a desire for absolute indolence, or the familiarity of one's surroundings on going frequently to the same place for one's annual holiday that inspires a feeling that there is not much to be gained by unduly exerting one's self, I know not; but I am fully conscious that on the occasion of my visit to Eastbourne in July and August last I felt no keen inclination to take any great amount of physical exertion, but rather to amuse myself by noting such facts and queries as came in my way whilst strolling about the vicinity of the town, inhaling the delightfully fresh sea breezes, or basking in the glorious sunshine which prevailed during the greater part of the fortnight or so that I was there.

One thing that particularly struck my attention was the comparative scarcity of butterflies met with on my daily rambles. Of course there are exposed parts of the Downs where one does not ever expect to find any great number; but there are also many sheltered nooks, such as the undercliff between Holywell and Beachy Head, where they are often, I may say usually, to be found in great profusion. Time after time I traversed this particular bit of ground, both during sunshine and when the shadows fell in the late afternoon, but always with the same result. At first I thought that the season being a late one, I must be too early for them, but this could not apply to the later days that I was there. The fact was brought more particularly to my notice by the circumstance that our fellow-member Mr. Lachlan Gibb of Montreal, who was staying in this country, was spending a couple of days with me, and expressed a wish to renew his acquaintance with the "Blues," such as we had collected over this same district many years ago. Leaving home in the early afternoon we made our way to Beachy Head (on the summit of which, by-the-bye, we saw the only specimen of *Vanessa cardui* that came under my notice while I was at Eastbourne), and descending by the path to the edge of the cliff, we reached the undercliff just as the sun was getting behind the hills and the "Blues" settling down to rest, just the most favourable time for taking them; but although we searched diligently, and found both *Lycæna corydon* and *L. icarus*, we hardly completed a score between them, although I had often in other years found them by hundreds. *Pieris brassicæ* and *P. rapæ* were, of course, to be seen wherever one went, the former predominating, and becoming, I hear, somewhat abundant in the neighbourhood after I had returned to town.

Epinephile ianira was noted in some numbers, but *Satyrus semele* was a comparative rarity on the down sides, where it is often one of the most abundant species. A few *Cœnonympha pamphilus*, two or three odd examples of *Polyommatus phlœas*, and the like of *Vanessa urticæ* complete the list of butterflies that came in my way, but doubtless the number of species might have been increased had the more inland districts been traversed.

So much has been said and written of late regarding the drinking habits of butterflies, that had not the following incident, which came under my notice, been unusually well demonstrated, I should have hesitated to record it. The morning of August 2nd was warm and sunny, with hardly a breath of air stirring, and to fill in an odd half-hour I strolled along the centre parade in front of the town. The path here is made of very fine shingle and chalky earth, and, to keep it in suitable order for the promenaders and others, who at times do congregate thereabout, is watered each morning and afternoon by means of a diminutive water-cart drawn by a couple of men. I had leaned my back against the rail, and was looking dreamily at things in general and nothing in particular, when one of these water-carts was drawn along, and my attention was attracted by quite a number of white butterflies that were following it; one and another of them would settle down from time to time on the freshly watered path, and I had no difficulty in approaching them, whilst thus settled, sufficiently closely to distinctly see them sucking up the drops of wet mud made by the water falling on the dusty surface of the ground. The operation was often repeated, a resting butterfly rising and following the falling water for a time, and then settling down to drink again. I also noticed that as the water-cart passed along, a butterfly would occasionally flit out from among the tansy that grows luxuriantly on the banks, and join those that were following the cart. The incident brought to my mind a similar one that came under my notice in the streets of the same town some years ago; but I was not then able to observe that the butterflies, though settling on the damp ground, were actually drinking, as they undoubtedly were in the present instance (*Proc.*, 1887, p. 68).

Perhaps there is no harder work to be found than the arduous task of doing nothing. When one is ostensibly taking a holiday many opportunities will occur for attempting it, but I will venture to say that a very few minutes' trial will fully satisfy any ordinary being of the difficulty of such an undertaking. At any rate, that has been my own experience; and possibly it was the desire to get away from such a hard task that led me to wander around the highways and byways of the town, seeking what its walls and gate-posts might reveal in the way of resting species. Eastbourne, so long as I can remember, has always been a good place for the two common species of *Bryophila*, but of late years *B. muralis* appeared to me to occur much less commonly than formerly; indeed, so few examples came under my notice when I was there two or three years ago that

I had great fear that the excessive cleanliness of the householders of the sea front was positively exterminating the species, an opinion which I think I ventured to express to you at the time. Formerly the "compo" gate-posts were the places where it was most frequently found; but these said posts having been painted or hearthstoned, or otherwise cleaned, the conclusion that *muralis* had been cleaned away also was not unnatural. At any rate, I had made several tours of inspection of these said gate-posts, having visited them almost daily for a week or so, without finding a solitary example, when we happened to get a dull, windy day, and several *B. muralis* were found, together with an unusually large number of *B. perla*. I did not at the time in any way connect the presence of the insects with the state of the weather, for the positions in which they were found were often by no means sheltered, but subsequent experience suggested to my mind very plainly that it was a case of direct cause and effect. The walls of an old bridge a mile or two out of the town have been a favourite place for *muralis* as long as I can remember, and on making a pilgrimage thither to see whether they would still prove as fruitful as formerly, one imago only was found; but a careful scrutiny of the recesses in the walls easily brought to light a considerable number of recently vacated pupa-cases, and fully a couple of score that contained living pupæ; these varied very much in size,—so small indeed were some of them that I thought they must be *B. perla*, but not one of that species was bred from them, nor have I ever taken it on these particular walls. It was while I was returning from this expedition that the thought occurred to me that it would not be very difficult to see whether there were any *Bryophila* cocoons on the posts on the sea front of the town where we had found the imagines already referred to. *Bryophila* cocoons are not easily seen, I admit; but with a practised eye, plenty of patience, and the aid of a not too sharp penknife, one may in time clear almost any get-at-able wall of most, if not all, the cocoons upon it. I therefore determined to make a thorough inspection of the posts and intervening low walls along the front. Selecting such times as the roadway was least frequented, I went over them leisurely from end to end, with the result that I found only one cocoon, and that fully half a mile from the spot where I had found the few imagines; and this cocoon, judging from appearances, was probably an old one, and possibly had been there for several years. I was not surprised at this negative result, for, as I have before mentioned, the posts had been so often cleaned that few of them had any growth of lichen at all upon them. Where, then, did the insects that one occasionally found on them come from? On passing my experiences of taking them through my mind, it came to my recollection that it was on windy days that they were found, and on windy days only. The obvious suggestion, therefore, was that they had been dislodged from their natural resting-place, wherever that might be, by the wind, and had settled down on the first spot that

afforded them necessary protection. This led me to look higher up on the house fronts; but although one may be gifted with fairly long sight, to say whether the darkening of the compo some fifty feet or more from the ground on which one stood was caused by the growth of lichen, was too much of an undertaking. But it so happened that in the house where I was staying I occupied a bedroom on the second floor, and as the lower rooms had bay-windows, which my room had not, I was enabled to get out of my window on to the roof of the bay and examine the coping, which, although out of reach, was not many feet above my head. Here I found not only a considerable growth of lichen, but was also fortunate in detecting a perfect insect resting close by it. Here, then, was the solution of the problem, and it is interesting to know that although the species may be exterminated from its lower feeding grounds, it is unlikely that anything short of pulling down the whole of the houses on the sea front of the town simultaneously would materially affect its numbers. The specimens exhibited include a bred series and one of captured examples; each, it will be noticed, vary considerably both in colour and the intensity of their markings. The former includes some miniature specimens bred from the small pupæ before mentioned, one of which is exceptionally dark and devoid of green coloration, being simply a grey and black insect; but none in the bred series are of the pale buff colour that some of the captured examples are, and I am inclined to think that this form, which is frequent among captured specimens, is the result of fading. *B. perla* is a decidedly commoner species in the district than the last-named, and may be found on almost any old wall in the town, though more abundant on the sea front than further inland. It appears to run into a local form, having an appreciable amount of buff tone in the pale ground colour. The series exhibited included the lightest coloured specimens taken this year, and the majority of them show a decided buff tone when compared with a series taken at Poole, in Dorset, last year, which I have placed beside them for comparison.

Another species that has interested me very much in previous years is *Acidalia marginipunctata*, and it is needless to say that a sharp look-out was kept for it; but, being some couple of weeks earlier in the season than I had been in recent years when I had found the species, I hardly expected to meet with it. My wanderings in quest of it were, however, not altogether fruitless, as on July 27th I met with an unusually large, much-wasted example, sitting on the stones as usual, a monument of an early brood, which had evidently passed, and of which I had never previously been fortunate enough to find even a trace. The only other example seen was on August 2nd. This was resting just out of reach, and an attempt, after having a good look at it, to get it under a pill-box simply disturbed it, and it was lost. It, however, had the glossy appearance of a specimen just fresh from pupa, and, I have little doubt, was an early example of the later brood (see "Proc.," 1896, p. 108).

Some years ago Mr. South, while collecting along the downs under Beachy Head, took some larvæ in shoots of *Rosa spinosissima*, from which he bred an interesting form of *Peronea permutana*. I have often since that time searched the scrubby bushes of the plant that grows sparingly on the banks all along the hollows of these downs; but although there were the most distinct evidences of the larvæ having been there, sometimes quite plentifully, I had never succeeded in taking one—I had always been too late. The present season being a late one, and the time of my visit somewhat earlier than previously, I thought I should have a good opportunity of finding some larvæ. I accordingly devoted an afternoon to the back-aching task, and had the satisfaction of finding a fine full-grown one; but it was the only one, all the other shoots had been deserted. Yet it is some satisfaction to know that the food-plant still flourishes in the district, and that the insect retains a footing in it.

It is now upwards of twenty years since I journeyed to Eastbourne with my friends Lachlan Gibb, and the late George Shearwood, with the expressed intention of having a day among the Pyrales. It was a glorious day at the later part of July, and I shall never forget the wealth of life in that particular group that we met with. The whole day was spent on the rough cliff front between the Wish Tower and the chalk-pit near Holywell, and long before it was time to return every box we had was filled twice over. How different has it been of late years! The whole of these rough cliff banks have been turned into parades and roads, and although the Pyrales held a footing on the more distant cliffs and downs for a time, my experience of recent years appeared to show that they were year by year diminishing in numbers, until I feared, when in the neighbourhood two years ago, that they had disappeared altogether. Happy, therefore, was I to find that my fears were unfounded, at any rate so far as two of the species formerly most common are concerned. Of these, *Stenia punctalis* was the more abundant. On the memorable occasion just referred to it was met with in the utmost profusion, numbers flitting up out of the herbage at every step that one took. For some years afterwards, although the greater part of its domain had been destroyed, it affected a small piece of waste ground that remained in its vicinity, but appeared to be diminishing in numbers year by year, and in 1896 I failed to find it. This summer, however, it again occurred there, although sparingly, and I was glad to find another and larger colony a couple of miles further along the coast, where it appears to be in somewhat greater plenty, and where it is subject to considerably less chance of disturbance. Odd specimens may be found over the greater part of the ground between the two places referred to, but it is only in sheltered spots having fairly thick cover that the species appears to exist in any numbers. *Odontia dentalis* used to occur, although somewhat sparingly, with the last-named species, but I have not met with it in the district for many years. I have not, however, lost all hope of yet finding it, as its food-plant,

the viper's-bugloss (*Echium vulgare*), still grows in many places on the downs. The other common Pyrale was *Botys flavalis*, a species of very different habits from the before-mentioned, frequenting the exposed downs, and formerly occurring pretty generally all over them, but of late years appears to have totally disappeared from those near the town, and it was quite by accident that I met with it this year.

The 1st of August, being a fine day with but little wind, provided an opportunity that I had long wished for of making a trip round Beachy Head by rowing-boat. It is not an undertaking that I would recommend to any one not pretty well used to boating, as the coast is, to say the least of it, an awkward one, being fringed by rocks all the way, and long spits of them run out into the sea for a mile or so at intervals. At high tide these are well covered; but, as we were avowedly spending a lazy time, we had no ambition to make the double journey against tide, and to avoid this one has to make a start when it is approaching low water; but even then, by a little careful manipulation, one may manage to slip through gaps in the reefs, and thus keep fairly close to the shore all the way. This we did without any great difficulty, and the grandeur of the scene well repaid us for any risk that we may have incurred. I had often gazed down from the giddy height of the cliff to the sea beneath, I had rounded the "Head" on steamers at a respectful distance from its rock-bound coast, but never, until I found myself dancing on the wavelets in a frail skiff at its foot, did I appreciate the majestic grandeur of that five hundred feet or so of sheer white cliff. Continuing our journey, we eventually reached Birling Gap, and having landed and hauled our boat a safe distance up the beach, we made our way up through the "Gap" on to the cliff, which, as the name of the place implies, is here quite low, to wait the advent of the young flood to help us on our way back to Eastbourne.

It was then getting towards late afternoon, the sun shining obliquely on the hill-sides, when, as much to "kill time" as anything else, we started to walk over the undulating downs in the direction of Cuckmere Haven. We had not gone many yards when I noticed a bright little moth jump up from the low soft herbage, flit a little distance, and settle down again; then another and another. The place was veritably alive with them. I had little doubt as to the species, yet wished to make certain of it, but being avowedly on a boating expedition, the only collecting tackle I had with me was a nest of four glass-topped boxes. I managed, however, by a little judicious "stalking," to secure one of the moths in one of the boxes, and there I beheld, sure enough, my old friend *Botys flavalis*. To fill the remainder of the boxes was only a work of time, not on account of the moths requiring looking for, but by reason of the difficulty of persuading a Pyrale, when "on flight," to rest long enough to admit of a pill-box being placed over it, especially when one comes to the smaller sizes of the nest. *Lithosia complana* was also on the

wing, and I have no doubt that a considerable number of species might be found on these little-frequented downs if they were properly investigated.

With regard to plants I have little to say, but I could not help noting the remarkable way in which the common centaury (*Erythræa centaurium*) accommodates its method of growth to its surroundings. On the lower parts of the downs, where there is a fairly luxuriant growth of herbage, it is met with as a fine erect plant of some eight to ten inches in height; but on the higher parts of Beachy Head, where the herbage is much walked over, and consequently very short, the stem of the centaury is also so diminutive that the flower-head has the appearance of springing directly from the ground. This dwarf form has, I believe, been described by some authors as a distinct species; but one has only to follow the growth of the plants as they occur on the various parts of the downs to see that the gradations of height follow so closely upon one another, from the tallest in the hollows to the shortest on the down tops, that it is impossible to say where any dividing line can be drawn. In a field that I believe was supposed to be cropped with oats, but the chief produce of which was scarlet poppies (*Papaver rhœas*), I found one plant of that species having pure white flowers, and at a short distance from it one in which they were intermediate,—not that they were pink by the blending of the two colours, but scarlet flowers with a considerable amount of white splashing. On visiting Alfriston, the quietest village that I ever set foot in, I noticed that the mullein (*Verbascum*, sp.) was growing luxuriantly out of the hard stone wall of the parish church. I believe the plant is occasionally found in similar situations, but it was its unusual robustness that attracted my attention in this instance.

I have, if my memory serves me, referred on a former occasion to the immense number of snails (*Helix aspersa*) that harbour in the ivy-covered walls of the Eastbourne parades. In dry weather not a snail is to be seen; but it happened that one afternoon, after a couple of hours' steady rain, I was strolling along one of the upper walks when I came to a spot where a grass lawn reaches to the top of one of these walls. For some reason, best known to themselves, the snails appeared to have congregated at this particular spot, and were making their way across this piece of grass in a steady stream. There must have been many hundreds of them, all moving in one direction as fast as they could crawl. The probable attraction was some flower-beds at the opposite side of the grass, some ten or twelve feet away from the wall, but the plants in the beds could not be seen by the crawling snails, nor was it likely that a sense of smell could have influenced them, as the wind was blowing from the snails towards the flowers, and would therefore take the scent away. What then could have influenced the snails to all take the one direction?

As you will have gathered from the title of this paper, I make no pretence to having worked out any special points or new features in

regard to the subjects that I have touched upon, but simply to record the impressions produced upon my mind whilst taking a few days' rest at the sea-side. Necessarily they have taken the form of sundry more or less disjointed sentences, the only connection between them often being that they refer to a comparatively short time and to one locality. I trust, however, that they may not be altogether devoid of interest.

AN ADDRESS TO THE MEMBERS

OF THE

South London Entomological and Natural History Society.

IT has been the custom of my predecessors in this chair to bring their year of office to a close by addressing to you a few words on the subject we have so much at heart. I do not propose to break through so excellent a time-honoured custom, and if I am unable to reach the high level set in some previous Presidential Addresses, at any rate I trust I may be able to interest you in a subject that has occupied the attention of some of the greatest intellects of this century—a subject that will make the nineteenth century famous in the annals of science, that has opened up to us new intellectual enjoyments, that has peopled with living beings the dark ages of the past, and that has led us to have a clearer conception of the organic beings around us, not even excepting man himself.

I may premise, however, by referring to the fact that we are, in name at least, a Natural History Society, in practice we are essentially an Entomological Society; and when one looks through the now extensive list of past Presidents one is struck with the fact that with scarcely an exception each has been essentially an entomologist, and we know that however interested they may have been in natural history generally, their serious work has been devoted to the study of insects, and to these almost alone. If I follow in their footsteps and base my remarks more particularly on insects, it will be for the same reason that I am an entomologist first, and a general naturalist only by the courtesy of those who do not expect too much from those so called.

In spite of this I should like to make a few remarks on the study of natural history, and the intellectual pleasure to be derived therefrom. Huxley once said: "The value of any pursuit depends upon the extent to which it fulfils

one or all of three conditions. Either it enlarges our experience, or it increases our strength, or it diminishes the obstacles in the way of our acquiring experience and strength. Whatever neither teaches, nor strengthens, nor helps us, is either useless or mischievous. The scientific calling, like all others, must be submitted to these tests, if we desire fairly to estimate its dignity and worth."

Supposing we follow up Huxley's dicta, and apply the principles involved to our own particular study, that is to natural history as a science, not the mere dilettante view of nature, but to the careful observation of the facts around us, to the careful working out of the life-history of some one organised being through all the numerous cycles of change to which it may be subjected, to the actual classification of the facts observed, and to the formation of logical conclusions based on the facts at our disposal. The study of natural history as a science may be considered under a variety of heads, of which the chief may be resolved into: (1) Its scope as mere knowledge. (2) The discipline gained in the acquisition of knowledge. (3) The power which the student gains in being able to utilise natural laws to the attainment of his own ends.

The mere acquisition of knowledge in itself gives no mean return for the time spent. Scientific study is continually opening up some new source of intellectual delight. Science, considered as power gained, is always improving the conditions of our daily life, by giving us some advantage not previously possessed. Possibly, however, the discipline gained by the training of the faculties is the most important result, and the greatest advantage which students obtain from their devoted study of natural science in any one of its multitudinous phases.

As mere knowledge, the pleasure to be obtained from the study of natural history is not to be despised. The study of any one branch necessitates, in a great measure, a knowledge of many kindred subjects. The study of entomology requires the knowledge of a considerable amount of general biology, physiology, botany, geology, geography, and meteorology; whilst the impetus that has recently been given to the study of variation and to the comparison of allied forms has made a knowledge of anatomy, morphology, and development absolutely necessary; and it is impossible, without a somewhat detailed grasp of a perfect cycle of these allied sciences, for a student to work out successfully the various problems connected with the existence of any single species,

however simple its structure, or however simple the conditions of its environment. All these subjects, therefore, are included in the study of natural history, and every student worthy of the name who takes an intelligent interest in his work must be more or less perfectly equipped with a general knowledge of these subjects, if he is to obtain satisfactory results from his own studies. Not that any naturalist can be supposed to have a really exact and detailed knowledge of all these sciences, any one of which is sufficient to occupy an individual for a lifetime; but no man can be considered a naturalist who has not mastered the general principles of each, so far as it refers to his own particular branch of work.

The range of natural history, then, is a vast one, even if we consider only the number of problems it presents; but if we come to consider the nature of these problems, the possibilities to the man of intellect are unsurpassed in any other field of scientific work. The great truths of morphology show that all organised beings are formed upon a small number of common types, and that these are to be resolved into still simpler structures, the whole being referable at last to simple cells which have been built up into a multitude of forms, some of which are of the utmost complexity. The facts of palæontology show us that most of the great classes of animals that exist to-day have persisted through vast æons of time, endlessly modified in detail, developing into slightly different forms, owing probably to a changed environment producing a multiplicity of specific types, that have been extinguished by developing into new forms as the environment has changed, and so on until the present time without losing the general appearance of the types to which they belong. That these common types had their inception in some simple form of life is now generally accepted by scientific men, but the time when this was so goes so far back that the mind utterly fails in its conception.

The value of natural history as mental discipline is scarcely equalled by any other branch of science. All education should lead to the development of the human mind, and a properly educated mind should be capable of readily carrying out the processes of observation, of experiment, of induction and deduction. No branch of science tends more perfectly to the development of accurate powers of observation than natural history, and the naturalist must of necessity be able to discriminate resemblances and differences of the closest kind, and often, indeed, of the most

complex character. To show the value of the experimental side of the subject is superfluous, for all the great advances that have been made during the present century in the sister sciences of physiology and of medicine, have been brought about by experimental research into the nature and functions of the organs and tissues of the animals that it is the naturalist's work to study; whilst the attempt to solve the relationship of any class of animals or plants, in other words to classify them, offers, perhaps, the very best training to the inductive and deductive faculties that it is possible to conceive. The classification of any group of organic beings is simply the application of inductive processes to the facts observed. The drawing of conclusions from details that at first seem altogether inadequate, but which are perfectly obvious to the trained observer and to a logical mind, shows that the deductive powers developed in a naturalist are of the very highest order.

The naturalist, therefore, in the true sense, is an observer and a reasoner, and he who thoroughly gives his attention to his work leaves no side of his intellect untrained. If any doubt the efficacy of natural history as a source of mental discipline, and as an educational instrument of the highest value, let him attempt to describe in detail an insect or a flower, let him attempt to draw an accurate comparison between two closely allied species of animal or plant, or attempt to analyse the relations which any organism bears to its environment. It is not always easy for a trained mind to do these things, and the clumsy attempts of untrained men are unfortunately only too familiar to all specialists; and a man who considers that these things may be done skilfully, accurately, and thoroughly without special training, should attempt the task before forming a conclusion as to the utility or inutility of natural history as an educational instrument, or as a valuable means of mental training. Huxley, however, says that "intellect, however gigantic, confers but half the qualifications required by one who desires to follow science with success, and he who gains only knowledge from her, gains but little. The moral faculties of courage, patience, and self-denial, are of as much value in science as in life. The origin of an erroneous doctrine lies as often in the heart as in the head, and the basis of the character of a great philosopher will commonly be found, on close analysis, to be earnest truthfulness, and no imaginary gift of genius. It is character and not talent which is the essential element of success in science . . . .

and it seems impossible to doubt that the training of the moral faculty necessarily undergone by the philosopher must react upon the man."

This preface as it were is, however, little to do directly with the subject on which I had determined to address you; but it will perhaps suggest an answer to many of you who may be assailed by some carping critic as to why we waste our time on what he considers trifles, or when one is suddenly asked as to what is the value of a society like ours, or what advantage is to be obtained from the study of natural history.

The subject to which I wish to direct your attention is the all-absorbing one of the variation and the natural consequence of variation, the nature of species. Little by little the old "shibboleths" that collected round the definition of species are being swept away; one by one the arguments that species, as we have pleased to term them, have existed through all time in their present forms as separately created entities falls into disuse; one by one facts are added to our knowledge of the organic beings by which we are surrounded, that give us a truer insight and more correct appreciation of the organisms themselves, and their actual relation to the environment that surrounds them. The old query, Show us some species that have been formed in comparatively recent times? no longer comes as a thunderclap to upset the equanimity of the evolutionist. The student has amassed material, he has made observations, and the general conclusions he is able to draw make for the strengthening of the theory that the species now in existence have been evolved from pre-existent forms, modified in response to a changed environment, each rising as it were on the ashes of its predecessor, which becomes extinct in giving birth to its offspring, the environment which requires the development of a new form sounding the death-knell of the old form, which no longer responds sufficiently to it. We see species in this sense as a continuous series of modifications of previous forms, each in turn becoming extinct, though never really dying or creating a break in continuity, each modification brought about as a change in the external conditions of the life of the species, each modification being developed because of its use to the species, and for this purpose only.

Long before the publication of "The Origin of Species," many scientific men had stated their belief in the instability of specific forms, both of animal and vegetable life. Buffon

considered nature to be always in a state of flux and movement, and expressed the opinion that "nature could effect anything with the forces at her disposal, except create matter and destroy it." Dr. Erasmus Darwin and Lamarck both held that changes in species were caused by the direct action of their environment, and by the use or disuse of their various organs. St. Hilaire, Herbert Spencer, and others elaborated views of a similar character; but it was not until the publication of "The Origin of Species" that a theory at all commensurate with the importance of the subject, with the mass of facts already collected, and generally applicable to the various forms of organic life, was elaborated to explain the process of organic evolution, nor had any previous writer been able to show in what manner organic beings responded to and were especially adapted to exist in their environment, nor how known natural laws had been able to produce the complex adaptations, as exhibited by the various organs, to the environment in which each individual lived. The explanation of the process of organic evolution as enunciated by Darwin was, therefore, readily received by scientific men, not as an actual explanation of all the facts connected with the subject, but as a theory that helped to explain many of the difficulties that had hitherto obscured the manner of evolution, and the mode of operation of the forces at work in its production, by an appeal to natural laws; and his theory of natural selection, although by no means accepted in all its details at the present time, still remains with some modifications as to detail, as facts have since accumulated, the basis of the theory of the lines on which evolution has taken place, and is generally considered to be the main if not exclusive means of the modifications that organic beings have undergone and are now undergoing.

Variation is the fundamental factor of the Darwinian theory of natural selection. It is quite safe to say that no two organic beings are exactly identical in all their characters, and the amount of difference between individuals of the same species, not only in size, shape, colour, and external characters generally, but in the performance of their vital functions, is much greater than has been generally granted or is now generally believed; and this variation in the performance of the vital functions of an organism is of the greatest importance, for, in some degree at least, certain external variations are but the expression of this internal variation, which may be rapidly weeded out by

natural selection, if disadvantageous to the species, but which may be seized upon, and thus made a factor in the evolution of a new form, if it be advantageous.

The details of the facts of variation are only known in a few classes of animals, and in these in a comparatively small number of species; but study shows that every organ and part, even the quality and nature of the tissue forming each organ, are subject to great and continued variation. The close study of a single species of our British Lepidoptera in the whole range of its geographical distribution, will show that these variations are not the small and comparatively unimportant differences that some opponents of the Darwinian theory have asserted them to be, but considerable and marked in their extremes, with as a rule intergrading forms between the extremes, sometimes filling up the gap by almost imperceptible gradations; whilst in others the gradations appear to be less numerous, the extremes being distinctly marked and apparently very different in their general facies. These, so far as I understand, are included with sports or chance aberrations that occur but rarely in the life of a species, as "discontinuous variations" by Bateson, yet in their essence it appears to me they are distinctly different both in their nature and essential characters. Probably I shall have occasion to refer to these so-called "discontinuous variations" later in this paper.

The rapid multiplication of species and their enormous fecundity are other important factors in the scheme of organic evolution. The rapidity with which many species multiply is, as a rule, far greater than is generally assumed, and this is especially the case in what are termed the lower forms of organic life. Their fecundity, too, or reproductive power is equally amazing. It has been estimated that a single puffball produces 600,000,000,000 of spores to a cubic inch, and it is known that a single Wood Leopard Moth (*Zeuzera pyrina*) lays on an average above 1000 eggs. Assuming that the progeny of a single puffball lived and came to maturity, it is evident that in a few years the whole earth would be covered with puffballs; and if the whole progeny of a single *Zeuzera pyrina* lived, say for five or six generations, the sexes being equally divided, the females would increase as 1 : 500 : 250,000 : 125,000,000 : 62,500,000,000 : 31,250,000,000,000, the sixth generation numbering in both sexes 62,500,000,000,000 examples. In a few years the whole of our timber trees would be destroyed by the amazing numbers of *Zeuzera* developed. It is, however, well known

that the average number of each species is maintained from year to year, that there may be a slight fluctuation in abundance comparing one year with its predecessor or successor; but we know that on the whole the single pair of 1880 was represented by a single pair in 1890, and that the single pair of 1890 will be represented by a single pair in 1900. We become aware after consideration of facts like these that a vast amount of destruction must take place year by year, and that only an exceedingly small percentage of the eggs laid can ever become perfect insects.

What causes this destruction? The answer is necessarily complex; but however complex it may be, it brings us to the third important factor in the Darwinian theory of evolution, the tremendous struggle for existence that exists amongst individuals of the same species, and the consequent survival of the fittest. The destruction may be brought about by a variety of causes: (1) Atmospheric conditions—rain, floods, storms, cold, drought, excessive heat or cold, &c. (2) Natural enemies—dependent, of course, entirely on the class or species of animal or plant. (3) Changes brought about by man—agricultural improvements, drainage, &c. (4) Starvation—owing to destruction of food-plant, either from natural causes or from the abundance of individuals devouring the particular food-plant, often converted here into a struggle with individuals of its own kind. (5) Disease. There are, of course, many other factors which will occur as readily to any field naturalist as to myself.

Probably the opponents of the theory of natural selection have objected most persistently and strongly to the small amount of variation noticeable amongst the individuals of most species from a given district. This is, of course, true up to a point, necessarily true; but the objectors forget that these individuals which have reached maturity are already the selected individuals of their race, having been already selected, if insects, in the oval, larval, pupal, and imaginal stages, for some qualities possessed which were lacking in and led to the destruction of their companions. The comparison is being made between those individuals which have been preferred owing to their having fallen in all their stages within the limits of the average type of the species, and because they responded best to the necessities of their environment in all their different stages. Surely this is sufficient to explain why the individuals appear to exhibit so small an amount of variation, especially when collected

in a restricted district, for it is well known that a species with a fairly constant form in one locality often branches off and produces distinct local races in other districts, each local race being very fairly constant in its general facies within its own area. The case of *Melitæa aurinia*, of *Gnophos obscurata*, &c., will at once occur to all naturalists.

It is well known that whole broods of Lepidoptera reared in confinement often give a much greater range of variation than the same number of examples taken by chance in the habitat of the parents, and that have been selected by nature before reaching maturity. This is probably due to the facts that the whole brood, or a great part of it, is reared by the experimenter without much loss, and because, having been reared under artificial conditions, no selection has taken place. This, too, probably explains why, in the years of comparative abundance of a species, there is frequently a wider range of variation than when the species is comparatively scarce, for the struggle for existence is more or less intermittent in its most severe forms, and under a combination of favourable circumstances that may occur from time to time a larger number of individuals come to maturity. Nor must it be overlooked that the diversity and complexity of conditions forming the environment tend, in different years, to the selection of different characters: *e.g.* extreme cold will select those that can bear, and kill off those that cannot bear, a very low temperature; extreme drought will kill off those weak in other characters, whilst extreme wet will tend to the preservation of those that can stand extreme moist conditions, and the destruction of those that cannot.

It is probably this complexity of characters, resulting from a complexity of environmental conditions, that permits of such a great range of variation as we often see in some species, although in every district (and I make this proviso so as to include distinct local forms, which often in their essence are almost species in themselves) that variation plays about a mean which may be looked upon as representing the type of the species. That this is so is distinctly proved by the difference that we often find existing in the types of a species from different districts, in which the species is subjected to different environmental conditions, including among many other factors heat, cold, drought, and moisture. The typical form for a given district represents, then, that form which is able to survive the various changes to which the species is subjected in different

seasons, whilst the more aberrant individuals are killed off, and sooner or later eliminated.

In spite of this general truth, it is well known that we do occasionally find a marked aberration occurring among a large number of specimens which differ but little from each other. Such a form may bear no close resemblance to any of the examples comprising the whole brood to which it belongs, and yet may occasionally recur in other broods at more or less distant intervals of time. Such individuals are known as "sports," and are generally considered to be of little value in the progress of organic evolution by those who believe in the general efficiency of natural selection. Sports of this nature are generally supposed to be atavisms; and that this view is possibly correct is fairly well proven by the well-known *Pyrameis cardui* ab. *clymi*, odd examples of which are occasionally captured at long-distant intervals in this country and on the Continent, but which Fischer bred rather freely by exposing the pupæ to low temperatures, 3° to 12° C., at a critical period of their development. In *Vanessa io*, too, an occasional aberration is taken in nature in which the ocellated spots are resolved into their constituent parts, producing the series of pale submarginal spots, which is a decided Vanessid character, in a comparatively unmodified form. In no part of the distribution of this species is this known to be the normal form, yet Merrifield was able to produce this form by icing the pupa at 33° F. for twenty-two days, following this by placing it in a refrigerator for twenty days, and then in a cool cellar for eighteen days, the imago, on emergence, showing the resolution of the ocellus into a chain of small bright white spots, with a slight bluish shade about them. There appears to be no doubt that the result is produced by the effect of a low temperature on the organic functions during histolysis and histogenesis; in other words, that it is an outward manifestation of an inward physiological change. Such internal variation as is here suggested appears to be due to the ability of the species (or its progenitor) to respond in past times to a degree of cold in its pupal stage now rarely experienced by it, the species still having sufficient elasticity in this direction to so respond if necessary, in which case the form produced is an atavism, and probably approaches to some extent the Vanessid stem from which *V. io* sprung. "Sports" in their most marked forms are apparently outward manifestations of the extreme possibilities of variations of physiological functions which lie at the present time outside the normal

mean of the typical species, and which usually are eliminated in the struggle for existence, but which occasionally manage to reach the final stage of the species. Such "sports" are, in their most marked forms, the true "discontinuous variations" of Bateson, and it is rather remarkable that certain modern evolutionists appear inclined, contrary to the generally accepted view, to look upon these discontinuous variations as not only of equal, but of even greater importance in the evolution of species than the smaller individual differences existing between the more typical forms.

It may be well before going further to obtain some definite and clear limitation to the term "discontinuous variation," which is coming into common use in our magazines and in the daily conversation of entomologists. It appears that the term is often misapplied, and one is inclined to think that the author of the term uses it in so wide a sense that it includes many cases widely differing in their essence. The black *Amphidasys betularia* ab. *doubledayaria*, is often quoted as one of the most marked cases of discontinuous variation, but is it really a case of discontinuous variation at all? It is well known that in some broods, reared in confinement, the progeny have separated distinctly into two portions, one of the typical "peppered" form, the other of the "negro" aberration, with scarcely any trace of what might be termed intermediates. On the other hand, other broods have given a graduated series from the pale to black, the examples showing a regular gradation of forms varying but little from those nearest, but leading from one extreme to the other. Apart from the fact, however, that an abundance of intergrading forms do exist, it may be well to ask those that call the "black" aberration a marked instance of discontinuous variation, whether it be really so? It occurs to me to ask whether this change from grey to black is so discontinuous as at first sight it appears? Of course the apparent change from white to black, as measured by the human sense of sight, is a great one; but is the change from a white or whitish grey to a black scale in *A. betularia* a great one, or so discontinuous as it appears? On the other hand, is it not the simplest change that can take place, due to a primary modification of the chemical condition of the scale contents? That there is an abundance of intermediate forms, with a fewer or greater number of black scales, does not vitiate the suggestion, but rather increases its value; for as the change is possibly due in this case to increased vital activities, it is to be expected that intermediate stages will exist and inter-

mediate forms result. In the same way it is possible that the yellow aberration *lutescens* of *Callimorpha hera* is in reality more closely allied to the scarlet type than is the intermediate ab. *saturnina*, the yellow being the simplest chemical change that can take place in the normal scarlet pigment. In this way probably the colour of the ab. *saturnina* is due to the ability of the two germs (represented by a yellow and scarlet form respectively) to mix organically and produce a tint that appears intermediate to our senses. In other words, we may suppose that certain conditions produce the typical red form; other conditions (acting through the organism in its early stages) produce the yellow form, cross the red and yellow form, and red, or yellow, or intermediate forms may result.

The question at once arises, Would under any conditions the yellow form become a species? It is quite clear, by the persistence and abundance of the yellow form in certain areas of the western distribution of this species, and its absence in other districts, that something in its environment is the cause of its development. It appears to be confined almost entirely to western France, the Channel Islands, and south-western England. Only once out of some hundreds (nay, thousands) of examples have I observed it abroad, and then in Piedmont (at Susa). Neither in the Pyrénées Orientales nor Asturias, in Savoy nor Dauphiny, near Aosta, the Austrian Tyrol, Bregenz, nor other localities in which we have seen this species (sometimes in amazing numbers) have we ever observed a yellow example. What conditions then occur in the west of France, the Channel Islands, and the south-west of England that do not occur in southern and central Europe? There are less sun, more moisture, a later spring, and a longer summer, with their resultant effects on vegetation in these western districts. There are as results the more rapid feeding up of the larva, and more rapid metabolism in the pupal stage, in central and southern Europe. Not that the yellow aberration never occurs in southern Europe; we have already noticed one at Susa among thousands of typical examples, and this shows that the physiological peculiarities that result in the production of the yellow coloration are within the limits of variation possible to the species even in its most typical form. If, however, this peculiar phase of the insect's organisation has become so far developed, owing to changed environment, as to produce a very large percentage of individuals so constituted in western Europe, it is clear that we have arrived

well on the way to the form becoming a specialised local race, responding by means of a peculiarity in organisation to a peculiarity in environment, and thus a distinct step towards its becoming a distinct species. On the other hand, one might ask whether this yellow coloration, being the expression of a slight change in the organism itself due to environment, and of value to the species under those peculiar environmental conditions amongst which it persists, indicates any greater step in the direction of a new species than does the development of a dark race of *Gnophos obscurata* on peat, and of a white one on chalk soils.

I would answer that it does not indicate a greater step, because I am firmly convinced that specialisation to the complex conditions of a particular environment is the great factor in the development of specific forms, and in both cases instanced the changed conditions of environment have apparently resulted in a modification of physiological function, in one of which the result has been the change of a red into a yellow pigment, whilst the other has resulted in the production of a greater number of black (on peat) or white (on chalk) scales. That these specialisations are mainly judged by naturalists by the external appearances of form and colour does not alter the fact that they are essentially manifestations of varying conditions of function in the organism, the external appearances being moulded by their utility to the preservation of the species in its respective stages. I was much struck, therefore, to read in the "Materials for the Study of Variation" that "the differences between species are specific, and are differences of kind forming a discontinuous series; whilst the diversities of environment to which they are subject are, on the whole, differences of degree, and form a continuous series. It is, therefore, hard to see how the environmental differences can thus be in any sense the directing cause of specific differences, which, by the theory of natural selection, they should be."

It may be well to examine this carefully. It is quite true that if we compare species such as *Dryas paphia* and *Argynnis adippe*, *Apatura iris* and *A. ilia*, the differences between them are specific and differences of kind; but can we say that their respective environments, even if inhabiting the same wood, are not just as different in kind? But if we consider a group of organisms such as *Anthrocera loniceræ*, *A. medicaginis*, *A. trifolii*, *A. palustris*, and *A. seriziati*, how far is this statement true? Certain groups of *Erebia*,

Melitæa, or *Colias* would serve our purpose for illustrating this point equally well, and it becomes necessary before saying that the differences between species are specific to have a definition of the term species, an almost impossible thing in the present state of our knowledge, for the definition is little more than a matter of personal opinion in all cases of real difficulty. Up to a certain point it is true to say that the differences between the various Anthrocerids just named are differences of kind, but do these differences form a really discontinuous series? One may also ask whether the differences are not in reality differences of degree rather than of kind, just as the diversities of environment are stated to be, on the whole, differences of degree? But do the differences of environment form a continuous series? Is there not a distinct difference between the environment of *Anthrocera filipendulæ* and *Polyommatus corydon* that live on the same chalk hills in Kent? Is there not a distinct difference between the environment of the meadows of Kent that produce *Anthrocera trifolii* and the environment of the marshes at Freshwater that produce *A. palustris?* There is a distinct climatic difference between Algeria and Kent; but this does not constitute the environment of an insect occurring in both districts, and therefore I am not surprised when I cannot satisfactorily distinguish between the meadow-haunting *A. syracusia* (as the Algerian *A. trifolii* is called) and the specimens of *A. trifolii* I take in the meadows at Strood. Still I can understand that the difference of latitude between Algeria and Kent may constitute an important factor in the environment of a species found in the two countries, and I am not surprised to find that *A. seriziati* (the Algerian form of *A. palustris*) varies distinctly from the *A. palustris* taken in the marshes of Sandwich or the Isle of Wight. But the effect of environment is evident, for although we are unable definitely to separate specifically the meadow-loving *A. trifolii* from the marsh-haunting *A. palustris*, often to be taken within a few miles of each other, as at Canterbury and Sandwich, yet the meadows of Algeria produce the meadow form of *A. trifolii*, and the marshes between Collo and Bono the form we are so familiar with as *palustris* from the marshes of Freshwater, Sandwich, &c. That the actual difference observable between English *palustris* and Algerian *seriziati* is due to a peculiar factor in one or other of their respective environments we are willing to admit; but we would urge that the environment of *A. trifolii* in the meadows of Algeria and

Kent, and the environment of *A. palustris* in the marshes of Algeria and Kent, are respectively nearer to each other and more continuous than are the environments of *A. trifolii* in the meadows and *A. palustris* in the marshes of Kent, or those of *A. seriziati* in the marshes and *A. syracusia* in the meadows of Algeria. There is really a greater discontinuity in the environment of the Kent *A. trifolii* and the Kent *A. palustris* than between the Kent *A. trifolii* and the Algerian *A. trifolii* (= *A. syracusia*).

If I appear to be taking my illustrations from a group not generally well known, I would urge two excuses for doing so: (1) that in the book I have recently written I have worked out the natural history, habits, and distribution of the Anthrocerids in considerable detail; (2) that I have recently exhibited at the meetings of this Society the various species and forms to which reference has been made; but, as I have already pointed out, illustrations might just as well be taken from almost any other family of the Lepidoptera whose species are in a state of flux—the Erebiids, the Brenthids, and the Melitæids would furnish many such, and my study of these as well as the Anthrocerids tends to show that environmental conditions are the primary causes of the development of so-called specific differences, the actual difference in kind which marks off well-defined species from their nearest allies being due to isolation by habit, food-plant, or some other outward manifestation of an actual difference in the organism, and which tends to intensify any peculiarity of colour, form, &c., to which the new form may be subject. It becomes clear, therefore, that we must define environment to obtain a clear insight into what this means. It is not sufficient to assume, because Algeria and the British Isles are some degrees of latitude from each other, that the environmental conditions of a species common to both countries must be very dissimilar. They may be, of course, but they may also be almost identical except in the matter of temperature and the influences arising therefrom. But temperature is only one factor of a long series, and the environment of an exposed chalk-hill and the wood that clothes its summit is probably far more dissimilar than a meadow in Southern Sweden and a somewhat similar meadow in Northern Africa.

What factors, then, constitute the environment which makes up the sum total that, in their effects, we consider so potent in their influence in the modification of animal and plant life? The factors are so numerous and the conditions

so complex that definition seems almost impossible. Not only must the condition of soil, climate (in all its local modifications), position, and surrounding fauna and flora be considered, but the relation of the individual constituents of the latter to the species under consideration must also be taken into account. Hence it happens that two different organisms occupying the same ground may, owing to a difference in habit, have two entirely different environments, with a difference of food-plant, different enemies, &c., and it is clear that the competition with other forms of animal life must react on almost every species in an entirely different way; whilst in the same little corner of a field or wood the larva, the pupa, and the imago of any common butterfly are subjected to three entirely different environmental conditions. Nothing is more discontinuous possibly than the environments of certain species when the habitat of such a species is compared with the neighbouring districts, both with regard to its inorganic condition and the organic beings peopling it. Hundreds of acres of waste ground occur in Britain, yet *Anthrocera viciæ* occurs only in a limited portion of the New Forest, an apparently continuous environment not leading to the spread of the species. Nothing can illustrate better the discontinuity of environment. *A. viciæ* occurs in the New Forest, again at Rheims, again at Cauterets in the Pyrenees, and nowhere probably between (or if there are other localities they are perfectly separate from each other). It occurs again in North Germany, in Pomerania, and in the Baltic provinces. From the New Forest we have to skip some hundreds of miles before we come to suitable spots where *A. viciæ* finds an environment suited to its peculiar requirements. Whether it be specialised to some particular food-plant, all other favourable circumstances being useless in the absence of this, we do not know, but it is evident that its environments are discontinuous in every possible meaning of the term. That the conditions of environment—climatic, inorganic, organic—acting on an already plastic and variable organisation is the primary cause of specialisation, leading up to the development of species, we feel certain that no competent and logical field naturalist would venture to dispute.

It often seems to be overlooked that the variations in species are indefinite in number, that the internal functions of the organism itself possibly give rise to the variations, that such variations as are useful to the species are moulded into the directions required, by natural selection, that every

external character of structure, colour, and texture is an outward manifestation of some functional character that had its origin in the internal organisation of the animal, and was selected owing to its utility, in some measure at least, to the organism. When a species is well placed with regard to its environment, when the conditions of its existence are such that the species flourishes, a standard or mean is set up, and the species undergoes no change. But the conditions of its environment may be suddenly altered, the drainage of a field, the flooding of hitherto fairly dry land, the introduction of new enemies, the change of wood into field, and similar modifications may bring about suddenly conditions that will lead to the destruction of the species. If it be specialised to some particular marsh food-plant, the drainage of its habitat spells death unless the larvæ can accommodate themselves to another food-plant, and this accommodation may bring about a rapid change in the species. The introduction of a new enemy into its haunts may be equally disastrous, unless the individuals become modified in such a way as to combat or deceive the new attacker. The stress of the organic environment due to any peculiar condition or combination of conditions may necessitate a change of location, of habit, of food-plant, &c., with a corresponding change in the organism. But all these contingencies necessitate a change in the organism to meet the new requirements, and the changed organism replaces the old that no longer responds to its environment; in other words, the old species *per se* ceases to exist, and the new form takes its place. This mode of development seems to be taking place in many of the predominant groups of the Palæarctic fauna, certain minor divisions of which are now in a state of flux. It is decidedly the case in certain groups of the Coliads, the Melitæids, the Erebiids, the Brenthids, and the Syrichthids. Some forms in each of these groups appear to be simple modifications of existent species, the typical forms having been lost in some localities in the development of the new ones, forms similar to which may even appear as aberrations with the type form in other localities, where the stress of the environment has not necessitated so distinct a change.

There can be no doubt, apart from the consideration of intra-selection within the organism and its bearing on the final development of certain variational factors, which must in their turn react on the external variational features produced, that natural selection is the prime agent in the moulding of local races, and in time of specific forms. Every

field naturalist who is also an observer knows how excellently every insect in all its stages fits into the conditions of its environment. He also knows that if the insect exists under varying conditions of environment a modification takes place, the modification really understood by the term "local race" applied to such instances. He has also noticed that it is the characters which are of service to the species under particular conditions that are most strongly developed, and that modification takes place in a direction (or directions) useful to the species. The usefulness of these characters is the salvation of the species, for it is the acquisition of these characters that allows them to fill a place in the economy of nature, from which they cannot be ousted by competitors or killed off by enemies. That there is no real distinction between races and species is certain, the matter often resolving itself into one of opinion, *e. g. Tephrosia crepuscularia* and *T. bistortata*, *Anthrocera trifolii* and *A. loniceræ*, *A. viciæ* and *A. charon*, and so on. It is only that such races or species are not yet so absolutely separated in all their characters, structure, organs, function, habits, &c., as are the older species which have been isolated through vast ages of time; and the criterion of fertility *inter se* which is sometimes used to determine whether a certain form is a local race or distinct species would scarcely lead the entomologist to label *Saturnia pyri* and *S. pavonia*, or *Smerinthus ocellatus* and *S. populi*, or *Amphidasys strataria* and *A. betularia*, or *Ennomos alniaria* (*autumnaria*) and *E. quercinaria* as species respectively. And really, when it comes to the crucial point of what is a "useful specific character," is it not largely a matter of what individual judgment would label useful? We have no very certain diagnostic characters in *Leiocampa dictæa* and *L. dictæoides*, but we are all agreed that they are distinct species because they have independent life cycles, are specialised to different food-plants, have larvæ that are clearly distinguishable, and present a small detail or two of difference in the arrangement of the imaginal markings. Yet, in spite of the closeness of their affinity, there can be no doubt that the two insects fill independent places in the economy of nature, and that every detail (even of habit) of the larva and imago is of importance; that the very essence of the perpetuation of two species apparently so closely allied is the fact that they do fill independent places, that they are differently constituted, and so have become specialised in different ways, each succeeding where probably the other would fail.

I have long maintained, and have previously suggested in this paper, that many of the differences in species are essentially physiological, and depend upon differences of constitution, performance of functional and vital processes, habit, &c., and that the morphological characters of the species are often only an outward expression of such differences. It is well known that certain species of Lepidoptera are restricted to a single species of food-plant, and will starve if it be not forthcoming, whilst many of its allies may be more or less general feeders. Here evidently we have to deal with a species that is probably maintained distinct purely from this physiological peculiarity, which will sufficiently isolate it from all its congeners. As a principle this is pretty generally held to be true by the more advanced Darwinians, and as far back as 1883 Meldola wrote, "It is most important to bear in mind that Darwin's prime mover, natural selection, acts not only upon external characters, but likewise upon internal organisation; minute constitutional or physiological deviations, at present utterly beyond the ken of science, can be seized upon and perpetuated by this agency when of any advantage to the possessor. The survival of the fittest is utilitarianism *in excelsis*." Later, in 1897, the same writer observes, "If variability of nervous function can be seized upon by natural selection, it is but reasonable to suggest that variability of other internal functions can also be utilised when of advantage. Of the functions discharged by the internal organs other than the nervous system, all those obscure chemical processes concerned with metabolism and nutrition, waste and repair, secretion and excretion, and so forth, must be in adjustment with the life conditions of the organism. If species are adapted to their mode of existence, as is admitted by all schools of evolutionists, the selectionist must explain the physiological adaptation in the same way that he explains the structural adaptation, viz. by the survival of individuals whose physiological processes are best in harmony with their mode of life; but this explanation starts from a variability of physiological function. From analogy with the known variability of structure it is fair to infer that a physiological variability also exists, of the range of which we are at present ignorant. At any rate, it appears to me inconceivable that any change of environment requiring a modification of structure of sufficient magnitude to rank as diagnostic in the systematic sense should not also be accompanied by a greater or less amount of physiological

readjustment." Cockerell, in 1896, wrote. "The essential distinctions between species are physiological, the morphological ones being only valid for diagnostic purposes just so far as they happen to coincide with the physiological."

Close study of certain groups of Lepidoptera in which evolution is at present at work in the direction of species formation—*Anthrocera*, *Erebia*, and *Melitæa*—incline me strongly to accept Professor Cockerell's view with very slight limitations. It appears to me certain that there is an essential difference between the development of morphological characters and physiological characters, the former tending to maintain the species *in statu quo* as a species, whilst its colour or superficial appearance is altered, *e. g. Gnophos* (in many species), *Amphidasys betularia*, &c., whilst the latter sets up at once a distinct isolation between the form and the parent stock, preventing any general tendency to cross-breeding, and eliminating the progeny when it occurs. Thus the two extreme forms of *Amphidasys betularia*, in spite of their external differences, cross freely in a state of nature; whilst *Anthrocera trifolii* and *A. loniceræ* (though equally able to cross and produce fertile progeny) are probably specialised in nature to some particular food-plant, habit, and habitat, and are maintained distinct. Again, *Anthrocera palustris* appears to be maintained in nature as distinct from *A. trifolii*, owing to its specialisation in the larval stage to *Lotus uliginosus*, the localisation of its food-plant to a marshy habitat restricting the species to the same habitat, the latter reacting on the species by making it later in its time of appearance than is *A. trifolii*. There must be some physiological peculiarity, some difference in the physiological processes between two allied species, that limits them to different food-plants, and allows them to die rather than to live on any other. Twelve months ago I pointed out how specialisation to food-plant, specialisation by habit, specialisation in the method of hybernation, &c., also resulting from a difference of physiological function, would insure isolation of any particular form, and cut it off from any connection with its nearest allies; and whilst quite agreeing with Professor Meldola that "any change of environment requiring a modification of structure of sufficient magnitude to rank as diagnostic in the systematic sense" would also "be accompanied by a greater or less amount of physiological readjustment," yet at the same time one can understand selection to work on some variable factor in the organisation of an insect in such a way as to allow it to take

up a comparatively vacant place in the economy of nature; whilst, at the same time, in other directions selection seizes on other external morphological characters, and fits by their development the insect still more completely for the changed conditions in which it finds itself,—that is to say, the primary conditions producing the change may be physiological, adjustment to the environment following as a matter of course.

I am insisting on this point because I wish to engage the attention if possible of some of our field naturalists to the points at issue. We want to know absolutely whether, in nature, certain species or forms are specialised by their attachment to certain food-plants, or by certain habits that differ from those of their nearest allies. This is true naturalist's work, work for the observer in the field, and not to be discovered by the examination of cabinet specimens. It is quite evident if internal structures and internal functions are variable, and that natural selection can act on these in the same way that it acts on variations of external structure, when such modifications are required in response to change in external conditions, that we have here factors of isolation in forming species that need have but little indication of their distinctness in external character and form. It is in this sense that *Tephrosia crepuscularia* and *T. bistortata* are species, their isolation having been begotten by a difference of physiological organisation, a difference that insists on the one form, *T. bistortata*, appearing in the spring some weeks earlier than the other, and tends to make it double-brooded, whilst the other, *T. crepuscularia*, appears later, and is religiously single-brooded.

Is difference of habit such as this a sufficient criterion of a difference of species? Meldola, speaking of characters important to a species that may be altogether left out in the diagnosis of cabinet specimens. refers to the disguises adopted by insects in the numerous cases of protective resemblance, and the mimicry that are so familiar to all of us, and adds, "If utility is not obvious in all such instances, then nothing in the realm of organic nature will bear the interpretation of utility. . . . Now these adaptive and demonstrably useful characters are surely 'specific,' whether the systematist attaches much or little weight to them in his diagnoses. Moreover the disguise is enhanced, and in many cases is only really effective, when combined with certain habits which are not and cannot be taken into consideration in ordinary diagnostic work. Nevertheless such habits are as

truly ' specific ' as the form, colour, and pattern with which they are associated. The attitude of a stick-like Geometrid larva, of a flower-like Mantis, or of a deceptively marked spider, is as fairly attributable to natural selection as the form, colour, and pattern. Such habits must also be associated with specialisations of nervous function, with physiological characters which find no expression in modern systematics. It is obvious that diagnostic work, as at present conducted, gives us only a restricted view of specific characters." It is quite clear that my contention of the development of species practically side by side under the influence of a difference of constitution tending to the isolation of a special form by any peculiar habit, such as hybernation in a different stage from the parent stock, appearance in the imaginal stage at a different time of the year, becoming double instead of single brooded, or *vice versâ*, would be in the main agreed to by those evolutionists of whom Professor Meldola may be considered the exponent. We must, therefore, know the complete life-habits of the animals we study, and to get a thorough notion of the real nature of species we must depend upon the close observation of the field naturalist, who will study such species as comes under his notice, not from the standpoint of specimens for a collection, but in their relations to their environment as living creatures, a part of the great system of nature into some niche of which each will be found to fit exactly when we have paid the necessary attention to discover the character and nature of that niche.

With regard to the question here discussed, it seems practically certain that, when we come to consider the change in pigmentation as one of the external means of the differentiation of species, the external characters are simply the result of changed physiological conditions or functions performed under different conditions; and it is quite possible that in a greater or less degree the forms exhibited in cases of seasonal dimorphism are simply the outcome of development of the two extreme points of physiological variability to which a species has been able to reach in response to climatic influences, and which are produced under the stimulus of such influences, the seasonal forms being the manifestation of two distinct kinds of physiological activity, set in motion by the necessary climatic influences, rather than the direct result of the climatic influences themselves. In the same way, results often attributed to food, temperature, &c., may be in reality

the results of particular forms of physiological activity (or inactivity).

There can be no doubt that the development of pigment in animals generally is to be associated with the physiological functions of the animal, and anything that would stimulate or weaken these functions would, in the case of insects, have its reaction on the colour produced in the final stage of the creature. But with regard to insects there is some difficulty, for the food material, so far as it goes towards and therefore is capable of influencing the formation of pigment, is simply stored up in the larval stage and converted into pigment in the pupal stage. We know that ill-fed larvæ of many species produce diminutive and ill-pigmented imagines; but the direct influence of food, except in its effect on the size of the resulting imago, is not easily demonstrable, although large and full-sized imagines are usually well pigmented. In the same way the effect of temperature, &c., on larvæ is not easily demonstrable, but the effect of any external factor—cold, excessive heat, &c.—that will affect the physiological functions of the pupa at the time that the pigment factor is being elaborated in the scales is almost certain to be marked in the imago. Merrifield's experiments prove this up to the hilt, and there is no doubt that any modification of the normal activities at this time will result in a difference of colour. Not, of course, in all species, for the variability in this direction is not elastic in all species, and the external influence that would simply produce a change (more rapid or less rapid) in the functions of one insect might arrest the vital functions of another, and produce death. And even in the case of a species with a certain degree of variability in the required direction there would certainly be some that would not respond, and others that would die under the treatment that would only create a change in others, and hence there would be a destruction of the physiologically unfit; and it is clear that what at first seems to be the transformation of a species by the influence of external temperature or climatic conditions is in reality a selection of those individuals that respond best to the changed conditions, the effect on those individuals that can undergo a more rapid or less rapid metabolism, as the case may be, being an external change of colour, which is in reality correlated with a somewhat different physiological organisation. But the selection of individuals which will respond to these changed conditions of environment, and the

elimination of those that will not, is surely the first step to their separation as a distinct race, or even as a distinct species.

There are many other facts connected with this all-absorbing subject with which I should like to have dealt, but this is not possible within the limits of an address. If these remarks lead any member of this Society to publish any observations bearing on the points suggested I shall be more than pleased. What we want now are fewer collection-makers and more observers—fewer specimens, but more observations on the habits of insects. We want to know more about the insects as living organisms, and the facts relating to these can be put on record by every member of our Society. The work of the field naturalist is not yet begun on these lines, and the energy of the hunter will only be diverted into another channel. He will still have an excuse for outdoor exercise, whilst the results obtained will be of the greatest value in the elucidation of some at least of the many mysteries of nature which everywhere surround us.

Before closing this address there are two things left to do. The first of these is important to all the members of this Society. I have in an earlier part of this address pointed out what I consider the advantages of natural history as a science, and there is scarcely need to suggest the great value of the work done by natural history societies, if carried on in a liberal manner, with an idea of developing the scientific tendencies of its members. I have quoted Huxley to the effect that character and not talent is the essential element of success in science, and that the training involved in the study of natural history must react upon the man. All these points, I take it, are exemplified and have been reached by members of this and kindred societies, and our members are willing, I doubt not, if the study of natural history has reacted on them in the sense suggested by Huxley, and made them men of logical mind, of generous and wide-reaching sympathies, to do all they can for the Society of which they are members, not ungrudgingly but generously.

I need hardly point out that the only connection between the members of the past and these of to-day, between the members of to-day and those of the future, are their books (the Library) and the "Proceedings." These are the links that bind our Society into one continuous whole, and we, who are proud of its past and sanguine as to its future, would strengthen those links in every possible way. But

Huxley says there are "lamentable examples of men who seem to have one moral faculty for science and another for their daily affairs;" and there seem to be members of this Society who are logical and business-like in their daily affairs, but who appear to think that a society of this description is an incarnation of spiritualism, requiring neither means, nor help, nor direction in the management of its affairs.

I learn from the Council's report at the end of last year that there were 173 members on our books; I see from the Treasurer's report that 125 paid their subscription, the life and honorary members are 9 in number, so that it left no less than 39 members in arrear. I observe also from these reports some other interesting but almost incredible facts. We published, at a cost of £55 4*s*. 6*d*., a volume of "Proceedings" containing altogether 182 pages. This would work out for 173 members at a cost of 6*s*. 5½*d*. per member, but taking the number of those that paid subscriptions it works out at cost of 8*s*. 10*d*. per member. But I also observe that while the ordinary rate of subscription is 7*s*. 6*d*., some members pay 6*s*., others 5*s*., and country members 2*s*. 6*d*. All these members receive a copy of the "Proceedings," so that each member represented a direct loss of 1*s*. 4*d*., 2*s*. 10*d*., 3*s*. 10*d*., and 6*s*. 4*d*., according as he paid 7*s*. 6*d*., 6*s*., 5*s*., or 2*s*. 6*d*. as his subscription. Besides this there is the cost of rooms, stationery, and incidental expenses absolutely necessary to carry on the work of a society of this kind. I turn to the Treasurer's report again, and I find that this state of affairs is met by gifts—"donations, £32 3*s*. 8*d*."

The rate of subscription was determined at a time when our "Proceedings" did not occupy a third of their present space, and it appears to me high time that a thorough revision of the present rate of subscription and the status of members took place on practical lines. At any rate it appears quite clear that the present position of "country members" should be abolished so far that no other country member should be elected, and that our present country members should be asked to qualify as full members. Probably they have never understood their position with regard to the finances of the Society, but now that it has been pointed out it is to be hoped that the few gentlemen who have reached the high conception so graphically described by Huxley, and who have paid in great measure for the "Proceedings" by private subscriptions, should not again be

asked to continue their donations; but that, on the other hand, each and every member should do his best towards the fulfilment of the aspirations of the Society we love, and aid in handing down to future generations of entomologists a standard of scientific work rarely attained by a local society, and perhaps excelled by none.

Only one other duty remains for me to perform. I desire to express my hearty thanks to each and every member who has attended our meetings, and borne with all my many shortcomings. I wish to thank also the members of the Council who have helped to make this year one of the most successful in the annals of this Society—to Mr. Lucas, Mr. Harrison, and Mr. Clarke more especially, for their work in connection with the lantern illustrations that have made many of our meetings so enjoyable. What the Society has in its Treasurer, Secretaries, Curator, and Librarian you know perhaps as well as I—hard-working men whose very lives seem to depend on making the Society as successful as possible; and if I have left my thanks to Mr. Adkin last, it is only because I do not know how to sufficiently thank him for taking on my duties when I was in indifferent health.

And now I have to hand over the chair to my successor, a pleasant duty not untinged with a certain amount of selfish regret. In Mr. Harrison you have one of the few Presidents not primarily an entomologist,—a quiet, unassuming, retiring gentleman, possibly more or less unknown to many members, yet a man full of reserve force, a great reader and student, a man of special attainments in more than one branch of science, a man who will keep the Society at its present high level, and who, I venture to prophesy, will be handed down to posterity as one of the very best Presidents who ever filled the chair—

> A man of parts, of mettle tried,
> A man who will—whate'er betide.

J. W. TUTT.

ABSTRACT OF PROCEEDINGS.

JANUARY 13th, 1898.

Mr. R. ADKIN, F.E.S., *President*, in the Chair.

Mr. Mansbridge exhibited a photograph of an ash tree and an elm tree, taken in winter, when they were without foliage, and remarked upon the very distinctive character of the branching shown by each tree.

Mr. R. Adkin exhibited trivial varieties of *Pararge megæra*. In the case of two males the ocellus near the apex of the fore-wing was much reduced in size, and in one of them the usual three ocelli near the margin of the hind wings were represented by one well-developed ocellus only, and in the other example by two indistinct ocelli. A female was asymmetrical, having a fully developed ocellus near the apex of the left wing, while on the right wing it was represented by a minute black speck. He thought these varieties, although but trivial in extent, were interesting as probably belonging to one class of modification. The examples shown were taken in various parts in the southern counties of England.

Mr. Adkin also exhibited a living example of a land planarian, which was identified as *Bipalium kewensee*, Mos., a species that is believed to have been introduced into this country from the forests of Samoa. The specimen exhibited was one of several that had been found in a hothouse at Bromley, Kent, whither it had no doubt been brought with some tropical plant, possibly a large tree-fern, near which it was found.

Mr. Pearce, of Hackney, exhibited a number of most remarkable forms of *Hemerophila abruptaria*. Some of the examples were the progeny through successive broods of several dark female aberrations captured in May, 1895, in Hackney; others were bred from larvæ found in the autumn of 1895, feeding in his garden on lilac; and some were captured or bred in 1896. One specimen bred in 1897 had a male and a female antenna on the left and right side respectively.

The Secretary read a paper communicated by Professor

A. Radcliffe Grote, A.M., entitled "The wing and larval characters of the Emperor moths," and exhibited specimens of *Saturnia pavonia* (British), *Aglia tau* (Europe), *Automeris io* (North America), *Hemileuca maia* (North America), *Citheronia imperialis* (North America), and *Attacus speculifer* (India ?), kindly lent by Mr. C. G. Barrett to illustrate the notes ("Proceedings," 1897, p. 82).

JANUARY 27th, 1898.

ANNUAL GENERAL MEETING.

Mr. R. Adkin, F.E.S., *President*, in the Chair.

The early part of the meeting was devoted to receiving the Reports of the Council and Officers, the election of Officers, and the reading of the President's Address.

The following is a list of the Officers and Council elected for the Session 1898–9:

President.—Mr. J. W. Tutt, F.E.S.

Vice-Presidents.—Mr. R. Adkin, F.E.S., and Mr. W. Mansbridge, F.E.S.

Treasurer.—Mr. T. W. Hall, F.E.S.

Librarian.—Mr. H. A. Sauzé.

Curator.—Mr. W. West.

Hon. Secretaries.—Mr. Stanley Edwards, F.L.S., &c. (*Corresponding*); Mr. H. J. Turner, F.E.S. (*Report*).

Council.—Dr. T. A. Chapman, F.E.S., Messrs. F. Clark, A. W. Dennis, A. Harrison, F.E.S., F.C.S., W. J. Lucas, B.A., R. South, F.E.S., and H. Tunaley, F.E.S.

Mr. Lucas exhibited a specimen of the earwig *Forficula lesnei*, Finot, and contributed the following note:

"*Forficula lesnei*, Finot.—At our last meeting, on January 13th, Mr. West gave me an earwig which he had captured in October, 1897, by sweeping plants on the chalk near Reigate in Surrey. It was a nice male, but from its pale colour, the shape of the forceps, and the absence of wings, clearly did not belong to the common species. I could not at the moment say whether it should be referred to *Forficula pubescens* or *F. lesnei*, but now find that it belongs to the latter species. Two specimens only had previously been

recorded from Britain, both by Mr. Burr, one of our members. The first he took himself in the Warren, at Folkestone, while the other was captured at Wallingford, in Berks. There is a third example, whose capture has not been recorded, in the Hope Collection at Oxford, and Mr. West's specimen makes the fourth.

"The Folkestone specimen was first recorded as *F. pubescens*, but M. de Bormans, after carefully examining a figure of it, thought it should rather be referred to *F. lesnei*. On comparing it with the description and figures of Finot, who stood godfather to *lesnei*, Mr. Burr felt convinced that it was truly that insect. It has been found in September amongst grass and rough herbage, in several places in the north and west of France, but *F. pubescens* is a South European insect. Consequently we should expect to find *F. lesnei* rather than *F. pubescens* in this country, and it is probable that the specimens of the latter taken by Messrs. J. C. and C. W. Dale at Charmouth, Bonchurch, Scilly, Glanvilles Wootton, &c., and by Curtis at Salisbury, will turn out to be *lesnei* also, though, of course, both species may be with us. But whether one or two species, these earwigs are evidently natives, and probably, since localities are so widely scattered, they only want searching for to turn up much more commonly.

"With regard to identification, the absence of wings should first be noticed. But four other earwigs destitute of these useful appendages have also been taken in England. None of them, however, are native. Moreover two of them, *Anisolabis maritima* and *A. annulipes*, have not even wing-cases, while in shape the forceps (especially of the male) are entirely different from those of a *Forficula;* besides, *A. annulipes* usually has ringed legs. The other two apterous earwigs, *Apterygida albipennis* and *A. arachidis*, have wing-cases and no wings, like *lesnei*, but they are much smaller insects; and, again, the forceps (widely distant at base in the male) are very different in shape from those of a *Forficula* (and also of an *Anisolabis*). In fact, *F. lesnei* is sufficiently like the common earwig, *F. auricularia*, to shew that it belongs to the same genus, but sufficiently distinct to make it at once clear that it belongs to a different species, and I hope that our Coleopterous friends and others who use a sweeping net will be on the alert for the species during the coming season. I might add that Mr. West's specimen was taken in a spot where rest-harrow (*Ononis*) was growing freely."

FEBRUARY 10th, 1898.

Mr. R. ADKIN, F.E.S., *Vice-President*, in the Chair.

Mr. Edwin J. Crow, of Brixton, and Mr. Robt. Hillsworth, of Stratford, were elected members.

It was announced that Mr. Hy. Tunaley had been chosen Vice-President in place of Mr. Mansbridge, who had resigned on account of being appointed to a post abroad.

Mr. McArthur exhibited an underside variety of *Polyommatus* (*Lycæna*) *bellargus* from Brighton, having curved spots on the margin, and an underside variety of *P.* (*L.*) *corydon*, having almost spotless forewings, while the hind wings had only the white ground of the usual spots remaining.

Mr. Dennis exhibited larvæ of *Callimorpha hera* reared from ova sent him by Mr. Tutt from the neighbourhood of Mt. Cenis. They had been kept indoors all the winter, and had continued feeding. Mr. Tutt said that in some limited districts of the Southern Alps this species was in great profusion.

Mr. Tunaley exhibited series of *Retinia resinella* bred from pine nodules sent to him from Aviemore. They emerged between May 20th and 31st, and were somewhat small, although they were in pupa in March when they were received. He found that when the pupa was removed from the nodule the imago failed to successfully extricate itself from the pupa case.

Mr. Routledge exhibited a variety of *Enodia* (*Epinephele*) *hyperanthus* from Carlisle, having a broad whitish submarginal band on the under side of the hind wings, and upon this the ocelli were placed; also two specimens of a Noctua for identification. These latter were considered to be female specimens of *Hydrilla palustris*. They were taken near Carlisle by Mr. Day, on whose behalf Mr. Routledge exhibited them.

Mr. Lucas exhibited imagines and living nymphs of *Calopteryx splendens*, and contributed the following notes:

"In January last I came across living nymphs of *C. splendens* for the first time, though I had searched for them before, and I now exhibit two specimens, one nearly or quite ready for the final change, the other quite young. They were taken by dredging amongst the roots of rushes in the canal near Byfleet. Last summer I found empty cases in the same neighbourhood, and noticed that in some instances the insects had walked a considerable distance, and then climbed

a wall or fence before disclosing the imago. The two British species of this genus, *C. splendens* and *C. virgo*, may be known by the extremely long basal joint to the antennæ, and also by the fact that the two lateral caudal lamellæ are three-angled instead of leaf-like. It is difficult to distinguish the two species from one another. Only *C. splendens*, however, occurs in the district in which these were taken. The most striking features about this nymph are the long legs and antennæ, and the longitudinal lighter markings on head and thorax. When at rest these, together with the position the nymph assumes, give it a close resemblance to a piece of dead stick, and conceal it very effectively from even close search. It is indeed extremely difficult to pick out the insect from its surroundings. Its form and markings also cause it to resemble some of the curious stick-like Hemiptera that live in the water, possibly to its advantage."

Mr. R. Adkin exhibited specimens of *Dianthœcia luteago*, var. *barrettii*, from Howth, Ireland, taken in 1878 and 1890, for comparison with the following exhibits by Major Ficklin and Mr. Tutt.

Major Ficklin exhibited a form of the same species, var. *ficklini*, from Cornwall, and contributed the following note:

"The four specimens of the variety of *D. luteago* were taken by me on June 10th, and during the following week, in Cornwall. They were all captured at dusk, flying at flowers of the *Silene maritima*. Two of the insects were quite fresh, and the others, which were taken a few days later, were much worn. The locality is very wild and rocky, large masses of the *Silene* hanging from the cliffs in sheets of blossom, making a splendid background on which to see the rapidly flying moths; but the high wind which prevailed made their capture very difficult, the flowers being in constant motion, and the moth, once disturbed, gone in a moment. I should like to draw attention to the beautiful violet-grey markings on the fore-wings which distinguish var. *ficklini* readily from var. *barrettii*."

Mr. Tutt also exhibited examples of a form of *D. luteago* which were bred by the Rev. Frank E. Lowe, of St. Stephen's Vicarage, Guernsey, on June 15th, 1897, from pupæ obtained under *Silene maritima*.

Referring to the various forms of *Dianthœcia* (*Luperina*) *luteago*, Mr. Tutt said that they were exceedingly interesting from the fact that the species appeared to form a distinct race in almost every district; in fact, the species was almost polymorphic with regard to its whole range, yet that each

race was in itself moderately constant. Several forms besides the type had been noticed in "British Noctuæ and their Varieties," vol. i, p. 134; but yet none of these were like Mr. Lowe's or Mr. Ficklin's specimens. Mr. Lowe's examples from Guernsey approached in their ochreous hue the Continental type; but, on the other hand, they had the markings extremely well defined, and in this respect were quite like var. *ficklini* and the better marked specimens of var. *barrettii*. It was remarkable, now that the three forms were for the first time brought together for comparison, how very similar they were in general facies, yet so unlike in tint. The two forms exhibited (1) for Mr. Lowe and (2) by Mr. Ficklin were equally worthy of distinctive names with var. *barrettii*, and he had already named Mr. Ficklin's form var. *ficklini*. He intended also to bestow a distinguishing name (var. *lowei*) on Mr. Lowe's variety. The three forms were characterised as follows:

Suffused fuscous form = var. *barrettii*.

Paler, much greyer, with lighter markings = var. *ficklini*.

Ochreous, with darker shading and almost white markings = var. *lowei*.

Mr. Tutt further exhibited on behalf of Rev. F. E. Lowe, of Guernsey, a fine aberration of *Melanippe sociata*, in which the central band was reduced to a dark discal lunule. The subterminal line was white, and all four wings were crossed by a broad dark grey band just within the subterminal.

FEBRUARY 24th, 1898.

Mr. J. W. TUTT, F.E.S., *President*, in the Chair.

Mr. Kaye, Worcester Park, Surrey, and Mr. Chatterton, 7, Clissold Road, Stoke Newington, were elected members.

Mr. S. Stevens exhibited several varieties of species in Lasiocampidæ, including two males and a female of *Bombyx trifolii*, bred by Mr. Mitford from the Kentish coast, of a light bright yellow brown; *B. quercus*, a dark male with semi-transparent pale yellowish hind wings, another with fore and hind wings semi-transparent over nearly their whole area; a pair of var. *Callunæ*, bred by the late Mr. Walton fifty years ago from the Yorkshire moors, (these had remained in pupa nearly two years); a dark and finely marked *B. rubi*; a very pale female *Odonestis potatoria*, devoid of the long oblique transverse line, and a remarkably light brown specimen of *Lasiocampa quercifolia*, with another of a pale buff colour with lines and shades grey.

Mr. J. A. Clarke exhibited a series of the following species: —*Trichiura cratægi*, *Pœcilocampa populi*, *Eriogaster lanestris*, *Lasiocampa* (*Bombyx*) *rubi*, *L.* (*B.*) *quercus* and var. *callunæ*, *Clisiocampa* (*Bombyx*) *neustria* and *C.* (*B.*) *castrensis*, including many light, dark, and extreme forms to illustrate Mr. Tutt's paper.

Mr. R. Adkin exhibited with the same object *Trichiura cratægi* from Gravesend and Abbott's Wood; *Pœcilocampa populi* from Winchfield, Polegate, and Colchester; *Eriogaster lanestris* from Rugby and Eynsford; *Bombyx neustria* from Lewisham and Abbott's Wood; *B. castrensis* from Shoeburyness; *B. rubi* from Arran, Northumberland, and Durham; *B. quercus* and var. *callunæ* from Aberdeen, Yorkshire, &c., one female from Lancashire being subdiaphanous; *B. trifolii* from the Scilly Isles, &c.; *Odonestis potatoria* from Sutherland, Sussex, &c.; *Lasiocampa quercifolia* from Cambridge, Hereford, &c.; and *L. illicifolia* from Cannock Chase.

Mr. Tutt exhibited series of *Anthrocera* (*Zygæna*) *filipendulæ* bred by Mr. W. H. B. Fletcher. The original parent, with a tendency to the blotching of the red spots on the fore-wing, came from Deal. By careful selection and inbreeding a race had been obtained that exhibited in almost all the individuals a considerable joining of the six spots, some examples having all the spots united into a large median longitudinal blotch.

Mr. J. W. Tutt read a paper entitled "The Lasiocampid Moths," illustrating it by figures on the blackboard and prepared diagrams (page 1).

Mr. J. A. Clarke related having observed the pupa case of *Bombyx rubi* sticking partly out of the extremely long, vertically placed cocoon, among moss and heather at Wicken. He said that years ago *B. castrensis* was exceedingly common all over Canvey Island, and fed freely on *Artemisia maritima*. Mr. Adkin remarked on the restricted distribution of *B. castrensis* and *B. trifolii* in this country, as compared with the more general occurrence of these species on the Continent. In his opinion this restriction showed that they were not thoroughly established in Britain, and that the occasional abundance was due to the recruiting of the species by immigration. Mr. Stevens said that both *B. neustria* and *B. castrensis* were much less common than formerly. The latter used to be exceedingly common among *Artemisia maritima*. Mr. Hillsworth said that larvæ of *E. lanestris* had been common recently around Laindon.

Mr. McArthur, referring to his experience of *B. rubi* in

the exposed island of Lewis, said that there the cocoon was placed horizontally and not vertically, as the growth of moss and heather was insufficiently deep to admit of that position being used. Dr. Chapman mentioned that he had once found the ova of *Lasiocampa quercifolia* on hornbeam, two or three in a group.

Herr Ernst Heyne said that *Lasiocampa ilicifolia* is rare in Saxony and Bohemia, but not so scarce in Silesia. In Silesia sometimes the red aberration *rubra* had been found; but it is very scarce, perhaps only one in fifty specimens. Several years ago a small number of larvæ were found in the beginning of August on the hills "Hohburger Schweiz" near Leipzig. He visited the locality a week later, but all were then gone.

Mr. Tutt stated that he had hitherto supposed the red form of *L. ilicifolia* peculiar to England.

MARCH 10th, 1898.

Mr. J. W. TUTT, F.E.S., *President*, in the Chair.

Mr. H. Donisthorpe, F.E.S., 73, West Cornwall Road, Mr. F. Bouskell, F.E.S., Leicester, Mr. F. Lemann, F.E.S., Plymouth, Mr. Parkin, Battersea, and Mr. Bevins, of Clapham Common, were elected members.

Mr. Frederick Clark exhibited a large number of photo-micrographic slides with the aid of the Society's lantern. The subjects were all entomological, and embraced most of the typical structures, *e. g.* the antennæ, eyes, probosces, feet and wings, &c., of the various orders. Many of these were of considerable interest, particularly the wing and scales of *Pseudopontia paradoxa*, a lepidopterous insect of the West African fauna and the only species of the genus, from specimens kindly lent by Mr. Harry Moore. The peculiarity of this insect lies in the shape of the scales, the majority of which are bifid in varying degrees, and cover the wing alternately with scales of a commoner form. A number of parasites, human and otherwise, were also shown.

Mr. Lucas also exhibited some slides in the lantern. The subjects were as follows, the first half-dozen having been prepared for him by Mr. Clark: Jaws of *Anax imperator* (nymph). Nymph of *Sympetrum striolatum*, just hatched. Claws and mask of *Calopteryx splendens* (nymph). Mask of *Erythromma naias* (nymph). Legs of *Erythromma naias* (nymph). Lamella of *Erythromma naias* (nymph), very fine

picture. Male *Sympetrum striolatum*, clasping female *per coll* while she was ovipositing. Emergence of *Erythromma naias* from the puparium, shewing five stages. Eggs of eleven species of British *Odonata*. Full-grown nymph of *Anax imperator*. *Anax imperator* nymph using its mask to seize a worm. Male and female *Agrion mercuriale*, taken in New Forest in August, 1897, with an enlarged view of segments 1 and 2 of abdomen. Male *Calopteryx virgo*. Male of the same, with pigment absent from one fore-wing. Female of *Calopteryx virgo*, with hind wings dark, and having a transverse darker band near the tip. Male *Calopteryx splendens*.

MARCH 24th, 1898.

Mr. J. W. TUTT, F.E.S., *President*, in the Chair.

Mr. R. Adkin exhibited a short series of *Grammesia trigrammica* (= *trilinea*, Bork.), in which the ground colour of the wings was so much darkened that the usual transverse lines were obliterated in some of the specimens. He said these dark-coloured examples were known as the Lewes form, and asked whether it was within the knowledge of members present that a similar form occurred elsewhere in any such considerable numbers as it did in the neighbourhood of Lewes, where the specimens exhibited were taken last year.

Mr. Tutt stated that he had only found very few dark specimens in the woods of North Kent, and knew of but few being taken in the neighbourhood of London. Mr. Turner said that some years ago Messrs. Porritt and Tugwell took a very considerable percentage of the dark forms in the Hailsham woods.

Mr. H. Moore exhibited a pale pigmented variety of *Anosia menippe* (*archippus*) from the Malay Archipelago, and stated that he had never before seen any such variation of this species. He said that neither Mr. Mansbridge nor Mr. Pearce knew of a similar form in America. Mr. Birch stated that he had seen thousands of the species, but had never met with a similar variety. Mr. Tutt described the migrations of the species from south to north as observed in America, and noted that fifty years ago it was exclusively a New World species, whereas now, with the spread of its food-plant, it was cosmopolitan.

Mr. Cant exhibited for Mr. Birch a series of strongly marked specimens of *Hybernia defoliaria* from Dean Forest,

and a specimen, *Xylomiges conspicillaris*, from Worcester, the form of the latter being that with a dark costal area.

Rev. J. W. Horsley, M.A., gave an interesting address entitled "A Chat on Snails," and exhibited a large number of land and fresh-water shells from all parts of the world to illustrate his remarks.

APRIL 14th, 1898.

Mr. R. Adkin, F.E.S., *Vice-President*, in the Chair.

Mr. Harrison exhibited a number of living specimens of the Coleopteron *Aspidimorpha sanctæ-crucis* from Bombay. It was a species of the *cassida* group, and looked like a piece of pure gold. It was stated to lose this appearance after death.

Mr. South exhibited, on behalf of Rev. C. D. Snell, a curious specimen of *Leucania littoralis*, having darkened hind wings appearing as though singed, and yet with the fringes perfect.

Mr. Barnett exhibited a living specimen of the viper (*Pelias berus*) from the New Forest.

Mr. Ashdown exhibited specimens of the spring-tail, *Machilis polypoda*, taken under wood and stones in the New Forest in April. Mr. Dennis had observed a very similar species under chalk at Folkestone, and he remarked that the scales of these insects were very similar to those of Lepidoptera.

Mr. Robert Adkin exhibited the following Scotch specimens of the genus *Tephrosia*, viz. one taken in Perthshire in 1891; one from Aberdeenshire, 1892; a female taken in Altire Wood, near Forres, Morayshire, at the end of April, 1896; and two reared from eggs deposited by the last-named, which emerged from pupæ on March 26th and April 16th, 1897, respectively. The specimens were all similar in appearance, and agreed closely with the early, double-brooded insect of the south English counties, *T. bistortata*, Goetze (*crepuscularia*, Dbl. List; *laricaria*, Dbl. Cat.). Referring to the Forres specimens, he said that only seven eggs were obtained, and only the two examples exhibited had resulted from them.

Mr. South exhibited a considerable number of specimens of Japanese species kindly lent by Mr. Leach to illustrate his paper entitled "British Species of Lepidoptera occurring in Japan" (page 12).

APRIL 28*th*, 1898.

Mr. R. ADKIN, F.E.S., *Vice-President*, in the Chair.

Mr. Bishop exhibited a bred series of *Tæniocampa miniosa*, some being very fine and bright in coloration, while others were dark. He remarked that many of the specimens he had bred had the claws of the front legs undeveloped, and were thus prevented from hanging on vertical surfaces. Mr. McArthur said that he had frequently met with similar imperfectly developed specimens.

Mr. Lucas exhibited flowers of the snake's-head (*Fritillaria meleagris*) from the fields near the banks of the Thames at Oxford. Mr. Tunaley said that he had recently had a bunch of the flowers sent to him from Pinner.

Mr. Sauzé exhibited a series of *Brachinus crepitans* from Swanage. This Coleopteron ejects a caustic volatile liquid from its abdomen when pursued. It is a very variable insect both as to size and colour.

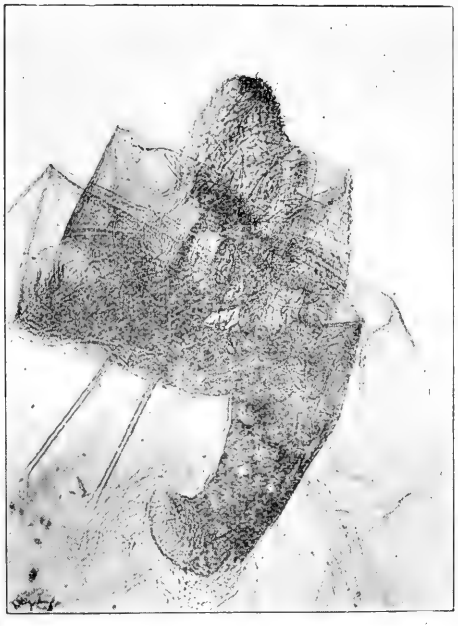
Mr. Edward Saunders sent for exhibition a series of Hemiptera Heteroptera, comprising examples of all the families and most of the genera of this order.

Mr. West exhibited a case of Hemiptera, comprising a large number of species taken by himself during the last three years.

Mr. Robert Adkin exhibited a series of *Eugonia quercinaria*, including males, females, and a gynandromorphous specimen, together with mounted specimens of the genitalia and photographs of the same enlarged 30 diameters, and read the following note:

"On the occasion of the Society's Field Meeting at Chalfont Road on July 23rd, 1896, *Eugonia quercinaria* was found somewhat commonly hanging from dry grass stems in the woods (*Proc.*, 1896, p. 107). From one of the females so taken I procured a small batch of eggs, which in due time hatched, and from them I bred the series now exhibited. The imagines commenced to emerge on June 30th, and the last came forth on July 10th, 1897. Some thirty-three in all emerged, the sexes being as nearly as possible equally divided; two of them were so badly crippled as to be beyond recognition, and one, although imperfectly developed, was so peculiar in its appearance that, although not quite perfect, I set it. This specimen emerged, or, to be correct, attempted to emerge, on July 5th; the head and appendages, legs, wings, and thorax were fully developed, but it had failed to free its abdomen from the pupa skin. Perhaps it was

Male.



Female.

Gynandromorphous.

GENITALIA OF EUGONIA QUERCINARIA.

Magnified × 20 diameters.

largely this fact that gave the specimen its peculiar appearance. Be that as it may, it was not until I was removing it from the setting-board some weeks afterwards that I noticed that the left antenna was female and the right male. Whether it was the excitement of this discovery that unsteadied my hand, I know not, but by some unfortunate means I chipped off the male antenna, and in my endeavour to replace it it broke into a number of pieces and was lost. The differences between the wings on either side are trivial, yet slight as they are the left appear to me to incline in general appearance to those of an ordinary female, while those on the right tend somewhat to those of the male. The specimen in its present condition appeared to be of no great interest; I therefore thought that it might be well to dissect out the genitalia for comparison with the same organs of the ordinary male and female. This Mr. A. Cant kindly undertook to do, and has very successfully mounted them, and with a view to a more easy examination of their structure Mr. F. Clark has, with his usual kindness and skill, produced enlarged photos. From these it will be seen that the organs of the gynandromorphous specimen differ slightly from those of both of the others, but there is a certain want of definition that suggests that the inability of the insect to free its abdomen from the pupa skin prevented its full development, but the absence of claspers and the general contour appear to me to indicate female structure."

A paper by Edward Saunders, Esq., F.L.S., entitled "Notes on collecting British Hemiptera," was read (p. 16).

In the discussion which followed, carding was advocated as the best method of mounting specimens. The structure of the under side, upon which in some cases the specific characters were based, could readily be made apparent if some examples were set with their legs uppermost. If they were worth collecting it was thought that they were worth making presentable by being placed in a symmetrical position

MAY 12th, 1898.

Mr. J. W. TUTT, F.E.S., *President*, in the Chair.

Mr. J. W. Downing, of Tooting Graveney, was re-elected a member.

Mr. Adkin exhibited some specimens from the collection of the late Mr. Tugwell which were labelled *Coremia uni-*

dentaria, red vars., and said that it had been doubted whether this species had a red form. Mr. Tutt remarked that Mr. Prout had bred a red form from true *C. unidentaria*, and thus there was no doubt as to its occurrence; but he was unable to express a decided opinion as to whether the specimens now exhibited were referable to that form, but they appeared to him to resemble it more closely than they did *C. ferrugata*.

Mr. H. Moore exhibited numerous specimens, and contributed the following notes:

Anasa tristis, De Geer (the squash bug).—This common bug is very destructive to squash vines in the United States during August, when it collects round the stems near the ground. The imago hybernates in October, but pairing does not take place till the end of the following June. The odour emitted by this insect appears to be particularly foul, as it is described as disgusting and very offensive.

Murgantia histrionica, Hahn (the harlequin cabbage bug).—This species is very injurious to cabbages, turnips, mustard, and other cruciferous plants, over a large portion of the United States. The imago hybernates and deposits eggs during the first fortnight in March. The larvæ mature in about twelve days, and there are a succession of broods throughout the summer. Riley observes, "The orange and blue-black markings of the imago are very variable both in colour and proportion, the orange inclining to yellow or red." I am indebted for my series of this species to our member Mr. Mansbridge, who collected them at Sequoyah, Indian Territory, U.S.A.

Anophthalmus tenuis (Horn).—During the summer of 1896, Professor Blatchley, in his capacity of State Geologist, explored all the known caves of Indiana, and with his assistants collected specimens of every living thing found in them. Amongst the Coleoptera were numerous examples of *Anophthalmus tenuis*, found beneath stones or running over the soft mud by the side of streams, chiefly in the great Wyandotte cave. The specimen exhibited is one of them. In his paper on the "Indiana Caves and their Fauna," included in the Twenty-first Annual Report of the Department of Geology, are some interesting particulars of the species. He says, "It is a true cave beetle, and never found elsewhere, and only in remote parts of the caves in which it occurs. It has no vestige of eyes, and appeared wholly unaffected by the light of a candle held within a few inches of it. Like other Carabids, they are supposed to be carnivorous. In Wyan-

dotte specimens of mites, spiders, and Podurids were taken in the same localities as the beetles, and probably furnish the latter a scanty supply of food."

Blissus leucopterus, Say (the chinch bug).—This is the most destructive enemy to wheat and corn found in the United States, some seasons being so numerous as to travel in armies from field to field in numbers almost as incredible as the millions of dollars' worth of crops they destroy. There are two broods during the season; that of the late autumn hybernates, appearing again early the following June. The eggs are laid in the ground about the roots; the female occupies nearly three weeks in depositing them, some 500 in number. The smell of this species is said to resemble that of *Acanthia lectularia*, and one writer said that when collecting them he found his nose as good a guide as his eyes. Some half a dozen varieties have been enumerated, and a whole library published upon its life-history, and ravages. The specimens exhibited were collected by Mr. Mansbridge at Sequoyah, Indian Territory, U.S.A.

Mr. Winkley exhibited a slug which had been found in a wood lying to the south-east of Croydon. It was presumably a variety of *Arion ater*, of a beautifully bright flesh-colour.

Mr. Lucas exhibited specimens of the marsh violet (*Viola palustris*) from near the Black Pond, Oxshott.

Mr. Tutt exhibited a specimen of *Libythea celtis* from South France, which he had taken after hybernation. It was set to show how it rested among the dead leaves, the upper wings being hidden by the lower, which in the veinings and markings closely resembled a weather-worn dead leaf. The long porrected palpi filled up the space between the antennæ, which then were comparable to a leaf-stalk. Among other things taken in the same district he also exhibited a tiny specimen of *Lycæna argiades* of a brighter blue than usual, and also a very fine blue female of *L. cyllaris*.

Mr. A. H. Jones exhibited several drawers of South European Rhopalocera, including series of *Thais cerisyi*, *T. polyxena*, and *T. rumina*, and their varieties, mostly bred, together with a large number of Pierids, to illustrate his paper on South European butterflies (page 24). In addition to these he exhibited a case containing examples of *Papilio hospiton*, *Parnassius apollo*, *Charaxes jasius*, *Libythea celtis*, *Satyrus circe*, and many others.

Mr. Tutt congratulated Mr. Jones on his paper, and the members on being able to see such a beautiful collection of the Palæarctic species under discussion. He remarked on

the habits of some of the species in Southern Europe, and made some observations on the habits of *Thais medesicaste* and *T. polyxena*, *Gonepteryx rhamni* and *G. cleopatra*, *Euchloë cardamines* and *E. euphenoides*, *Anthocharis belia* and *A. tagis*. He referred to the great difference in flight between *Anthocharis* and *Euchloë*, and stated that the flight of *Pieris daplidice* was much more like that of *Anthocharis* than that of *Euchloë* or *Pieris*. He touched on the hybernation of *Colias* in Southern Europe, and stated that there was now no doubt that the natural hybernating stage of both *C. hyale* and *C. edusa* was the larval, and that this probably led to the extermination of these insects after each immigration into this country.

Dr. Chapman said that the method of pupation of the genus *Thais* was most curious. The larva made a tail-pad of silk like the Pierids, and also a girth in the same way and position. Immediately after the change, and while the pupa was still soft, the girth was slipped forward and attached to some hooks near the anterior tip of the pupa. There were not three pads, as some writers had observed. He had also noted that the pupa very soon became stiff after the change.

MAY 26th, 1898.

Mr. J. W. TUTT, F.E.S., *President*, in the Chair.

Mr. Edwards exhibited two very large prawns (probably *Palæmon lar*) from Madras, and also a living specimen of a scorpion (*Euscorpius*) found by himself in considerable numbers under stones in the neighbourhood of Cannes. He said that it was an adept at catching flies, and fed readily upon young cockroaches.

Mr. West, of Greenwich, exhibited a series of the smallest British water-bug, *Microvelia pygmæa*. He stated that it ran over the surface of the water.

Mr. Turner exhibited a life-history series of *Coleophora genistæcolella* from Carlisle, showing imagines and cases made by the larvæ on the food-plant *Genista anglica* (the petty whin). He stated that the larvæ and cases were to be obtained at Oxshott, where the members who attended the field meeting on May 21st found them. He also exhibited a very perfect fossil specimen of the Trilobite, a very early form of Crustacean, from which our crabs were doubtless derived.

The collection of slides formed by the South-eastern Union

of Scientific Societies, to illustrate the geological formations of the Gault and Wealden series as they appear in the south-eastern counties of England, were exhibited in the lantern. Mr. Lucas, B.A., read the descriptive lecture circulated with the slides, and a short discussion ensued.

JUNE 9th, 1898.

Mr. J. W. TUTT, F.E.S., *President*, in the Chair.

Mr. Lucas exhibited coloured drawings of the rare Odonata *Libellula fulva*, showing details.

Mr. Bishop exhibited a bred specimen of *Brephos parthenias*, having a gap in the wing, due to an injury to the pupa. The gap was noted to be ciliated. He also exhibited specimens of *Thecla rubi*, and remarked on the variability of the androconial marks in this species, while in all the rest of the species of the genus they were notably constant; specimens of *Rumia luteolata* showing considerable variation in the red spotting; and larvæ of *Tæniocampa munda*, *T. incerta*, and *T. stabilis*.

Mr. Tutt, referring to eggs of *Hepialus lupulinus*, which he exhibited, said that under a lens they looked liked little black sloes, and were most distinctive.

Mr. West, of Greenwich, exhibited series of *Trapezonotus agrestis* and *Tropistethus holosericeus* obtained by shaking moss in Headley Lane.

Mr. Shortridge Clarke mentioned a remarkable occurrence. He stated that thousands of larvæ and imagines of *Caradrina quadripunctata* (*cubicularis*) had been observed in a large flour store in a warehouse where a quantity of new-mown hay was stored annually. From a small mass of cocoons he had bred more than 500 imagines, none of which, however, showed the slightest variation from typical lines. The cocoon mass looked like a dirty sponge, in which each pupa had a cell of its own as it were. To obtain light in the store it was necessary to clean the window twice a day. He also remarked upon the difficulty of rearing the pupa of *Dianthæcia cæsia*, which, according to his experience, almost invariably died in the last stage.

JUNE 23rd, 1898.

Mr. J. W. TUTT, F.E.S., *President*, in the Chair.

Mr. E. Broome, Christchurch, Oxford, was elected a member.

Mr. Filer exhibited living larvæ of *Thecla rubi* feeding on rock-rose (*Cistus*), and called attention to their remarkable protective coloration.

Mr. R. Adkin exhibited living larvæ of *Acidalia marginipunctata* (*promutata*). The ova from which they were reared were deposited by a female taken at Christchurch in August last. They hatched early in the autumn, and the larvæ continued to feed so long as the mild weather lasted, but remained stationary during the winter, commencing to feed again with the return of warm weather in spring. Some of them were now full-fed, but others were still only about half grown.

Mr. H. Moore exhibited two specimens of *Arctia caia* bred from ova by Mr. Cooke, of Lower Road, Deptford. The batch of larvæ, about sixty in number, fed through the winter on cabbage. The imagines exhibited emerged on May 30th, and were extreme varieties, but in opposite directions :—

1. Fore-wings uniformly dark chocolate, without the usual cream markings. Hind wings with the black markings increased in area, and the red very intense.

2. Fore-wings with a very considerable decrease in the area of the dark markings. The imagines were derived from French parents, and were of good average size.

Mr. Barnett exhibited a specimen of *Venilia maculata* taken in a wood south of West Wickham, having the blotches of dark colour irregularly joined and blurred on one side only.

JULY 14th, 1898.

Mr. R. ADKIN, F.E.S., *Vice-President*, in the Chair.

Mr. H. Shortridge Clarke, F.E.S., Sulby Vicarage, Isle of Man, was elected a member.

Mr. South exhibited a series of *Lycæna corydon* to illustrate the scheme of variation in the spots of the under surface. With regard to the spots on the basal area of the fore-wings, it was seen that these might be entirely absent, or range from one up to five in number. Gradations leading up to

complete union of the second basal spot with the initial spot of the central series were also shown. In some other examples the maculation was asymmetrical. Mr. South also exhibited a series of forty-two specimens of *Spilosoma lubricipeda*, comprising thirty-five var. *zatima* (= *radiata*) and seven typical males reared from ova deposited by a dark female *zatima*.

Mr. H. Moore exhibited an exceedingly dwarfed form of *Polyommatus* (*Lycæna*) *icarus* taken in the Warren at Folkestone. Mr. Turner stated that he had a similarly dwarfed specimen, which formerly belonged to Mr. Wellman.

Mr. Lucas exhibited specimens of *Libellula quadrimaculata*, and observed that of those he had taken this season most were highly coloured, either by a dark suffusion under the pterostigma and under the nodal spot, or else by a saffron coloration spreading along the wing near the costal margin. In some cases both forms of variation were present, as in the smaller example exhibited.

Mr. West, of Greenwich, exhibited a short series of the Hemipteron *Lopus flavomarginatus* taken at Abbey Wood.

Mr. Little exhibited a full-sized drawing of a curiously fasciated stem of holly which had been found in the New Forest by one of the foresters. At some distance from its origin it divided into six flat strips, which were curiously curled and twisted. At the extremities of these stems were several diminutive leaves.

Mr. Perks exhibited specimens of the orchids *Herminium monorchis* and *Neottia nidus-avis*, which he had recently found still flourishing at Box Hill.

Mr. Dennis exhibited the egg of *Polyommatus* (*Lycæna*) *icarus* under the microscope. It resembled in symmetry and beauty the flower of a white double dahlia.

Mr. R. Adkin read the following report :

"The second Field Meeting of the season was held at Reigate on June 11th. Accommodation for twenty persons was reserved on the 2.17 train from Cannon Street, of which sixteen members and two friends availed themselves, reaching Reigate Station about half-past three, where they were met by three other members, bringing the total attendance to twenty-one.

"The town of Reigate is situated at the foot of a spur of the North Downs, partly on the chalk formation, partly on the gault and greensand, the latter cropping up prominently at Reigate Heath, about a mile west of the town. It is intersected by the main London and Brighton road, from

which former place it is just over twenty miles, and the river Mole passes close by.

"The operations of the afternoon were confined to the southern slope of the Downs, which were reached after walking somewhat less than a mile from the railway station, and by taking the main road towards London for about a hundred yards, and then turning sharp to the left along the 'Pilgrims Way.'

"A more enjoyable afternoon for a country ramble could not well be imagined, the fierce heat of the sun beating on the chalky slopes of the Downs, being tempered by a gentle northerly breeze; but it was only too evident that the prevalence of the latter and the too frequently cloudy skies of the previous few weeks had tended to make the season an unusually late one, and as a consequence many species that were confidently looked for were not to be found. There was, however, no reason to be dissatisfied with the afternoon's operations, which appeared to be thoroughly appreciated by all present. On returning, a substantial tea was provided at the Railway Hotel, and the homeward railway journey commenced by the train leaving Reigate shortly before 9 o'clock.

"A suggestion made that members should send in lists of their captures, and observations made during the meeting, was well supported, a considerable number of communications being received, and these have materially assisted in the preparation of the report.

"The first species to attract attention was *Euchloë cardamines*, numerous examples of which were seen flying over the railway banks as the train passed along, at none too rapid speed, between New Cross and Forest Hill railway stations, the orange tips of their wings showing very distinctly in the brilliant sunshine. Other specimens of the same species were met with on the borders of the town of Reigate, together with *Pieris brassicæ* and *P. rapæ* in some numbers, and *P. napi* less commonly. *Gonopteryx rhamni* was seen on the wing by Mr. Bishop, and it may not be out of place to mention that both males and females of this species were observed by the same gentleman, in the Guildford district, so late as June 17th and 18th, whereas he had found ova deposited as early as May 10th, a good illustration of the irregularity of the present season.

"*Vanessa urticæ* was flying in some numbers, and several nests of larvæ were found on the nettles, odd specimens of *V. atalanta*, *Pararge megæra*, *Thecla rubi*, and *Polyommatus*

phlæas were also noted. *Cœnonympha pamphilus* and *Lycæna icarus* were somewhat abundant, flying among or resting on the long grass, a luxuriant growth of which covers the downs at this season of the year. *Lycæna minima* was not uncommon in some few sheltered nooks; *L. astrarche* was found sparingly, and a few *L. argiolus* were still on the wing. One or two male specimens only of *L. bellargus* were met with—a strong contrast with the record of the Society's Field Meeting in the same locality on almost the same date in 1894 (June 9th), when this species was fully out, and a large number of exceedingly blue forms of the female were secured. *Syrichthus malvæ* and *Nisoniades tages*, both of which occurred plentifully, conclude the list of butterflies that were noted.

"The males of *Bombyx rubi* pursued their wild flight over the Downs in the afternoon sunshine, some few of them falling victims to the more dexterous members of the party. Larvæ of *Zygæna filipendulæ* were sufficiently abundant on the lower herbage, while an occasional pupa case was to be seen on the grass stems. The down-loving *Setina irrorella* was found very sparingly during the earlier part of the afternoon, but coming on flight towards seven o'clock proved to be present in far larger numbers than the work of the previous hours had suggested, and provided some fine series. Single examples of *Hepialus lupulinus* and *Euchelia jacobææ* were taken.

"A light-coloured Noctua was several times seen hovering in the sunshine among the grass, and darting wildly away before capture was possible, owing to the hilly nature of the ground, thus exciting the imagination of several members. Could it be *Pachetra leucophæa?* The species had been taken on this very spot, but then it could hardly be expected to be on the wing in the daytime. Or perchance a *Heliothis* of some sort? Much nearer the mark this time, but not quite right, for on one at last being secured it proved to be but that personification of perpetual motion, *Plusia gamma*, and we wondered how often our hopes have been raised and as suddenly dashed to the ground by this same species.

"*Phytometra viridaria* (*ænea*) was fairly common; but as a rule the individuals examined showed unmistakable signs of wear, and in this respect were in strong contrast with the brilliant specimens of *Eucledia mi* and *E. glyphica* which fell to the lot of many of the members present. Larvæ of *Cucullia verbasci* were found on the mullein wherever the plant occurred.

"The Geometræ noted included *Rumia luteolata* (*cratægata*), *Venilia maculata*, *Ligdia adustata*, *Eupithecia vulgata*, and *E. subumbrata*, *Acidalia ornata*, which was in very fresh condition and fairly common, *A. remutata* and *A. subsericeata*, *Ematurga atomaria*, *Bapta temerata*, *Melanippe montanata*, *M. rivata*, and *M. sociata*, *Camptogramma bilineata* and *Anaitis plagiata*, of which species the long slender larvæ were also found.

"The small fry were common enough, but the records that I have received of them are somewhat disappointing; they include *Scoparia dubitalis*, *Crambus pratellus*, *C. hortuellus*, *C. culmellus*, and *C. pascuellus*, *Dichorampha sequana*, *D. plumbana*, *D. plumbagana*, and *Penthina gentiana*. *Adela viridella*, *Dasycera sulphurella*, *Elachastis biatomella* and *Glyphipteryx fischeriella*. Also larvæ of *Mimæseoptilus phœodactylus* on rest-harrow, *Botys ruralis* (*verticalis*) in stinging-nettle leaves, and a nest of *Scythropia cratægella* on hawthorn.

"To Mr. W. West, of Greenwich, I am indebted for the following list of species in orders other than Lepidoptera. He reports that a couple of hours' hard sweeping produced many species of Coleoptera, including *Conurus immaculatus*, *Mycetophorus splendidus* and *M. longulus*, *Lithocaris brunnea*, *Anisotoma badia*, *Cryptocephalus lineola*, a species that he was very pleased to meet with, *Syncalypta spinosa*, *Drilus flavescens*, *Hedobia imperialis*, and numbers of Apions, Sitones, Orchestes, Atomarids, Lathridius, and Staphylinids too numerous to mention. The Hemiptera taken included *Coreus denticulatus*, *Metacanthus punctipes*, and *Dicyphus annulatus*; and the Homoptera *Philænus exclamationis*.

"Among the flowering plants noted may be mentioned the corn crowfoot (*Ranunculus arvensis*), the yellow wort (*Chlora perfoliata*), the green man orchis (*Aceras anthropophora*), the bee orchis (*Ophrys apifera*), and the spotted orchis (*Orchis maculata*).

"Mr. Frederick Clark reports that he obtained quite a nice collection of microscopic material, the result of which we shall, no doubt, hear later on."

SEPTEMBER 8th, 1898.

Mr. J. W. TUTT, F.E.S., *President*, in the Chair.

Mr. Little, of King's Cross, was elected a member.

Mr. Frederick Clark exhibited some very admirable photographs of the eggs of Lepidoptera, including those of *Erebia*

embla, *Chionobas jutta*, *Polyommatus bellargus*, *P. icarus*, *Gonepteryx rhamni*, and *Spilosoma menthastri*. These were all much magnified, and their forms and markings very well defined, especially in the case of the fine reticulations of the last-named.

Mr. Edwards exhibited three captured specimens of *Abraxas ulmata* received from Mr. Hewitt, of York. Two were very fine, dark, smoky forms, and the third was one with the usual ground colour unusually clean white. Mr. Tutt said that it had been reported by Dr. Riding that out of the large number of specimens reared from dark parents not one had been of the varietal form. Mr. Mansbridge said that some years ago the experience of the Yorkshire men was precisely the same, only normal forms resulted from ova laid by the then captured varieties.

Mr. West exhibited a number of specimens of *Forficula lesnei* taken by himself, some at Reigate on September 3rd, and some at Box Hill. There were both males and females, and the species was common. Mr. Lucas said that among them was another form which he supposed to be a more or less immature form of the female. It might even be a distinct species.

Mr. Lucas exhibited a series of the local grasshopper, *Mecastethus grossus*, which had this year been comparatively common in the New Forest. He very kindly presented a specimen of both male and female to the Society's collections.

Mr. Turner exhibited a yellow variety of *Callimorpha dominula* (var. *rossica*) bred from a larva taken at Deal; bred specimens of *Myelois cribrella*, and stated that out of some 150 examples, there was scarcely a trace of variation; a specimen of *Abraxas grossulariata*, having the space internal to the marginal spots of a brownish tinge, while the remainder of the wing-surfaces were normal; and a series of *Aglais* (*Vanessa*) *urticæ*, bred from Box Hill larvæ, having the large black blotch on the inner margin entirely absent or only represented by one or two slight streaks. He stated that about half the brood were of the varietal form, and suggested that the fact of the larvæ being fed up in a greenhouse, and subject to abnormal heat and moisture, might have produced this partial approach to the South European form, var. *ichnusa*. He also said with reference to *A. grossulariata*, that the species, so far as London was concerned, seemed to have changed its food, being rarely found on the currant or gooseberry, but almost invariably on *Euonymus*. Mr.

Tutt said that he had repeatedly seen the yellow form of *C. dominula* on the Continent, but that it was undoubtedly rare in this country. With regard to *A. grossulariata*, he said that Mr. Merrifield had remarked how commonly the species was found feeding on the *Euonymus* in the squares of Brighton. Mr. Adkin said that years ago it was most abundantly found on hawthorn, and Mr. West had taken it commonly on spindle.

Mr. Dennis exhibited specimens of the filmy fern, *Hymenophyllum wilsoni*, from Wales. It was found in much drier and more exposed situations than its close ally, *H. tunbridgense*.

Mr. H. Moore exhibited a series of blue females of *Polyommatus* (*Lycæna*) *icarus* from Folkestone. Mr. Tutt remarked that in the south of Europe he had very rarely seen blue-marked females; they were nearly all of the dark type form of the sex.

Mr. Mansbridge exhibited a series of under sides of the female of *Plebius* (*Lycæna*) *ægon*, selected to show the ordinary range of variation in the species as it occurred in St. Leonard's Forest. He was of opinion that with most of the blues the females were getting more blue than they were years ago. He related a curious experience that had happened to him with both *Polyommatus* (*Lycæna*) *icarus* and *P. ægon*, viz. that of a male taking up the position of a female, and actually attracting other males. That these were males he verified by capture. Mr. Tutt referred to *P. argus*, and stated that although the difference of these two species from each other was so slight that some entomologists considered them specifically identical, yet even when they occurred in the same valley they were perfectly distinct as regards locality.

Mr. Montgomery exhibited an exceedingly fine dark suf-

fused male aberration of *Dryas* (*Argynnis*) *paphia*, one of two specimens bred from ova.

Mr. Ashby exhibited a tiny aberration of *P. corydon* taken at Riddlesdown, and a female of *P. ægon* from Oxshott, showing numerous blue splashes on the upper surface.

Mr. Bishop exhibited a beautiful series of bred *Geometra vernaria* from Guildford.

Mr. Tutt said, with reference to the drinking habits of butterflies, that of every species of skipper he had seen alive he had observed the males indulging in this curious habit. Mr. Lucas said that he had seen male dragon-flies dip their heads in the water on one occasion.

SEPTEMBER 22nd, 1898.

Mr. J. W. TUTT, F.E.S., *President*, in the Chair.

Mr. Robt. Adkin exhibited a short series of *Dianthœcia nana* (= *conspersa*) from Shetland, and read the following note:—"In the autumn of last year I exhibited a number of examples of *Dianthœcia nana* that I had reared from larvæ taken in Cunningsburgh and the Isle of Mousa in the Shetlands in 1896 ("Proceedings," 1896, p. 142). Those from Cunningsburgh varied from comparatively light-coloured specimens to almost wholly blackish, whereas the few from the more isolated Isle of Mousa were all of the darker form; but I expressed an opinion that with more material to work upon we should probably find identically the same range of variation in both places. Some of the pupæ that remained over from 1896 produced imagines this summer, which I now exhibit. It will be seen that those from Cunningsburgh show a somewhat larger proportion of the very dark forms than those which emerged in 1897; but this I attribute to accident rather than to any effect of the prolonged pupal existence, as one or two of the specimens are quite of the lighter form. The single example, too, that was reared this year from the Mousa pupæ is also of the light form, thus establishing the fact that although the Shetland forms differ so vastly both from those of the Scottish mainland and Orkney, those from the Shetland mainland and the outlying islands are identical in their range of variation."

Mr. W. Reid, of Pitcaple, sent for exhibition long series of varieties of *Tæniocampa gothica*, the result of breeding from selected parents through some four generations. The eggs were, in the first instance, obtained from strongly-marked

wild females, the male parents being unknown, and in the first broods reared only about 10 per cent. were of the same form of the particular female parent. These were paired with males of the same variety, and again bred from, with the result that in the fourth year only about 4 per cent. were dissimilar to the parent form. The series exhibited comprised, among others, dark forms with pale stigmata and the "gothic" mark purplish black; light "golden" forms, gothic mark reddish brown; banded forms, stigmata outlined with yellow; reddish forms with gothic mark of a slightly darker shade; greyish and reddish-brown forms in which the "gothic" mark was absent (= var. *gothicina*). He also sent for exhibition series of two very distinct forms of *Abraxas grossulariata*, in one of which the fore-wings were much obscured by an increase of the black markings, while in the other the black markings, with the exception of the discoidal spots, were absent from the central areas of all the wings. Also series of *Melanthia bicolorata*, var. *plumbata*, and very fine examples of *Pachnobia hyperborea* from the Perthshire mountains.

Mr. Harrison exhibited the eggs of the Niger crocodile (*Crocodilus cataphractus*), and also the eggs of a *Bulimus* from the same locality.

Mr. Lucas exhibited five species of the scarce or little known British dragon-flies, taken this season. These were *Sympetrum sanguineum*, from Sandwich, Kent, and one male from Ockham Common; *Sympetrum flaveolum*, from Ockham Common; *Æschna mixta*, one male from Ockham Common; *Libellula fulva*, one male from Sandwich, shewing the blue coloration, which only develops a considerable time after emergence; *Agrion mercuriale*, male and female from the New Forest.

Mr. Tutt exhibited specimens of *Zonosoma annulata*, bred by Dr. Riding from ova obtained from females bred or captured near Buckerell. These were remarkable from the fact that a large percentage were of the ab. *obsoleta*, and one example of the ab. *biobsoleta*. He stated that Dr. Riding had twice captured the ab. *obsoleta* in East Devonshire, in the neighbourhood where Mr. D'Orville, some twenty or thirty years ago, had taken a similar aberration. Details of the two broods were given, and the results from the second brood were anxiously looked forward to in the spring of 1899.

Mr. Tutt also exhibited for Mr. Thornhill a most curiously marked female specimen of *Euchloë cardamines* from Cam-

bridge. Two wings were largely clouded with black, while the others were irregularly streaked with the same colour.

On behalf of Mr. Manger, Mr. Tutt exhibited a number of insects captured long distances out at sea, including *Deilephila alecto, D. livornica, Chærocampa celerio, Abraxaphantes perampla, Margaronia unionalis, Euchera capitata, Patula macrops, Ophideres dividens, O. fullonica, Macroglossa stellatarum, Acridium peregrinum, Morinus asper.*

Mr. Dolman exhibited a curious specimen of *Abraxas grossulariata*, found at rest on a tree trunk by a boy. The black markings were quite typical, but the ground colour was entirely of a uniform deep orange. He also exhibited the ova of *Aporia cratægi* from Dover, and stated that ova, larvæ, and imagines of the species were to be found this year all at the same time.

Mr. T. W. Hall exhibited a gravid female and a colony of worker ants which he had found inhabiting burrows in the stems of alder, from which he had expected *Sesia sphegiformis* to emerge. On cutting the stem open no trace of the Lepidopteron was discovered, the assumption being that the ant had made away with the *sphegiformis* larvæ.

Mr. Perks exhibited a specimen of the pipe-fish, *Sygnathus*, from Portscatho, Cornwall. It was a male, and showed very well the long ventral pouch in which the ova undergo the process of hatching.

Mr. West, of Greenwich, exhibited bred specimens of the Hemiptera *Podisus luridus* and *Goniocerus venator*, both from Box Hill.

Mr. H. J. Turner exhibited a bred series of *Porthesia chrysorrhœa* from larvæ taken in North Kent. Mr. Montgomery had found a larva in Sussex this year. He also exhibited a larvæ of *Dicranura bifida*, taken in West Kent, and the remarkable starfish-like flower of a South African plant, *Orbea* (*Stapelia*) *irrorata*, of which he had exhibited a photograph at the last meeting.

Mr. Dennis exhibited under the microscope the ova of *Thecla w-album*.

Mr. Edwards exhibited a kitten with an extra toe more or less developed on each foot. The extra claw on the right fore-paw being of the ordinary size.

OCTOBER 13th, 1898.

Mr. J. W. TUTT, F.E.S., *President*, in the Chair.

Mr. Russell, The Limes, Southend, Catford, was elected a member.

Several donations to the collections were exhibited, including numerous species of dragon flies from Messrs. Ashdown and Lucas, and a large number of specimens of micro-lepidoptera from Mr. Drury, F.R.H.S.

Mr. Moore exhibited a series of *Polia chi*, and read the following note:—"A writer in the current number of the "Entomologist" has instanced this species as an example of protective resemblance, 'appearing like a grey spot of lichen on the rocks.' My experience does not confirm it. In the neighbourhood of Matlock, Derbyshire, it was common during the last week of August and the first of September. The stone hedges thereabouts are black with age, but the moth shows no melanic tendencies; in fact, it is as conspicuous as a white spot on a black place well can be, and is easily seen from a comparatively long distance. What its natural enemies may be I do not know; neither in the morning nor evening did I see any birds after it, and considering how readily they capture inconspicuous Diptera, &c., they could scarcely miss *Polia chi* if they wanted it; in short, to consider the species specially protected by its resemblance to its surroundings seems to me a far-fetched fancy."

Mr. Fremlin exhibited, on behalf of Mr. Auld, three specimens of the summer form of *Pygæra curtula*, and three examples of the spring form of that species; also three specimens of *P. anachoreta*, and eleven hybrids from a crossing between female *P. curtula* and male *P. anachoreta*. These last were bred in April, 1898, by Dr. Knaggs. It was noticed that in their markings the hybrids followed the female parent, and that the coloration was somewhat similar to the darkest form of the spring brood of *P. curtula*; the chocolate tips of the wings, however, were darker than is often found in that species.

Mr. Fremlin exhibited also (on behalf of Mr. Hope Alderson, of Farnborough, Kent) a beautiful var. of *Eubolia bipunctaria*, which at first sight looks like *Melanippe montanata*.

Mr. Winkley stated that he had observed the blue tits attacking the galls on some willows in his garden, while the

sparrows did not touch them. Dr. Chapman remarked that sparrows and finches no doubt attacked the buds in spring for the sake of the delicate tissue, and did a vast amount of damage; but it had never been proved that the tomtits injured the buds. They doubtless attacked the galls for the grubs which they contained.

Mr. Hall exhibited two fruits of the banana, which, although they had separate stems, had anastomosed together almost their whole length.

Mr. Adkin exhibited a bred series of *Cidaria sagittata*, and said that larvæ still appeared to be obtainable in the fen districts by those who knew how and when to look for them.

Mr. Turner exhibited a bred specimen of *Eugonia* (*Vanessa*) *polychloros* from Horsham. It was much darker than typical examples, having scarcely a trace of blue in the hind border; the fulvous area generally darker, with many black scales scattered over it; the black markings seemed slightly more intense. It was comparable to some of Mr. Merrifield's specimens produced in his temperature experiments.

Mr. Kaye exhibited a *Syntomid* moth from Venezuela, *Macræneme ladis*, and a species of wasp which it mimicked. The development of hairs on the long posterior legs of the moth, to correspond with the swollen tibia of the wasp, was most remarkable.

Mr. West, of Greenwich, exhibited specimens of the Hemipteron, *Ploiaria vagabunda*, from Reigate.

Mr. Tutt read a paper entitled "Scientific Aspects of Entomology" (page 33).

OCTOBER 27th, 1898.

Mr. J. W. TUTT, F.E.S., *President*, in the Chair.

Mr. Ashdown exhibited the following species of Coleoptera of the Longicorn group, all of which he kindly added to the Society's collections:

Clytus arietis, *C. mysticus*, *Rhagium bifasciatum*, *R. inquisitor*, *Toxotus meridianus*, *Molorchus minor*, *Anoplodera sexguttata*, *Strangalia armata*, *S. melanura*, *S. nigra*, *Leptura livida*, *Grammoptera analis*, *G. tabacicolor*, *G. ruficornis*, *G. præusta*, *Agapanthia lineatocollis*, *Saperda populnea*, *Phytœcia cylindrica*, *Tetrops præusta*, and *Leiopus nebulosus*.

Mr. Montgomery exhibited a specimen of the third brood

of *Cyaniris* (*Lycæna*) *argiolus*, bred on September 30th; specimens of three broods of *Selenia bilunaria*, and remarked that the third brood followed the second brood, and did not revert to the first brood form; and also specimens of a third brood of *Coremia ferrugata*.

Mr. Mansbridge exhibited four specimens of *Polyommatus* (*Lycæna*) *bellargus*, two blue vars. of the female, and two underside aberrations. He remarked that the females in the localities he collected in were getting bluer year by year, and that he usually found that the females of the spring brood were more liable to this variation than the autumn one. Mr. Tutt said his experience in Kent had been the same.

Mr. Dennis exhibited pupæ and cocoons of *Chærocampa elpenor* and *Sphinx ligustri*.

Mr. Adkin exhibited series of *Bryophila perla*, *B. muralis*, and *Botys flavalis*, in illustration of his paper entitled "Lazy Days by the Sea. Chiefly concerning Lepidoptera" (page 50).

In the discussion which followed, Mr. Tutt said that many species were more or less continuous brooded in more southern countries of Europe, and suggested that *Acidalia marginipunctata* was a species which attempted to carry out this habit in England. He also remarked that several Pyrales, which occurred in all kinds of inland localities in Europe, were strictly confined to the neighbourhood of the coast in our own country, such as *Stenia punctalis* and *Odontia dentalis*. In reply, Mr. Adkin thought there were several broods of *A. marginipunctata* which overlapped each other.

Mr. Tutt exhibited, on behalf of Mr. Gordon, a considerable number of species taken in Wigtonshire, including—

Cœnonympha typhon, chiefly of the *rothliebii* form, one having the ocellated spots reduced in size; *Saturnia pavonia*, four female specimens, very variable in size, one with much red on the hind wing; *Smerinthus populi*, one pale fawn example and one pale grey; *Phalera bucephala*, three specimens, each with the right fore-wing dark; *Euthemonia russula*, five specimens, with the hind wings much suffused; *Dasychira fascelina*, five specimens, very variable as to the transverse line just external to the discoidal spot.

NOVEMBER 10th, 1898.

Mr. J. W. TUTT, F.E.S., *President*, in the Chair.

The evening was devoted to a special exhibition of varieties of all orders.

Mr. F. J. Robinson exhibited, on behalf of Mr. A. H. Jones, of Eltham, specimens of the following species:

Melanargia galatea, having the irregular white band across the centre of the wing wide, and more than usually conspicuous; *Argynnis paphia*, var. *valesina*, in which the basal spots are confluent; *Lycæna corydon*, a light brown female example; *Xanthia aurago*, nearly unicolorous; *Ephyra pendularia*, red suffusion on wing; *Thais cerisyi*, female, a melanic form from Armenia; and *Argynnis pales*, var. *arsilache*, taken in the Engadine.

Mr. Robinson also exhibited gynandromorphous specimens of *Cleora lichenaria* and *Crocallis elinguaria* from the New Forest. In both cases the right side was female and the left male, even to the genitalia.

Mr. D. Chittenden exhibited among others—

Agrotis segetum, a black variety; *A. exclamationis*, a very pale form and a red form; *A. corticea*, several dark varieties; *Anchocelis lunosa*, a reddish form and a black form; *Xanthia aurago*, a varied series showing red forms, yellow forms without the inner band, pink forms and dark forms; *Dianthœcia carpophaga*, a white variety.

Mr. Williams exhibited long series of *Pararge egeria* and *Amphidasys betularia*, and read the following notes:

"*Pararge egeria*.—The series of this insect shown to-night have been, with the exception of the few labelled New Forest, bred by myself from ova.

"The ova were deposited on July 27th, 1892, and hatched on August 7th. One larva showed signs of feeding up long before the others, and made such progress that it pupated on September 1st, the butterfly emerging on the 19th, a female. The remaining larvæ reached the pupal stage during the last fortnight of September. At that time I was not aware, and I think it was not generally known, that this species could pass the winter as a pupa, and therefore, thinking they would probably perish unless the imagines were forced to emerge at once, I determined to subject them to various temperatures by way of experiment. Some pupæ were exposed to a high dry heat, some to a high temperature but saturated with moisture, and a third batch were placed

in a breeding cage near the fire-grate. In addition, eight pupæ were placed out of doors in November, and were left exposed to the cold of the winter. These lived, retaining their lovely green colour till the end of the following March, and they all emerged during the first nine days of April.

"The resulting insects are not, perhaps, sufficiently numerous to generalise upon, but it will be seen that a certain amount of variation exists, in particular some of those of November and December, 1892, have a tendency to a darkening of the outer margin of the under side of the hind wings, and also have a greyish tone compared with the spring specimens. The under sides of the latter are of a warmer brown, and have not the dark edging before referred to so pronounced.

"*Amphidasys betularia*.—The whole of the batch of fifty specimens of this insect were bred by myself from ova deposited by a captured female of the normal type, taken in Essex in June, 1895.

"There being nothing striking about this female, when she had finished laying, her remains were thrown away, and of the male parent I have, of course, no knowledge whatever. Wishing to enlarge my series, I fed up the larvæ, little thinking that the resulting insects would be anything other than typical, but to my gratification they covered a range in colour varying from a form lighter than the type to a black, almost equal to that of the variety *doubledayaria*."

Mr. Mansbridge exhibited a specimen of *Cabera pusaria*, var. *rotundaria*, bred from North Kent.

Mr. Edwards exhibited a specimen of *Abraxas grossulariata*, bred from Edmonton. The usually white areas were closely dusted with fine dark dots, and the orange markings were well developed and intense.

Mr. Rose exhibited a long series of *Xanthia aurago*. They showed a very extensive range of variation, including rich uniform red, bright canary-coloured, and banded forms of all shades. They were taken at Reading.

Mr. Butler, of Reading, exhibited ordinary forms and dark varieties of *Stauropus fagi* taken in May, 1897; ordinary forms and dark varieties bred in April, 1898; pale, intermediate, and dark forms bred in July and August, 1897–8; very dark forms from August pairing (black parents), bred June, 1898—the first time a second brood has been reared in this country. *Xanthia aurago*, long series, all the forms given by Mr. Tutt, "British Noctuæ and their Varieties," also a pink form not mentioned in the above work.

Mr. Tutt exhibited six specimens of *Anthrocera trifolii* from Rennes of the form named *palustris* by Oberthür (= *trifolii-major*, Tutt). These were of large size, and were compared by M. Oberthür with the large form captured at Freshwater in the Isle of Wight, of which M. Oberthür has examples in his collection. Also the cocoon and two parasites, one dipterous, the other hymenopterous, which had emerged from larvæ of this form. He also exhibited two cabinet drawers of British Argynnids and Brenthids, for comparison with Dr. Chapman's exhibit of Continental specimens of the same species; also a long series of *Brenthis pales* from various parts of the Continent. He pointed out the great sexual difference that existed in some of these individuals; it was exceedingly well marked in the specimens from the Dauphiné Alps. He further called attention to the small amount of black markings on the upper side of the males of this species from Dauphiné compared with those from the Austrian Tyrol. In the heavy character of the black markings on the upper side of the male specimens the Tyrolean examples most nearly approached those from Scandinavia.

Mr. Pearce exhibited a long series of *Bryophila perla* taken at Folkestone this year. Only one yellow form was taken, but a considerable proportion of the captures were of the leaden form, which seems to occur chiefly on walls in the town itself.

Mr. R. South exhibited a series of *Eubolia limitata*, comprising five specimens with the ground colour light golden brown, from North Devon, and seven dark examples from Weardale, Durham. A series of nine specimens of *Boarmia cinctaria*, bred from ova deposited by a female taken in Ireland; the majority of these had a light ground colour, but one example was rather dark. *Hydræcia micacea*, a pair bred from larvæ feeding in potato stems in Aberdeenshire. These were received from Miss Ormerod, and are remarkable for their small size and the dark coloration of the fore-wings.

Dr. Chapman exhibited *Aglais* (*Vanessa*) *urticæ* and several species of European Argynnids, and contributed the following notes:

"*Aglais urticæ* bred from larvæ taken at Kaafjord, Alten, Finmark, Norway (lat. 69° 50′ or thereabouts).

"As the butterflies emerged and many of them pupated also in England during the hot weather of August, 1898, they may be less mælanic than normal for their habitat, though an imago taken by Mr. Lloyd at Bossekop (a dozen

miles off) has a more English facies than the average of these.

"Taken altogether, they are much darker than the common English form. They are also more variable than an equal number of English specimens would be,—variable in the sense that there is not a central uniform mass with a few outliers of more or less marked aberrations, but throughout the greater part of the range of variation individuals are as abundant of one form as of another. The range of variation is also no doubt greater than in an equal number of English specimens, but does not at all exceed or indeed equal that of the English race of *Urticæ*, if selection of extreme varieties be made from a sufficient number of specimens; but a similar selection from Lapland specimens would, no doubt, afford a wider range of varieties.

"There are not only dark forms, but some really very pale ones. The two black spots on the centre of the fore-wing are always present; but in several specimens they are very small and pale, and in other specimens there is a distinct tendency for the yellow patch of the inner margin and the outer one of the costal margin to join as a fascia past these spots, the ground colour also being pale. At the other extreme a large proportion of the specimens have numerous dark scales tending to join the second costal with the inner blotch in a black fascia; in a few this is nearly, but in none quite complete.

"The Argynnids shown belong to that section that we now know as the genus *Brenthis*. The specimens illustrate one or two points that are probably more or less familiar to most of us. Our British species *euphrosyne* and *selene* are fairly representative species of the genus, which contains a number of both palæarctic and nearctic forms. Of these a very large proportion are on the upper side very similar to *selene* and *euphrosyne*, so much so that if the various geographical varieties and aberrations of *selene*, *euphrosyne*, *dia*, *aphirape*, and probably several other species were mixed together, it would be almost impossible to separate them by their upper surfaces, whilst the under surfaces are always very definite and distinctive. Not that the under sides do not vary, especially in the amount of silvery spotting, but that the upper surfaces vary in precisely parallel manner in all the species, so that varieties of one species are vastly more different than are similar forms of two distinct species.

"Looking at the matter from the point of view as to how these facts bear on the question of the suitability of each

species to its environment, we must conclude that the under-surface modifications correspond to the differences in the conditions that are proper to each species; whilst the variations of the upper surface are related to the great range in some other conditions—such, perhaps, as climate or altitude—that most of the species are able to accommodate themselves to.

"The specimens exhibited are *all* that I took of each species, except a few in even poorer condition than those shown, and only suitable for laboratory purposes. They show, therefore, how far each species is of uniform type at the place where they were captured,—that is, the range of variation of the mass of individuals, apart from extreme forms or aberrations.

"I think there is greater variation than there would be found amongst a similar group of English individuals. This is rather hard, however, to be sure of, for two reasons: first, that most accessible British series consist not of the first score or hundred that might be taken, but of a pair or so of assumed type, and the remainder of varieties selected from a large number; and secondly, because in taking a long (though my series are by no means long) series of almost any species one finds the amount of variation is considerably greater than one's preconceived prejudices prepared one for, and that may be my attitude as to these specimens.

"With regard to *selene* and *euphrosyne*, I think the *selene* from Sœterstœn are paler than Scotch specimens, and not perhaps very far from English forms; whilst those from Bossekop are largely the variety *hela*, and many of them are nearly devoid of silver spots beneath.

"The *euphrosyne* are, I think, darker than English specimens; but as to this I will leave the matter to be judged by those who have a greater and more recent familiarity with English *euphrosyne* than I have.

The *aphirape* are almost entirely the variety *ossianus*, marked by a greater development of silvery spots beneath, and by the ante-marginal row of spots of the upper wing above, having the apical one very distinct. In the series shown this forms a specifically distinctive mark separating these from *selene* and *euphrosyne*, but is really only a varietal character; in other respects many of the specimens could not be distinguished from *selene*. The ante-marginal row of black spots on the hind wing are often united to the marginal chevron line; this is very rare in *selene* and *euphrosyne*, except as regards the terminal ones.

"I show also a series of *pales* (is this a true *Brenthis ?*), var. *lapponica*. It appears to me to differ little from the type; the ground colour is rather paler, perhaps. This insect has had a great range of variation in every locality where I have seen it in quantity."

Mr. Lucas exhibited a series of *Libellula quadrimaculata*, consisting of five typical specimens, three from the south of England and two from Rannoch, with five suffused varieties extending from the typical form to the var. *prænubila* of Newman. Some of the last, besides possessing the brown patches, were suffused with saffron near the costal margin of all the wings. The finest *prænubila* was from Rev. J. E. Tarbat's collection. A series of *Calopteryx virgo* containing three smoky males from Surrey, out of Mr. Tarbat's collection; a typical male from the New Forest; a male with the hind wings minus the male coloration, from Mr. Tarbat's collection; a male from the New Forest with the right fore-wing in the same condition; and four females, one greenish, one of the typical brown form, one with a dark brown bar across the hind wings, and one with all the wings more or less smoky.

Mr. Nevinson exhibited the following varieties:—*Cleora glabraria*, an unusually dark variety; *Fidonia clathrata*, an almost unicolorous example; *Acidalia contiguaria*, one light specimen and a dark one, both taken at Criccieth in 1898; *Fidonia atomaria*, a male with the coloration of the female; *Acidalia marginipunctata*, well banded, leaden, and light forms from Cornwall, Wales, and Folkestone; *Carpocapsa pomonella*, an aberrant example, bred from a walnut, in which all the central and basal portions of the fore-wings were unicolorous and pale.

Mr. R. Adkin exhibited local forms of *Aplecta occulta*, from the Scotch localities; the specimens from Forres were pale in colour, with a deep pink shade in many of them; whilst those from Rannoch were very dark (almost black), with the pale outlining of the markings in strong relief; but in one specimen the hind wings were pale, and sub-diaphanous. *Dianthæcia nana* (*conspersa*), from English, Scotch, and Irish localities. The series showing the largest amount of white were from the Scilly Isles; those from the south of England and Ireland had slightly less; while in those from the Scottish mainland the dark coloration was more prominent, increasing in amount through the Orkney and Hebridean examples, until in some of those in the Shetland series there were no white markings. Also, for comparison

with Dr. Chapman's exhibit, series of *Vanessa urticæ*, *Argynnis selene*, and *A. euphrosyne*, from various British localities.

Mr. Moore exhibited a fine and very variable series of *Kallima inachis*, the leaf butterfly of South India, showing the various forms of the under side, and also a series of *Salamis anteva* from Madagascar.

Mr. West, of Streatham, exhibited a specimen of *Vanessa atalanta* having no spots in the red marginal band of the hind wings, and a variety of *Catocala nupta* having the nervures of the hind wings curiously unpigmented.

NOVEMBER 24th, 1898.

Mr. J. W. TUTT, F.E.S., *President*, in the Chair.

Mr. Montgomery exhibited a photograph by Mr. Clark of an ovum of *Hesperia comma*. This showed the egg to be smooth, and without reticulations.

Mr. Adkin exhibited two specimens of *Dicranura bifida*, taken this year on the trunk of a poplar tree in his garden at Lewisham. Several members expressed the opinion that this species was more or less common in the immediate neighbourhood of London.

Mr. Tutt exhibited, from M. Oberthur of Rennes, more local forms of *Anthrocera* (*Zygæna*) he showed at the last meeting, viz.:

Anthrocera (*Zygæna*) *trifolii*.—(1) A mountain form; (2) an Algerian form, var. *syracusia*, comparable with our New Forest form; (3) a coast form, much like the usual Norfolk form; (4) the large *palustris* form from Rennes, similar to the Freshwater race; and (5) a series from the coast of France opposite to the Channel Islands.

A. (*Z.*) *filipendulæ*.—(1) A form termed var. *dubia*, which appeared to be similar to var. *ochsenheimeri*; (2) a five-spotted var. from the Pyrenees, comparable to a race taken by Mr. Tutt some years ago at Courmayeur.

Also *A.* (*Z.*) *trifolii*, on behalf of Mr. Bacot, taken in mid July at Waxham, and another series of the same species received from Major Robertson, taken in South Wales.

Mr. Milton exhibited a portion of a stone in which an *Odynerus*, sp., was found alive with its cocoon. From the appearance of the stone it was presumable that a fissure had existed for the entrance of the parent. He also showed a very fine polished flint instrument from Enfield.

Mr. Lucas read a paper entitled "Some Surrey Shells," which was illustrated by some fifty lantern slides. After a few general remarks on collecting in this branch of natural history, a glance was bestowed upon the subdivisions of the mollusca, after which a majority of the land and fresh-water shells found within or near the Kingston district of Surrey were treated seriatim. In connection with *Anodonta cygnea* and *Helix pomatia*,—the one a bivalve and the other a univalve,—some account of the anatomy of the mollusca was given. Reference was made to the interesting subject of the dispersal of shells, and one or two slides were shewn illustrating it. Both the lantern and the microscope were employed to exhibit the tooth-bearing palate or odontophore of the univalves, while by means of the latter instrument those interested were able to examine the curious love-darts of one of the common land shells (*Helix nemoralis*).

DECEMBER 8th, 1898.

Mr. J. W. TUTT, F.E.S., *President*, in the Chair.

Mr. Bliss, University School, Hastings, and Mr. Sich, 65, Barrington Road, Chiswick, were elected members.

Mr. Carpenter exhibited a series of *Melitæa cinxia*, being some fourteen varieties out of about two hundred imagines which emerged. No very extreme aberrations were bred, the majority being exceedingly constant. One specimen had the fulvous bands on the under surface much enlarged in area, without the usual black markings. The other varieties were examples with the black markings on the under surface more or less increased in width.

Mr. Brooks, of Rotherham, exhibited a store-box with a considerable number of species bred by him near that town during the year. Among them were *Apamea didyma* (*oculea*), a long and varied series; *Euchelia jacobææ*, a sooty variety with a pink flush; *Amphidasys betularia*, var. *doubledayaria*, very fine intermediate forms and light forms, one of the latter being very transparent, with a minimum of dark markings; *Triphæna fimbria*, in great variety; and *T. janthina*, nicely marked specimens.

Rev. E. Tarbat exhibited the cocoons of *Plusia moneta* found in a friend's garden at Weybridge.

Mr. R. Adkin exhibited a series of *Xylina socia* (*petrificata*) and examples of *Calocampa vetusta*, *C. exoleta*, *Agrotis segetum*, *Miselia oxyacanthæ*, *Cidaria siderata*, all from co. West

Meath, Ireland, and remarked that although many species taken in this district showed a good deal of variation, those now exhibited were typical.

Mr. South exhibited three examples of *Abraxas grossulariata* bred from larvæ fed on a species of Sedum. The majority of the larvæ died, a few pupated, and of these seven only were bred. He also showed a suffused variety of *Melanippe sociata* approaching the form taken in the Hebrides, for which the varietal name *obscurata* has been proposed ("Entom.," xxi, 27).

Mr. Andrews exhibited a Noctuæ from Darenth Wood, which was supposed to be a very extreme form of *Caradrina cubicularis*. It was very dark, and almost the whole central area of the fore-wings was black.

Mr. Lucas read a paper entitled "The Dragon-fly Season of 1898." This paper, from which the following notes are extracted, was illustrated by some fifty lantern slides, not the least interesting of which were sixteen photographs of different stages of the emergence of *Æschna cyanea* taken from nature by Rev. A. East, of Southleigh, Oxon., and kindly placed at the disposal of Mr. Lucas for the evening.

Owing to the ungenial spring the dragon-fly season of 1898 was very late in commencing, and it is probably quite safe to say that the earlier species were nearly or quite a month behind their usual time of appearance. Whereas *Enallagma cyathigerum*, *Pyrrhosoma nymphula*, *Libellula depressa*, and *Libellula quadrimaculata* appear at the beginning of May, or in very early seasons at the end of April, in 1898, except for stragglers, they were not well on the wing till early in June.

Those members of the Society who attended the field meeting at Oxshott on May 21st will recollect how few dragon-flies were taken, scarcely more than might have been counted on one's fingers; yet by that date several species should have been swarming at the Black Pond and its vicinity.

Towards the end of June the summer dragon-flies began to put in an appearance at the proper time, unaffected apparently by the prolongation of the cold weather, and so the periods of certain species overlapped more than they usually do. The season thenceforward was a most satisfactory one, and owing to the fine autumn was late in closing. The last specimens noticed were of *Sympetrum striolatum* in Richmond Park, on October 23rd, though in 1897 the same species was observed at the Black Pond on November

14th. It is probable, however, that, had it been sought for, the same species might have been found at least as late in 1898.

Several good species fell to the net, chiefly in the latter part of the season. In the New Forest on July 30th, and during the early days of August, *Agrion mercuriale* was found to be common in one of its centres, where it seems quite safe from extinction. Towards the end of August *Sympetrum sanguineum* was found in some numbers in one of its habitats, that near Sandwich, in Kent. It was then, however, past its best, the wings being worn and chipped. In the same neighbourhood, on August 22nd, a male *Libellula fulva* fell to my lot. Though so very late for this species, it was in fair condition; but whatever the condition might have been, the capture would have been acceptable, for there seem to be but six previous localised records of it in the magazines, &c. This insect so closely resembles *L. depressa*, or *Orthetrum cancellatum*, that it may be sometimes passed over, for there is little doubt that it is a true British species and breeds in this country.

Æschna mixta, one of the scarcest species of the fine genus to which it belongs, seems to be present at some of the Surrey ponds more commonly than is supposed, though it is somewhat difficult to distinguish on the wing, and still more difficult to secure. After patient watching for a long time on September 12th, a beautiful male was captured when at last it settled after flying high round the fir trees. In one locality in England it was common in 1898, but on the whole it must be looked upon as a very scarce insect, and but few British specimens are to be found in cabinets.

Perhaps the most interesting point in connection with the season was an immigration of *Sympetrum flavcolum*. Though occasionally taken in this country, and once at least present in large numbers, it is probable that this insect never breeds here. On the present occasion I captured about twenty specimens at two ponds on Ockham Common, in Surrey, and at the end of the month saw one near Thursley, in the same county. One was taken near Oxford also, and one near Colchester. It is fair to suppose that if many entomologists had been on the alert the record might have been added to considerably. Every insect taken was a male, and there seems little hope of the insect breeding here. It seems likely that a few *S. sanguineum* accompanied their congeners. Too few captures have been recorded to allow one to speak with any certainty, but it seems that the migration took

place across the North Sea rather than the English Channel.

On September 11th *Æschna grandis* was observed ovipositing near the margin of the larger of the Penn Ponds in Richmond Park. This it did by settling on a weed on the surface or on one but just submerged, bending its abdomen and dipping the tip perpendicularly into the water. The eggs were laid deliberately, and no doubt under the cuticle of a leaf or stem of a water plant. Earlier in the season, on July 24th, *Pyrrhosoma nymphula* was observed doing the same thing on Esher Common, and the eggs were afterwards found *in situ* beneath the cuticle of a leaf of *Potamogeton*. In the New Forest, at the beginning of August, a female *Platycnemis pennipes* was noticed acting in the same way on the flower-stalk of a water-lily, but the eggs could not afterwards be found. A more interesting observation, however, was that of *Enallagma cyathigerum* descending some distance below the surface of the water with the same object. This took place near Byfleet. When the insect again emerged the surface of her body was not wet; in fact, below the water she appeared to glisten as if surrounded by a coating of air.

On more than one occasion I was fortunate enough to watch almost the whole of the emergence of the imaginal dragon-fly from the nymph case. The fall-back of the body to rest after the withdrawal of the head, thorax, wings, legs, and forepart of the abdomen was very striking, as was also the sudden spring forward, after nearly an hour, in the case of *L. quadrimaculata;* but *P. nymphula* did not throw itself back, nor did an *A. puella* noticed in the midst of emergence appear to have done so. In all cases the body increased but little in length till the wings were of their full size, and the new-born insect kept its wings as in the resting position of the Agrionids for some hours after leaving the nymph skin.

JANUARY 12th, 1899.

Mr. J. W. Tutt, F.E.S., *President*, in the Chair.

Mr. West exhibited and presented to the Society specimens of 125 species of Hemiptera-Heteroptera to form a nucleus for a typical collection of the group.

Mr. Carpenter exhibited four specimens of *Apatura iris* bred from New Forest larvæ. These were taken before hybernation, and kept in an outhouse during the winter. He complained of the damage which was being done to the

sallows by some of the local dealers, who tore down the branches with ropes and laid a sailcloth under the bushes, while smashing them with a cudgel.

Mr. Tutt exhibited various rare and local species of *Anthrocera* which he had received from M. Oberthür. These included a number of South European forms of *Anthrocera medicaginis*, Bdv., a five-spotted species that was closely allied to, if not a local race of, *A. loniceræ*. The specimens showed considerable variation in the width of the marginal border on the hind wings, some reaching about one half to two thirds over them. Another interesting species was *Anthrocera seriziati* from Algeria. This insect Mr. Tutt considered to be a southern form of *A. palustris*, generally spoken of as the "marsh" race of *A. trifolii*. It had the *palustris* facies, although the broad marginal border which almost covered the hind wings gave it a very striking appearance. Mr. Tutt further remarked that it was confined to the low-lying districts between Bona and Collo, whilst in the higher and drier parts of Algeria *A. trifolii* took on the form known as *A. syracusia* scarcely distinguishable from the early meadow form of *A. trifolii* found in Britain. He also exhibited specimens of a new Anthrocerid species, *A. maritima*, from the Riviera, and recently described in the *Annals Ent. Soc. France*, and for comparison some *A. hippocrepidis* (*nec* Stephs.) from Central France.

Mr. R. Adkin exhibited fine specimens of *Cymatophora octogesima* (*ocularis*), bred from pupæ received from Colchester, the larvæ having been found in that neighbourhood.

Mr. Lucas exhibited specimens of recent uninvited visitors which arrived in packages sent to Kew. These comprised *Periplaneta americana* (Belgian Congo); *Periplaneta australasiæ* (Belgian Congo); *Panchlora maderæ* (Belgian Congo); *Anisolabis annulipes* (immature, and possibly some neighbouring species from Penang); *Phillodromia* (species ?) (Zomba, British Central Africa).

Mr. H. Moore exhibited male and female larvæ, larval cases, pupæ, and female imagines of the large Psychid moth *Œceticus* (*Oiketicus*) *kirbii* (Guilding) which he had received from Antigua, West Indies. No males were bred, but upon cutting open some of the cases the females were found to have attained their full development, and broken the pupal skin. Like other Psychids, the males are active fully winged insects, but the female *Œceticus kirbii* has neither wings, mouth, nor antennæ, and only the rudiments of legs, being in fact nothing more than a living egg-sac.

Mr. Malcolm Burr exhibited a porcelain model of a grasshopper. It was received from China, and was a very clever imitation, the minute parts even to the tarsi being present; but the species it represented was not determined. He also exhibited a specimen of every large group of the Orthoptera, together with various species to show their protective resemblance.

Mr. Edwards exhibited numerous species to illustrate his paper entitled "A Few Notes on the Group Orthoptera." Among them were a considerable number of specimens from British North Borneo. One box contained some very fine species of Mantidæ, another had representatives of most of the sections of the Phasmidæ, and a third was chiefly devoted to specimens of the Locustidæ, including several species of the curious stick-like Proscopidæ which so much resemble the Phasmids.

JANUARY 26th, 1899.

ANNUAL MEETING.

Mr. J. W. TUTT, F.E.S., *President*, in the Chair.

This Meeting was devoted entirely to the business of the Society. The Report of the Council and Officers was read, and the Balance-sheet was received and adopted. The following List of the Council and Officers elected for the ensuing session was read:

President.—Mr. A. Harrison, F.L.S., F.E.S., F.R.M.S., &c.

Vice-Presidents.—Dr. T. A. Chapman, F.E.S., and Mr. J. W. Tutt, F.E.S.

Treasurer.—Mr. T. W. Hall, F.E.S.

Librarian.—Mr. H. A. Sauzé.

Curator.—Mr. W. West.

Hon. Secretaries.—Mr. Stanley Edwards, F.L.S., F.E.S., F.R.G.S., &c. (*Corresponding*), and Mr. Henry J. Turner, F.E.S. (*Report*).

Council.—Messrs. R. Adkin, F.E.S., F. W. Clark, H. S. Fremlin, M.R.C.S., L.R.C.P., F.E.S., W. J. Lucas, B.A., F.E.S., H. Moore, A. M. Montgomery, R. South, F.E.S.

The retiring President then read his Address (page 58), and votes of thanks were passed to the Officers.

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Printed by E. Knight, 22½ Bartholomew Close, E.C.

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(ESTABLISHED 1872).

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1889 BEAUMONT, A., F.E.S., The Red Cottage, Pond Road, Blackheath, S.E. *l*, *c*, *orn*.

1888 BENNETT, W. H., F.E.S., 15, Wellington Place, Hastings. *h*, *c*.

1877 BILLUPS, T. R., F.E.S., 20, Swiss Villas, Coplestone Road, Peckham, S.E. *h*, *o*, *c*, *d*, *he*.

1897 BISHOP, E. B., 60, Griffiths Road, Wimbledon, S.W.

1900 BLENKARN, S. A., Clifton House, E. Dulwich, S.E. *l*.

1898 BLISS, M. F., University School, Hastings. *l*.

1893 BOND-SMITH, W., Potton, near Sandy, Beds. *l*.

1898 BOUSKELL, F., F.E.S., Sandown Road, Knighton, Leicester. *l*.

1895 BOWMAN, K., 18, Victoria Road, Clapham Common, S.W. *l*.

1887 BRIGGS, C. A., F.E.S., Rock House, Lynmouth, N. Devon. *l*, *m*, *n*, *o*, *British fishes*.

YEAR OF ELECTION.

1887 BRIGGS, T. H., M.A., F.E.S., Rock House, Lynmouth, N. Devon. *l.*

1891 BRIGGS, H. MEAD, 8, High Street, Canterbury. *l, orn.*

1890 BRIGHT, P., F.E.S., Aston Lodge, Surrey Rd., Bournemouth. *l.*

1890 BRISTOWE, B. A., F.E.S., Durlstone, Champion Hill, S.E. *l.*

1893 BRISTOWE, L. W., Durlstone, Champion Hill, S.E. *l.*

1895 BROOKS, W., Grange Hall, Rotherham. *l.*

1898 BROOME, E. G., Hurst Vicarage, Twyford, Berks. *l.*

1890 BROWN, E. W., Capt., 2nd Royal West Kent Regiment. *l.*

1900 BROWNE, G. B., 43, Southbrook Road, Lee, S.E. *l.*

1899 BUCKSTONE, A. A., The Lodge, S. Norwood Park, S.E.

1897 BURR, MALCOLM B., F.Z.S., F.E.S., Bellagio, E. Grinstead. *o.*

1890 BUTLER, W. E., Hayling House, Oxford Road, Reading. *l, c.*

1888 CANSDALE, W. D., F.E.S., Sunny Bank, South Norwood, S.E. *l.*

1889 CANT, A., F.E.S., 10, Chandos Street, Cavendish Square, W. *l.*

1886 CARPENTER, J. H., F.E.S., Riverdale, Leatherhead, Surrey. *l.*

1899 CARR, F. B., 46, Handen Road, Lee, S.E. *l.*

1899 CARR, F. M. B., 46, Handen Road, Lee, S.E. *l.*

1877 CARRINGTON, J. T., 110, Strand, W.C. *l, cr.*

1872 CHANEY, W. C., 32, Stroud Road, Woodside, S. Norwood, S.E. (*Hon. member*). *h, l, c.*

1897 CHAPMAN, T. A., M.D., F.E.S., Betula, Reigate, Surrey. *l.*

1898 CHATTERTON, F. J. S., F.E.S., 78, Clissold Road, Stoke Newington, N. *l.*

1888 CHITTENDEN, D., 98, Court Hill Road, Lewisham, S.E. *l.*

1896 CLARK, F. NOAD, Paddington Infirmary, W. *mi.*

1887 CLARK, J. A., F.E.S., L.D.S., M.P.S., 57, Weston Park, Crouch End, N. *l.*

1898 CLARKE, H. SHORTRIDGE, F.E.S., 40, Athol Street, Douglas, Isle of Man. *l.*

1879 CLODE, W. (*Life member*).

1899 COLTHRUP, C. W., 127, Barry Road, E. Dulwich, S.E. *l.*

1899 CRABTREE, B. H., Oaklands, Levenshulme, Manchester. *l.*

1885 CROKER, A. J., F.E.S., 21, Church Street, Shoreditch, N.E. *l.*

1898 CROW, E. J., 26, Tindal Street, North Brixton. *l.*

1888 DAWSON, W. G., Plumstead Common, Plumstead, Kent (*Life member*). *l.*

1900 DAY, F. H., 6, Currock Terrace, Carlisle. *l, c.*

YEAR OF ELECTION.

1889 DENNIS, A. W., 45, Park Street, Stoke Newington, N. *l, mi.*

1884 DOBSON, H. T., F.E.S., Ivy House, Acacia Grove, New Malden, Surrey. *l, orn.*

1898 DOWNING, JOHN W., F.E.S., 45, Trevelyan Road, Tooting Graveney, S.W. *l.*

1897 DRURY, W. F., F.R.H.S., F.E.S., Rocquaine, West Hill Park, Woking, Surrey. *l.*

1886 EDWARDS, S., F.L.S., F.Z.S., F.E.S., *Hon. Sec.*, Kidbrook Lodge, Blackheath, S.E. *l, e l.*

1886 ENOCK, F., F.L.S., F.E.S., 13, Tufnell Park Road, Holloway, N. *d, mi.*

1900 ENOCK, J. K., 658, Woolwich Road, Charlton, Kent.

1889 FARRANT, M., jun., 137, St. Thomas, Exeter. *l.*

1872 FICKLIN, A., Weston Villa, Elm Road, New Malden, Surrey. *l.*

1891 FILER, F. E., F.E.S., 58, Southwark Bridge Road, S.E. *l, mi.*

1887 FLETCHER, W. H. B., M.A., F.E.S., Aldwick Manor, Bognor, Sussex (*Life member*). *l.*

1889 FORD, A., Rose Mount, Hannington Road, Boscombe, Hants. *l, c.*

1891 FORRESTER, A. C., 42, West Kensington Mansions, W. Kensington. *l.*

1886 FREMLIN, H. S., M.R.C.S., L.R.C.P., F.E.S., *Vice-President*, Government Lymph Laboratories, Chelsea Bridge, S.W. *l, mi.*

1895 FURNEAUX, W., F.R.G.S., "Penlee," Ommaney Road, New Cross, S.E. *l, pond life, gen. zool.*

1899 GADGE, S. W., 9, Longley Road, Tooting Graveney. *l.*

1884 GIBB, L., 148, St. James Street, Montreal, Canada (*Life member*). *l.*

1889 GREENE, Rev. J. G., M.A., F.E.S., Rostrevor, Clifton, Bristol. *l.*

1895 GRIFFITHS, G. C., F.Z.S., F.E.S., 43, Caledonia Place, Clifton, Bristol. *l, e, l.*

1893 HALL, A., 16, Park Hill Rise, Croydon, Surrey. *l, e l, ool.*

1888 HALL, A. E., F.E.S., Norbury, Pitsmoor, Sheffield. *l.*

1884 HALL, T. W., F.E.S., *Hon. Treasurer*, Stanhope, The Crescent, Croydon, Surrey; and 61, West Smithfield, E.C. *l.*

YEAR OF ELECTION.

1891 HAMM, A. H., 52, St. Mary's Road, Oxford. *l.*

1892 HARRISON, A., F.C.S., F.L.S., F.E.S., F.R.M.S., *Vice-President*, Thames Sugar Refinery, Silvertown, E., and 72, Windsor Road, Forest Gate, E. *l, mi.*

1899 HARRISON, J. A., 72, Windsor Road, Forest Gate, E. *l.*

1884 HELPS, J. A., Newstead Lodge, 91, Wood Vale, Forest Hill, S.E. *l.*

1888 HILLMAN, T. S., F.E.S., Eastgate Street, Lewes, Sussex. *l.*

1889 HINCHLIFF, Miss K. M., Worlington House, Instow, N. Devon. *l, e l.*

1888 HOPKINS, H. E., 153, Camden Grove North, Peckham, S.E. *l.*

1889 HORNE, A., F.E.S., Ugie Bank, Aberdeen. *l.*

1886 JÄGER, J., 65, St. Quentin's Avenue, North Kensington, W. *l.*

1887 JENNER, J. H. A., F.E.S., Eastgate House, Lewes, Sussex. *l, c, d, m, b.*

1884 JOBSON, H., 1, Rock Villas, Maynard Road, Walthamstow. *l.*

1886 KANE, W. F. DE V., M.A., F.E.S., M.R.I.A., Drumreaske House, Monaghan, Ireland. *l, mi, marine invertebrata.*

1898 KAYE, W. J., F.E.S., Worcester Court, Worcester Park, Surrey. *l.*

1900 KEMP, S. W., 80, Oxford Gardens, Notting Hill, W. *l.*

1884 KENWARD, J., 195, Hither Green Lane, Lewisham, S.E. *l.*

1888 KNIGHT, E., 2, Lichfield Grove, Church End, Finchley, N.

1894 LAMB, H., Acacia Place, Upper Faut, Maidstone. *b, orn.*

1898 LEMANN, F. C., F.E.S., Blackfriars House, Plymouth. *l.*

1884 LEVETT, C., 107, Brockley Road, S.E. *l.*

1898 LITTLE, W. W., 17, Belgrave Street, King's Cross, N. *l.*

1872 LUBBOCK, The Right Hon. Sir JOHN, Bart., M.P., D.C.L., F.R.S., F.L.S., F.G.S., F.E.S., &c., High Elms, Down, near Farnborough, Kent (*Hon. member*). *h, b.*

1896 LUCAS, W. J., B.A., F.E.S., *President*, 12, Caversham Road, Kingston-on-Thames. *l, o, n, m.*

1900 MACGEE, W. H., 79, Lillie Road, S.W. *l,*

1890 MCARTHUR, H., 35, Averill Street, Fulham, W. *l.*

YEAR OF ELECTION.

1872 M'LACHLAN, R., F.R.S., F.L.S., F.Z.S., F.E.S., Westview, Clarendon Road, Lewisham, S.E. (*Hon. member*). *n.*

1892 MAIN, H., B.Sc., F.E.S., 131, Windsor Road, Forest Gate, E. *l.*

1886 MANGER, W. T., F.E.S., 100, Manor Road, New Cross, S.E. *l, c. cr.*

1889 MANSBRIDGE, W., F.E.S., Colegate, Horsham, Sussex. *l.*

1885 MERA, A. W., 79, Capel Road, Forest Gate, E. *l.*

1881 MILES, W. H., F.E.S., The New Club, Calcutta, India. *mi, b.*

1888 MITCHELL, A. T., 5, Clayton Terrace, Gunnersbury, W. *l.*

1896 MONINGTON, H. W., 8, Weswell Road, Streatham Common, S.W. *b.*

1896 MONTGOMERY, ARTHUR M., 32, The Grove, Ealing, W. *l.*

1896 MONTGOMERY, EDMUND M., 32, The Grove, Ealing, W. *l.*

1880 MONTIERO, Senor A. A. DE C., F.E.S., 70, Rua do Alecrinar, Lisbon.

1885 MOORE, H., F.E.S., 12, Lower Road, Rotherhithe, S.E. *l, h, d, e l, e h, e d, mi.*

1887 MORRIS, C. H., School Hill, Lewes, Sussex. *l, c, m.*

1887 NEVINSON, E. B., 7, Staple Inn, W.C. *l, stalk-eyed crustacea.*

1889 NICHOLSON, W. E., F.E.S., School Hill, Lewes, Sussex. *l.*

1872 OLDHAM, C., 2, Warwick Villas, Chelmsford Road, South Woodford, Essex. *l.*

1891 PALMER, J. F., Ewell Road, Surbiton Hill, Surbiton. *l.*

1892 PANNELL, C., East Street, Haslemere. *Conchology.*

1898 PARKIN, E.

1883 PEARCE, W. A., 88, Croxted Road, West Dulwich, S.E. *l, b.*

1880 PERKINS, V. R., F.E.S., Wotton-under-Edge, Gloucestershire. *l, h, d.*

1888 PERKS, F. P., 41, St. Martin's Lane, Charing Cross, W.C. *zoology, mi, pond life.*

1889 PERRY, Rev. J. F., Oxford Road, Banbury. *l, c*

1899 PICKIN, J. R., 2, Industry Terrace, Brixton, S.W. *l.*

1897 PREST, E. E. B.

1887 PORRITT, G. T., F.L.S., F.E.S., Crossland Hall, Huddersfield. *l n.*

YEAR OF ELECTION.

1896 POTTER, A. T., Whangarei, Auckland, New Zealand. *l, zoo.*

1888 REID, W., F.E.S., Pitcaple, Aberdeen. *l, continental l.*
1887 RICE, D. J., 13, Great Ormond Street, W.C. *orn.*
1887 ROBINSON, A., B.A., F.E.S., 1, Mitre Court, Temple, E.C. *l.*
1894 ROBINSON, LEIGH, 13, Victoria Street, Westminster, London, S.W. *l.*
1888 ROBSON, H., 93, Watling Street, E.C. *l, b.*
1887 ROUTLEDGE, G. B., F.E.S., Tarn Lodge, Heads Nook, Carlisle. *l.*
1900 ROWDEN, ALFD. OLIVER, 34, Park Road, Kingston Hill, Surrey. *l, b.*
1890 ROWNTREE, J. H., Westwood, Scarborough. *l.*
1898 RUSSELL, A., F.E.S., The Limes, Southend, Catford, S.E. *l.*

1886 SALWEY, R. E., F.E.S.
1897 SANDISON, JOHN, 2, Francis Grove, Wimbledon, Surrey. *l.*
1888 SAUZÉ, H. A., *Hon. Librarian*, 11, Venner Road, Sydenham, S.E. *l.*
1898 SICH, ALF., F.E.S., "Brentwood," 65, Barrowgate Road, Chiswick.
1899 SMITH, E. W., 16, Tresco Road, Linden Grove, S.E. *l.*
1890 SMITH, WILLIAM, 13, St. Merren Street, Paisley. *l.*
1890 SMITH, WALTER, 1, Arundel Villas, Hampton Road, Twickenham. *l.*
1882 SOUTH, R., F.E.S., 96, Drakefield Road, Upper Tooting, S.W. *l.*
1873 STANDEN, R., F.L.S., F.E.S., Thorpe Hall, Colchester (*Life member*). *l.*
1872 STEP, E., F.L.S., 19, Fortune Gate Road, Craven Park, Harlesden, N.W. *b, m, orn.*

1894 TARBAT, Rev. J. E., M.A., Holmlea, Weybridge. *l.*
1895 THORNHILL, W. B., Castle Cosey, Castle Bellingham, near Drogheda, Ireland. *l.*
1895 TOLHURST, J., "Glenbrook," Beckenham, Kent. *l.*
1899 TOMLINSON, F., 10, Caversham Road, Kingston-on-Thames. *l.*
1899 TOOMBS, G. W., 40, Shrubland Grove, Dalston Lane, N. *l.*
1894 TRENERRY, E. H., 3, North Road, Clapham Park, S.W. *l.*
1895 TUNALEY, HY., F.E.S., 30, Fairmount Road, Brixton Hill, S.W. *l.*

YEAR OF ELECTION.

1887 TURNER, H. J., F.E.S., *Hon. Report Secretary*, 13, Drakefell Road, St. Catherine's Park, S.E. *l, orn, c, n, he, b.*

1886 TUTT, J. W., F.E.S., Rayleigh Villa, Westcombe Hill, Blackheath, S.E. *l.*

1887 VERRALL, G. H., F.E.S., Sussex Lodge, Newmarket. *d.*

1889 VINE, A. C., 45, Temple Street, Brighton, Sussex. *l.*

1889 WAINWRIGHT, C. J., F.E.S., 2, Handsworth Wood Road, Handsworth, near Birmingham. *l.*

1880 WALKER, J. J., R.N., F.L.S., F.E.S., H.M.S. Katoomba, Sydney, N.S.W. *l, c.*

1888 WALLER, R., 2, Grand Parade, Upper Richmond Road, Putney, S.W. *l.*

1886 WALSINGHAM, The Right Hon. Lord, M.A., LL.D., F.R.S., F.L.S., F.Z.S., F.E.S., &c., Merton Hall, Thetford, Norfolk (*Hon. member*). *l, orn.*

1888 WARNE, N. D., 8, Bedford Square, W. *l.*

1888 WARNE, W. F., 8, Bedford Square, W. *l.*

1888 WEBB, S., 22, Waterloo Crescent, Dover. *l.*

1872 WEST, W., *Hon. Curator*, 8, Morden Hill, Lewisham Road, S.E. *l, c.*

1878 WEST, W., L.D.S., 75, Lewin Road, Streatham Common, S.W. *l, mi.*

1887 WHIFFEN, W. H., 49, Granville Park, Lewisham, S.E. *l.*

1891 WILLIAMS, H., 6, Langthorne Terrace, Ashburnham Road, Southend-on-Sea. *l.*

1888 WINKLEY, M. H., 9, Glen Eldon Road, Coventry Park, Streatham, S.W. *l.*

1893 WOLFE, J. J., Skibbereen, co. Cork, Ireland. *l.*

1899 WOOD, Rev. FRANCIS HENRY, M.A., Brabourne Cottage, Bromley Park, Kent. *l.*

1895 WOOD, H. L., The Old Grammar School House, Ashford, Kent. *l.*

1886 WRIGHT, W. H., Secretary's Department, Somerset House, Strand, W.C. *l.*

Members will greatly oblige by informing the Hon. Sec. of any errors, additions, or alterations in the above Addresses and descriptions.

REPORT OF THE COUNCIL, 1899.

THE Council of the South London Entomological and Natural History Society, in presenting the Twenty-Seventh Annual Report, is gratified to note that the condition and progress has again been satisfactory.

During the past year fourteen new Members have been admitted, while ten have resigned. Two have been removed by death, viz. Messrs. S. Stevens and B. H. Walters. Under Bye-law 10, Section 2, the names of four Members have been removed from the list for continued non-payment of subscription. The present strength of the Society, therefore, stands at one hundred and sixty-six Members.

The finances of the Society are still in a sound condition, but the unusual procrastination that many Members have shown in the forwarding of their annual subscriptions has caused the Hon. Treasurer a considerable amount of trouble, and resulted in publication of Part I. of the "Proceedings" being much delayed.

No less than fourteen Papers and four Reports of Field Meetings have been read before the Society, of which contributions the following eleven Members and three non-members were the authors:—Mr. R. ADKIN, three; Mr. J. W. TUTT, two; Mr. F. NOAD CLARK, two; Dr. CHAPMAN, Mr. E. STEP, Mr. MALCOLM BURR, Mr. STANLEY EDWARDS, Mr. W. J. LUCAS, Mr. ASHDOWN, Mr. HY. J. TURNER, Mr. CARRINGTON, Mr. SCOURFIELD, Mr. MERRIN, and Mr. MORLEY, one each. This is a larger number of Papers than in any former year, and more than half of them dealt with orders other than lepidoptera, with general natural history, or with scientific biological problems. The Society's lantern continues to be of great use in illustrating the Papers read, and the authors of Papers and Notes have made considerable use of diagrams, microscopes, and the blackboard.

The Council feels that very great thanks are due to those gentlemen who not only came forward to read Papers, but took every possible means of illustrating their remarks and interesting the general body of Members.

Although the exhibits made during the twelve months have not been so numerous as in many previous years, they have been quite up to the average in point of interest. Some admirable exhibits of European lepidoptera have been made, and an Exhibition of Varieties, held on November 9th, was a most successful, attractive, and well-attended meeting.

The attendance of Members at the Ordinary Meetings has been about the same as in the last few years. The average number signing the Attendance-book at the Meetings was twenty-four. The actual attendance was, however, in excess of that figure.

Four Field Meetings were held during the summer months, viz.:

CHATHAM, on May 27th, conducted by Mr. J. J. WALKER, R.N., F.E.S.

BYFLEET, on June 10th, conducted by Mr. W. J. LUCAS, B.A., F.E.S.

CHALFONT ROAD, on July 1st, conducted by Mr. R. ADKIN, F.E.S.

WISLEY, on July 15th, conducted by Mr. W. J. ASHDOWN.

The Collections remain under the skilful management of our Hon. Curator, Mr. WEST, who reports:

The donations to the Society's cabinets are—

A store-box of micro-lepidoptera, from Mr. DRURY, F.E.S.

A box of various species of lepidoptera, from the PRESIDENT (Mr. A. Harrison, F.L.S.).

A pair of *Dianthæcia luteago*, var. *ficklini*, from Major FICKLIN.

Various dragon-flies, from Messrs. LUCAS, ASHDOWN, and TURNER.

A specimen of *Somatochlora metallica*, from Mr. C. A. BRIGGS; and numerous species of hemiptera, from the HON. CURATOR.

Messrs. LUCAS and ASHDOWN have kindly undertaken to arrange the dragon-flies and make the Collection as perfect as possible.

The following works, pamphlets, and *separata* have been added to the Society's bookshelves, for which the Council desires to tender its hearty thanks to the respective donors:

"British Lepidoptera," Vol. I., by J. W. TUTT; "Flora of Kent," by F. J. HANBURY; "Cambridge Natural History," Vol. VI. ("Insects"), and Vol. IX. ("Birds"), from Mr. STANLEY EDWARDS.

"Favourite Flowers," Vol. IV., by E. STEP; "Flowering Plants" (Anne Pratt), Vols. I. and II., by E. STEP; "Romance of the Wild Flowers," by E. STEP, from Messrs. W. F. and N. D. WARNE.

"Insects," by G. H. CARPENTER; "British Birds," by BUTLER and others, illustrated by W. F. FROHAWK (six volumes), from Mr. A. HARRISON.

"Entomologist," 1899, from Mr. SOUTH.

"Entomologists' Monthly Magazine," 1899, from Mr. M'LACHLAN.

"Zoologist," 1899, from Mr. NEWMAN.

"Science-Gossip," 1899, from Mr. CARRINGTON.

"Knowledge," 1899, from the PUBLISHERS.

"British Hawk Moths," by W. J. LUCAS, from the AUTHOR.

"Butterflies of N. America," by W. J. HOLLAND, and "Report of the Entomological Society of Ontario," from Mr. L. GIBB.

"British Lepidoptera," Vol. V., by C. G. BARRETT, from the AUTHOR.

The "Entomologische Tidskrift," 1886—99, fourteen volumes, from Prof. AURIVILLIUS.

"Contributions to the Entomology of New Mexico," sixteen *separata*, by T. D. A. COCKERELL, from the AUTHOR.

"Catalogue of Longicornia," from the BRITISH MUSEUM.

"Larvæ of British Lepidoptera," Vol. VIII., Ray Society, by purchase.

"Address to the Entomological Society of London," by R. TRIMEN, from the SECRETARY.

"Report of the Lancashire and Cheshire Natural History Society;" "Reports of the Smithsonian Society," 1896 and 1897; thirty-six pamphlets on "Natural Science," extracted from the Smithsonian "Reports;" "Flora of N. America: Gamopetalæ," by ASA GRAY; "Report of the City of London Ent. Soc.," 1898—99; "Report of the City of London Coll. Science Soc.," 1898—99; "Proceedings of the Holmesdale Nat. Hist. Soc.," 1895—98; "Canadian Entomologist," 1899; "Irish Naturalist," 1899; and "Journal of the City of London Science Soc.," by exchange.

The Library has been carefully tended by the Hon. Librarian, Mr. H. A. SAUZÉ, whose Report is appended:—

"There has been steady application on the part of Members to the books placed at their disposal by the Library.

"The gradual accumulation of books, mostly by donation, seemed likely to place the Librarian in a dilemma to find accommodation for them in our bookcase, especially as the stock of "Proceedings" increases yearly, and takes up much room in our cupboards. Under these circumstances the Council feels much indebted to the generosity of two of our Members, who last autumn very kindly added a handsome mahogany book-cabinet to the Society's furniture, which has relieved this pressure and removed any difficulty for some time.

"One of our Members has started the good idea of the usefulness of having the various loose pamphlets belonging to the Society bound together as far as their size and subjects will allow, and has followed up the advice by contributing for the binding of three volumes. The binding of a further volume has been guaranteed since by another Member, and the Librarian commends the plan to the attention of those interested in our books, as affording ease of reference to the pamphlets, and their safe preservation."

THE SOUTH LONDON ENTOMOLOGICAL AND NATURAL HISTORY SOCIETY.

BALANCE SHEET FOR THE YEAR 1899.

GENERAL FUND.

Receipts.			£	s.	d.
To Balance in Hand			21	13	4
,, Subscriptions received, 93 at 7/6 ...	£34	17 6			
,, ,, ,, 4 ,, 6/– ...	1	4 0			
,, ,, ,, 9 ,, 5/– ...	2	5 0			
,, ,, ,, 15 ,, 2/6 ...	1	17 6			
			40	4	0
,, Entrance Fees, 11 at 2/6			1	7	6
,, Arrears of Subscriptions received ...			4	8	6
,, Subscriptions paid in advance ..			0	6	0
			£67	19	4

Expenditure.			£	s.	d.
By Rent (1 year)	£25	0 0			
,, Attendance (1 year)	2	10 0			
,, Postage, Stationery, and Sundries ...	5	7 7			
,, Insurance of Library and Collections (Fire)	0	8 3			
			33	5	10
,, Entrance Fees carried to Suspense A/c			1	7	6
,, Advertisement in "Readers' Monthly"			0	15	0
,, Transfer to Library Fund			3	0	0
,, Transfer to Publication Fund			20	0	0
,, Balance in Hand			9	11	0
			£67	19	4

SUSPENSE ACCOUNT.

Receipts.		£	s.	d.
To Balance in Hand		9	17	6
,, Entrance Fees from General Fund...		1	7	6
		£11	5	0

Expenditure.		£	s.	d.
By Balance in Hand		11	5	0
		£11	5	0

LIBRARY FUND.

Receipts.	£	s.	d.
To amount transferred from General Fund	3	0	0
„ Library Fines	0	5	10
„ Special donations for binding Pamphlets, per Mr. Sauzé	0	13	6
	£3	19	4

Expenditure.	£	s.	d.
By Debit balance from 1898	0	7	3½
„ Binding Books	0	14	6
„ Librarian's Postages	0	2	9
„ Ray Society Subscription	1	1	0
„ Printing Labels	0	6	10
„ Balance	1	6	11½
	£3	19	4

PUBLICATION FUND.

Receipts.	£	s.	d.
To Donations	26	0	0
„ Reprints, Papers	0	6	9
„ Sale of "Proceedings"	1	3	0
„ Amount transferred from General Fund... ..	20	0	0
	£47	9	9

Expenditure.	£	s.	d.
By Debit Balance from 1898	13	16	6
„ Printing	29	19	7
„ Balance	3	13	8
	£47	9	9

ASSETS AND LIABILITIES.

Assets.	£	s.	d.
To Balance, General Fund	9	11	0
„ „ Suspense Account	11	5	0
„ „ Library Fund	1	6	11½
„ Publications Fund	3	13	8
„ Arrears of Subscriptions, £15 5s., valued at say	5	5	0
	£31	1	7½

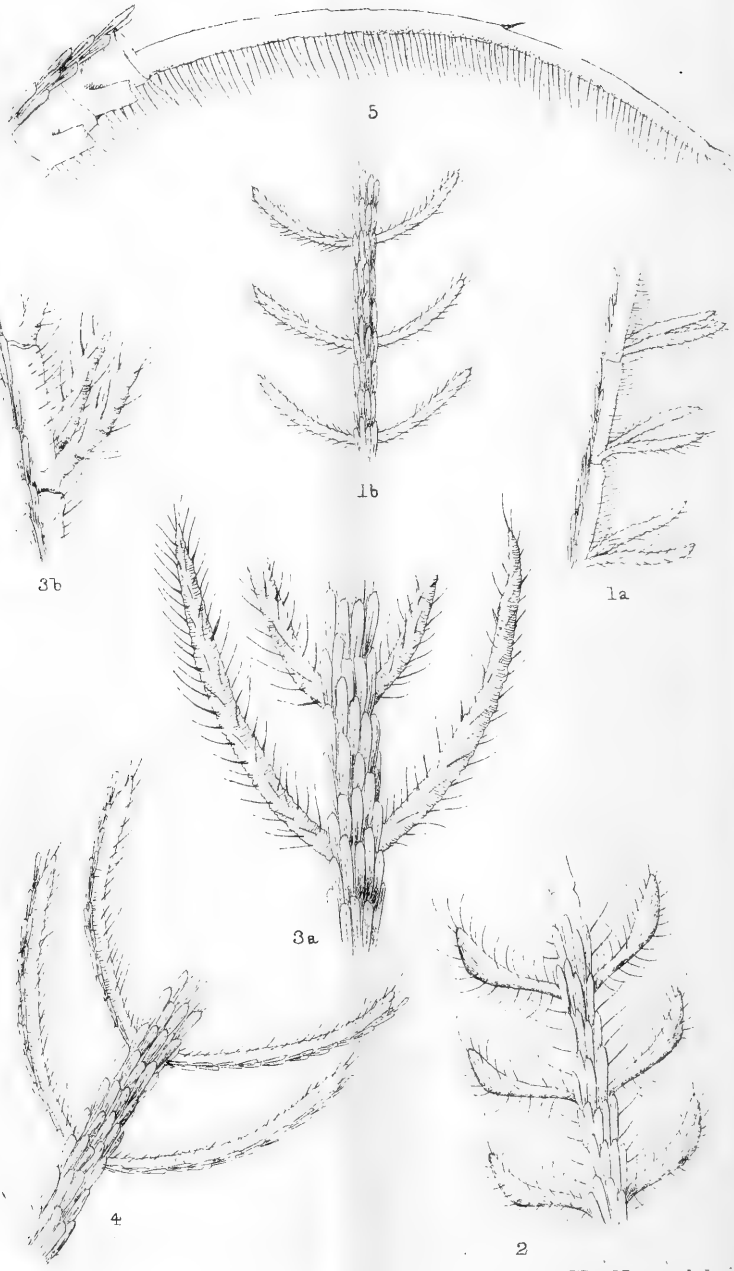
Liabilities.	£	s.	d.
Nil			
Balance in Hand	31	1	7½
	£31	1	7½

Examined, compared with Books and Vouchers, and found to be correct, *January 16th*, 1900.

H. A. SAUZÉ,
ALFRED W. DENNIS, } *Auditors.*

PAST PRESIDENTS.

1872 ... J. R. Wellman.
1873 ... ,,
1874 ... ,,
1875 ... A. B. Farn, F.E.S.
1876 ... ,,
1877 ... J. P. Barrett.
1878 ... J. T. Williams.
1879 ... R. Standen, F.E.S.
1880 ... A. Ficklin.
1881 ... V. R. Perkins, F.E.S.
1882 .. T. R. Billup, F.E.S.
1883 ... J. R. Wellman.
1884 ... W. West, L.D.S.
1885 ... R. South, F.E.S.
1886 ... R. Adkin, F.E.S.
1887 ... ,,
1888 ... T. R. Billups, F.E.S.
1889 ... ,,
1890 ... J. T. Carrington, F.L.S.
1891 ... W. H. Tugwell, Ph.C.
1892 ... C. G. Barrett, F.E.S.
1893 ... J. J. Weir, F.L.S., &c.
1894 ... E. Step, F.L.S.
1895 ... T. W. Hall, F.E.S.
1896 ... R. South, F.E.S.
1897 ... R. Adkin, F.E.S.
1898 ... J. W. Tutt, F.E.S.
1899 ... A. Harrison, F.L.S., etc.



West, Newman lith.

Antennæ of Psychides

DESCRIPTION OF PLATE.

Antennæ of Psychides.

The antennæ of Solenobiads, which are simple, are not illustrated, nor of Lypusids, which follow both types as illustrated in Figs. 1—3, and in Fig. 4.

Figs. 1*a* and 1*b*.—Portions of antenna of *Luffia lapidella*, lateral and dorsal views. × 60 diams. Each joint carries two pectinations. Scaling, in four rows, occurs only on dorsal aspect of shaft. The slightly clubbed pectinations carry sense-hairs on all aspects.

Fig. 2.—Dorsal aspect of portion of antenna of *Bacotia sepium*. × 60 diams. The structure is essentially the same as in *L. lapidella ;* the clubbing of pectinations is marked.

Figs. 3*a* and 3*b*.—Dorsal and lateral aspects of antenna of *Proutia betulina*. × 110 diams. Same type as last ; pectinations not clubbed, more slender and flowing, but sense-hairs in all aspects ; scaling of shaft less regular.

Fig. 4.—Portion of antenna of *Fumea casta*. × 70 diams. General form very like Fig. 3, but type entirely different, scaling along whole dorsum of pectinations, which are not at all clubbed, but look so, owing to scaling being terminally denser and somewhat porrected.

Fig. 5.—One plumule (or pectination) of antenna of *Acanthopsyche opacella*. × 70 diams. It is shown a little thicker than it should be ; sense-hairs ventrally only, dorsum smooth, ancestrally existing scales (as in Fig. 4) being lost.

Some Points in the Evolution of the Lepidopterous Antenna.

By Dr. T. A. Chapman. *Read February 9th*, 1899.

The whole subject of antennal evolution in the Lepidoptera would be much too large for a short paper like this, and so I propose to confine myself to some points only. Really I have only studied some points, and so am not in a position to handle others. Those which I have looked into, chiefly affect the questions connected with the relative dispositions of scales and sensory hairs on the antennæ, with some others on which the authorities we have on the subject are not in agreement, or appear to have left room for further consideration of some aspects of antennal structure or development.

I do not know that antennal evolution has been treated in any systematic way before Bodine's "Thesis," published in 1896.

Bodine deals especially with the different forms and structures of sensory hairs, especially as regards their minute anatomy, their disposition in different families, but covers the other items of antennal structure and evolution in a less complete manner. He leaves some things hardly touched on, and others not very fully treated; but whatever he does say, and whatever observations he describes, appear to be always well founded and agreeable to the facts whenever I have tested them.

More recently, Dr. K. Jordan published last summer an account of the antennæ of butterflies, in which he gives a great mass of detail as to the structure of butterfly antennæ, and in his account of the actual antennæ examined he is apparently very correct and accurate. Most of his deductions from his observations are also fully justified; but some of them seem open to question, and in some statements he makes apart from the Rhopalocera, in which he disagrees with Bodine, there is more doubt as to the validity of his conclusions.

I am not aware of any other than casual references to antennal evolution outside these two very full and valuable papers. There are such references to isolated items, as Professor Poulton's speculations as to the relations of the pupal to the imaginal antennæ in Saturnians.

This was not a point I contemplated fully discussing, as there are no facts available beyond those Professor Poulton was in possession of, and his conclusions and any agreement or disagreement with them can be little more than speculation.

In Saturnians with widely pectinated antennæ the males have

much the largest antennæ. This is the same also in the pupæ; but in these, though the pupal antenna of the female is smaller than that of the male, it is larger than the imaginal antenna it contains.

Professor Poulton was of opinion that this indicated that the female antenna was smaller than it had been in its ancestors, their larger antennæ being recorded in the large pupal antenna. The difficulty of accepting this explanation is that these female Saturnians have very widely pectinated antennæ, not so widely pectinated as the males, but for female moths perhaps the most pectinated antennæ we find anywhere, and it seems very problematical that they could be derived from female ancestors with wider antennæ. It is also observed that in all moths whose males have well-pectinated antennæ the female pupa has antennæ cases decidedly in excess of the requirements of the imaginal antenna.

The explanation seems rather to be that the male and female antennæ tend to be alike, especially in the pupa. Wherever we have sexual dimorphism (or, *mutatis mutandis*, any dimorphism) it is as if we had two species mingled, which are separately responding to the effects of natural selection, and each tending to vary in a different direction, and yet unable to avoid a certain amount of crossing, making each to a certain extent follow the other. So if the male moth gets a large antenna by selection, the female tends to do so by inheritance from the male. Selection, however, keeps action on the female antenna to prevent its further development; but does not act so strongly on the pupal antenna, which is a quiescent and unimportant structure, and so the pupal antenna outstrips the imaginal one.

It is difficult to handle any subject without a sound beginning, and so in considering the evolution of lepidopterous antennæ it is necessary, if it can possibly be done, to ascertain, and if not, to build up, some representative of the actual ancestor of the antenna of the order.

Bodine gives us the "antenna of *Micropteryx* (*Eriocrania*) *semipurpurella* as the ancestral type, and describes its arrangement of hairs, but in dealing with the evolution says nothing about scales; so that, though he elsewhere describes this antenna as scaled all over, there is no doubt he regards the primitive ancestor of the lepidopterous antenna as covered all over with sensory hairs. Dr. Jordan gives us the same definition, that the primitive lepidopterous antenna was covered all over with sensory hairs, but adds that it was without scales, and gives us *Hepialus* as a representative.

Stated in this way the two views appear to be fairly in accord, and yet they might be more correctly described as exactly opposite to each other. This is much obscured by the fact that Bodine proceeds to deal with the further evolution of the antennæ with reference to the further development and arrangement of sense hairs, and says little or nothing of scales. Jordan, on the other hand,

founds his lines of evolution very much on the gradual spread of scales, which he conceives as wanting in the primitive lepidopteron, but developing from time to time out of the sense hairs, and so securing the distribution over the antenna that they have in each form.*

Jordan's picture is of a primitive Lepidopteron fully scaled except as to the antenna, which has a covering of only sensory hairs. Then the sensory hairs on the dorsal aspect of the antenna begin at the base to change into scales, and this process extends thence till it reaches the apex dorsally, and also extends, from any point of the dorsum that it has reached, downwards, till it meets beneath the segment, covering it entirely with scales. This hypothesis has only one fact to support it, that is that the distribution of scales and hairs of the "macro" Heterocera and of the butterflies would in each instance, in almost all cases, correspond to some stage in the process so postulated. There are, however, at least two overwhelmingly fatal objections to it. The first is that it does not correspond to the relative distributions of hairs and scales in the lowest Lepidoptera. The second, that it implies an almost miraculous succession of discontinuous variations, by which elaborate (probably olfactory, certainly special) sense-organs are *per saltum* converted into scales, not now and then, but in the case of almost every species. A third and equally great (from Dr. Jordan's standpoint probably a greater) difficulty is that the progress is not always forwards; sometimes there is retreat, as in no other way can the great variety of scaling in related forms be explained, and a *per saltum* (or in any other way) change of scales into sense-organs (no intermediate forms exist) seems to be impossible.

Both Bodine's and Jordan's hypothesis, that the antenna from which that of the Lepidoptera was derived was without scales, and covered all over with hairs, is one that may readily be accepted as true; but they both err in looking for this form within the order. Bodine finds it in *Eriocrania*, quite ignoring the fact that he fully recognises elsewhere, that it has a complete covering of scales. This error is from Bodine's standpoint trivial, as he devotes little attention to the evolution of the scaled areas, and discusses fully the evolution of sensory surfaces; in fact, he rather ignores scales than, strictly speaking, makes any error in regard to them.

Jordan finds the desired primary type in *Hepialus*, a more serious error, since the fully haired and scaleless antenna of *Hepialus* is not a primary form, but secondary to the loss of scales. *Hepialus* is often spoken of as a very primitive and generalised form, and in many respects it is so. In many of its structures, especially its venation, it belongs to the Jugatæ, in association with the Micropteryges and Eriocraniæ, which are the most primitive Lepidoptera; and so, regarded from a standpoint of Phalenæ Obtectæ, it seems

* Page 400 of his paper.

to be not very material whether we build our ideas of a primitive moth on *Hepialus* or on *Eriocrania*. Such a view of the matter is, however, very far from correct. If we take our view from the *Micropteryx* (*calthella*) starting-point, we see that even *Eriocrania* (*purpurella*) is a good way ahead of us, but that *Hepialus* is really in the far distance, much further off than the lower Adelids (Incurvaria, etc.), further off than the Nepticulas and Cochlidids. It still comes within the accepted definition of Jugatæ ; and so far we have not to reach it by going through or over the families named and others, but as to actual distance it is further off. In acquiring a larva with well-developed prolegs, it has made a long stride past the trichopteroid Eriocranias. The somewhat solidified pupa has not only passed the *Eriocrania* type, but is more advanced than *Nepticula* and *Limacodes*. It is at the summit of one branch of Jugatæ, a branch which perhaps gave rise to the Cossids and Tortrices, and other Frenatæ ; but a branch which has risen to a considerable height, overtopping various generalised Frenatæ that originated nearer the Micropteryges and Eriocranias. It follows that the scaleless antenna that occurs in the Hepialidæ is by no means a type of the primitive lepidopterous antenna, for this we must go to the Micropteryges or Eriocranias. We shall see good reason for following Bodine in taking *Eriocrania* (*purpurella*, etc.) as presenting the nearest existing representative of the primary lepidopterous antenna, which Bodine is correct in describing as provided all over with hairs, and from which he can derive all other distributions and evolutions of hair structures. Jordan is in error in rejecting it and passing on to the much more highly evolved *Hepialus* in search of a scaleless antenna, whence he falls into the necessity of making scales evolve themselves from hairs in the remarkable way already alluded to. The eriocraniad antenna is covered not only with sensory hairs, but also with scales, and is thus an eminently generalised lepidopterous antenna. The further evolution of the scaling takes place in quite parallel (but we might perhaps say opposite or opposed) lines to that of the hairs. The history is one of retirement of hairs and scales each to their own more advantageous territory, and of after advance and retreat over the territories where they adjoin.

We ought not, perhaps, to throw over without further notice the hypothesis of our two authorities, so far as its verbal definition goes, that the primitive lepidopterous antenna was covered with sensory hairs (and without scales). There never was a primitive Lepidopteron with such an antenna, but there can be little doubt that such was the antenna of the ancestor of the Lepidoptera.

I do not know that such an ancestor exists, still less that anyone has spotted it, but amongst our familiar insects the one that probably approaches it most nearly is the common scorpion fly (*Panorpa vulgaris*). The ancestor of the Lepidoptera was not very distantly related to the Panorpidæ. Here we have an antenna that satisfies our definition, a scaleless antenna covered with sensory hairs. There

are other Neuroptera planipennia that have not very dissimilar antennæ, all no doubt related to the primitive pre-lepidopterous antenna.

Micropteryx originated somewhere here, and still presents some panorpid characters. As we have it to-day, however, *Micropteryx* has antennæ that have taken a very special line of development, and show that *Micropteryx* is not on the main stem, but is a side branch therefrom.

It is a primitive Lepidopteron in having both hairs and scales, and in these having no special orientation. The hairs arise over the whole antenna, but the scales are collected together over a small area on opposite sides of the antennæ. These spots may be right and left, or dorsal and ventral; I have found it impossible to be sure which, but in any case they impartially affect both sides.

A segment of a *Micropteryx* antenna, especially when the scales have been removed, is a very curious object, a somewhat cubical but rounded black box, with a window on each side, so that it seems as if one might look right through it. These windows are the delicate colourless areas associated with the attachment of the scales.

Eriocrania is the next form we have preserved. It is more on the direct line of evolution, absolutely so, most probably, from an antennal point of view; more so than *Micropteryx*, since not only is there no orientation of hairs or scales, but no condensation of either, as is the case in so curious a manner in *Micropteryx*. It may be asked why pick and choose in this way between *Micropteryx* and *Eriocrania*, and since *Micropteryx* is so much the older form, why shall we not accept its antenna as the primitive lepidopterous antenna. *Micropteryx* is a very isolated form, but is unquestionably somewhere between the Neuroptera below, and the Lepidoptera and Trichoptera above, and the Diptera in some upward or lateral direction. Amongst all these there are no antennæ specialised in a manner similar to that of *Micropteryx*; one cannot help concluding, therefore, that though its position otherwise is fairly obvious, and though its antennæ are easily derivable from a probable antenna for that position, it is not an antenna that leads forward to any other known form.

I have just referred to the Diptera, there can be little doubt that the neuratocerous stem of the Diptera originated somewhere here, and the tendency to have scales is not entirely absent in the lower Diptera. But it is within the limits of our survey to note that the antenna of many of these comes within the definition of the primitive lepidopterous antenna by Bodine and Jordan, *i. e.* one with a uniform distribution of sense-hairs on all surfaces. And that the dipterous antenna evolved on lines parallel with Lepidoptera in so far that orientation of the hairs took place early.

The Trichoptera are another group that comes in here. Having postulated *Micropteryx* as a Lepidopteron, we are almost compelled to claim Trichoptera as a family of Lepidoptera. The only logical alternative is to throw over *Micropteryx* altogether, and following

Dr. Sharp cede *Eriocrania* to Trichoptera. The matter is more one of words and arrangement than of fact.

Micropteryx is more neuropterous than the Trichoptera are; whilst Trichoptera and *Eriocrania* are on about the same horizon. Both have larvæ without prolegs, both especially have pupæ with jaws for escaping from their cocoons or cases, with various other structures similar in both groups.

I incline myself to the belief that the primitive Trichopteron had scales, and that when we find Trichoptera with scales they are not new and separate acquirements, but directly inherited from a scaled ancestor common to them and the Lepidoptera.

As regards antennæ, we may note in the Trichoptera that the mass of species has got rid of scales on the antennæ, as elsewhere, and presents an antenna answering very closely to the primitive form stipulated by Bodine and Jordan for Lepidoptera. There are also forms mentioned by Bodine in which the antennæ are almost identical with those of *Eriocrania;* one he specifies is *Mystacides nigra.* There are also others more perhaps resembling adelid antennæ, such as in the genus *Œcetis.*

Bodine advances several grounds in antennal structure for approximating Eriocraniadæ and Phryganeidæ.

All these points are of great interest in themselves, and of interest to us just now as strongly increasing the presumption that we have in *Eriocrania* a really primitive lepidopterous antenna, one in which there is a uniform distribution of sense-hairs, and uniformly distributed amongst them a protection of scales.

There is one point, a large one, however, on which I have not sufficiently definite observations, and that is the relative distribution and predominance of the different sorts of hairs, of which Bodine defines three, and Jordan makes two classes, viz. "sense-hairs" and "bristles." In many cases these are easily distinguished, and in different groups they vary much in their relative predominance, whilst there is tolerable uniformity within the group. But it so often occurred that I found it impossible to say in some particular species precisely which hairs were which, that I gave up trying to differentiate them. The proper course was, no doubt, greater care and attention, and a wider field of observation; this, I must confess, I did not follow, and it will possibly appear that this has deprived me of a means of distinguishing antennæ which I have passed over as being practically identical.

I must confess to a doubt as to whether Dr. Bodine's three classes quite include all the forms met with in the lower Incompletæ, the range of size of hairs in these being very great, and yet difficult to gauge, owing to the great variation in the size of the moths. In many of the Obtectæ the "bristles" are easily distinguished from the "sense-hairs," and in these I refer to "sense-hairs" when I speak of hairs. It is in the Incompletæ that it is often difficult to distinguish them satisfactorily, and so quite possible to ascribe a

distribution to hairs (that is "sense hairs") that is too wide owing to its including areas with "bristles," and no "sense-hairs." I have avoided this as far as may be by seeing that usually the hairs are of the same characters over all the area noted as clothed with hairs, *i. e.* that usually none of the hair-covered surface is devoted to one kind of hair to the exclusion of others.

I ought, perhaps, earlier to have given some account of a lepidopterous antenna when fairly evolved, to enable any member who has not studied antenna to see better whither evolution is guiding the primitive antenna we have just considered.

There is a curious parallelism between the pupal structure and the antennal structure in this respect: that throughout the generalised moths that constitute the Incompletæ there is great variation in antennal as in pupal structure, but all show some tendency—one might almost say desire—to acquire the structure characteristic of the Obtectæ both in pupæ and antennæ; whilst again, both in pupæ and antennæ a somewhat different departure is taken by butterflies.

The obtect antenna obtains throughout nearly all the Phalenæ Obtectæ and the Pyrales. It also occurs in some Tortrices and elsewhere. It is, therefore, of greater range than the obtect pupa. It also presents a much greater variety of forms than is to be found in the obtect pupa.

Reduced, however, to its essentials, and omitting consideration of its numerous varieties, it may be very simply described.

It has an upper outer surface covered with scales, to the exclusion of hairs, and an inner lower surface covered with hairs, to the exclusion of scales.

I ought also to say that I am considering throughout only the clavola or flagellum of the antenna, omitting the two proximal joints, the scape and pedicel.

Hairs and scales are, no doubt, homologous structures; and it is, no doubt, very difficult to say what is the precise function of any particular hair in an insect.

Nor do we know how the scales of Lepidoptera arose—whether they arose *de novo* from epidermal cells that were not previously hairs, or whether they were preceded by, that is arose, by a change in the development of pre-existing hairs.

Let us suppose the latter to be the case, since I think it is the usually accepted theory. Why it should be I am not quite clear, since the preceding forms, Panorpidæ and Hemerobiidæ, are not remarkable for abundant hairs; whilst scales and equivalent hairs are very abundant in Lepidoptera, Trichoptera, and lower Diptera that take a common origin from somewhere amongst them. However, let us suppose scales are developed from preceding hairs: are they developed from any hairs—from mere protective hairs, from tactile hairs, or also from special sensory hairs? *A priori*, it seems that mere protective hairs, if there are such apart from tactile hairs, are the most likely sources, and that tactile hairs also might originate

scales, since a scaled surface is less in need of tactile sense than are unprotected ones. But it seems very unlikely that special sensory hairs should undergo such an evolution.

Leaving, however, the ground of probability, and looking for facts, when we find the primitive lepidopterous antenna of *Eriocrania* possessing both scales and hairs equally distributed, we find the conclusion almost irresistible that the hairs are the sense-hairs, special sensory, and at least some tactile also, of the pre-lepidopterous antenna remaining unchanged, and that amongst these—in hypodermic cells, in protective hairs, or in tactile hairs—the proper structure to evolve into scales has been found on the antennæ, as on other parts of the surface.

If the antennæ are really the special sensory organs we believe them to be, then it seems as unlikely that the structures—hairs, or whatever else they may appear—that receive the special sensory nerves should be transformed into scales, as that, say, the facets of the compound eyes should do so.

It would almost appear that the antennæ became scaled unwillingly, but were obliged to do so because they possessed some of the same structures of the chitinous envelope that developed into scales elsewhere. This appears from the fact that in *Eriocrania* and some Incurvarias the scales are, as it were, buried amongst the hairs, and can be of little use either for protection or coloration.

In nearly all the orders of insects there appear to be instances of antennæ without any definite orientation, but also in all, or nearly all, there is a strong tendency to specialisation of surfaces, one side having a different character of development to the other. This tendency soon took effect in the Lepidoptera; and if we go to the immediate descendants of the Eriocraniadæ, we find a greater variety in the results of this tendency than in any other family. The antennæ have not yet taken any determined line of evolution, and are, therefore, decidedly more plastic than they afterwards become.

The lower Adelidæ, and especially the genus *Incurvaria* (*musculella*), are closer to the Eriocraniadæ than any other Frenate is to any Jugate family.

The male of *Incurvaria musculella* has unipectinate antennæ. The pectinations are flat spathulate projections from the middle of the lower surface of each joint. This is a strong determination of growth in one direction. The most remarkable feature of the antenna, however, is the presence of both hairs and scales over its whole surface. The scales are not confined to the dorsum of the antenna, and the margins of the pectinations as in the pectinate antennæ of many Obtectæ, but are tolerably uniformly scattered over the faces of and between the pectinations. They are more abundant than elsewhere along the dorsum, and also at the opposite surface, viz. the lower or proximal surface of the pectinations. At precisely the same points the hairs are most abundant also, and overtop the scales.

In *Incurvaria œhlmanniella*, which has non-pectinate antennæ, the

hairs and scales are everywhere mixed, but the hairs predominate ventrally. There is here, therefore, a distinct beginning of the aggregation of hairs ventrally, and of scales becoming less in proportion on that aspect. In *I. prælatella*, in the male the scales are more abundant dorsally, sparser ventrally; the hairs also exist all over, but are less abundant dorsally. In the female the scales practically form two rows or rings, with hairs everywhere sparsely mixed amongst them. This type of antenna is that which is developed in the Tineidæ, a family that appears to have originated in the Adelidæ.

In *Lampronia capitella* and *L. rubiella*, which closely follow the Incurvarias in phylogenetic relationship, the antennæ are completely encircled with hairs, and the scales have disappeared, except on some eight or ten segments at the base, which carry scales on their dorsal surface.

This is a type of antenna that Dr. Jordan does not appear to have met with, and he even asserts its non-existence in frenate Heterocera, recognising it only in the lycænid stirps.

Although I think it is most probable that the lycænid antenna originated from one of the hesperid type, there is, no doubt, much to be said in favour of its having arisen, just as we have it here in Lampronia, by near relationship to Jugatæ. Such a form is clearly more easily attained whilst the structures are in the plastic condition of these earlier stages. Still, when we see how, even in much later stages, the hairs and scales advance into and retreat from each other's territory, there is no insuperable difficulty in the origin from Hesperidæ. Dr. Jordan postulates such an impossibility by assuming the method of origin of antennal scaling that I have already discussed.

Though it is somewhat out of proper order, I may here refer to the way in which the dorsal scaling of the antennæ may disappear in certain of the most highly specialised Heterocera. It is clearly apposite here, when we are considering the possibility of a haired surface existing dorsally apart from direct inheritance from the primitive forms.

The Noctuæ, Agaristidæ, and Geometræ undoubtedly have antennæ closely and widely scaled to the tips as their typical forms; yet in *Anarta*, in *Alypia*, and in *Psodos* the terminal joints of the antennæ have the scaling reduced to the width of one scale, and in *Anarta melaleuca* and *Psodos coracina* there are several terminal joints without scales. It is, no doubt, possible to argue that in my specimens the odd scale has been accidentally removed. I am tolerably well satisfied, by examining several specimens, that this is not so; but if it is, the reduction of the scaling to a width of one scale is nearly as strong a proof of the scaling retreating as if it had been finally lost. The case of *Polyploca ridens*, alluded to later, is, perhaps, a still stronger case in point

Bodine tells us that the antenna of *Eriocrania* is wholly scaled. Dr. Jordan says there are no wholly scaled antennæ; he accompanies

the statement with another to the effect that there is always a space reserved for the hairs.

There are antennæ that appear to be wholly scaled ; they are so, certainly, in the sense that there is no special area reserved for hairs. It would seem quite useless for an antenna to be wholly scaled in the sense of having no hairs whatever, as it would then be destroyed as a sense-organ. But it is the case that in *Nepticula* and other Incompletæ the scales form a continuous coat, as perfect on one aspect as another. These cases all occur tolerably near the phylogenetic base, whilst the structures are fairly plastic.

The Gracilariadæ (including *Lithocolletis*, *Ornix*, etc.) have wholly scaled antennæ. They have the rather unusual allowance of only one row of scales to a segment, the ruling figure being two rows. Two or more hairs are visible on each segment protruding through the scales. As this family is one of the highest of the Incompletæ, the single row of scales is probably an indication that the wholly scaled antenna is not here a direct derivation of the Jugate or *Incurvaria* antenna, but arose from some form in which the first row of scales disappeared, giving place to hairs, and that the hairs finally hid themselves beneath the scales. We shall see that there are many forms in which the first row of scales tends to disappear in favour of hairs, and some in which it actually does so. I presume that short hairs or rods are present in such an antenna as that of *Gracilaria*, hidden away beneath the scales, but I have not demonstrated them. There are in some Gracilariadæ a few hairs visible as a ring at the base of the scales.

In Lyonetiadæ (*Cemiostoma*, etc.) the scaling closely resembles that of *Gracilaria*.

Some of these antennæ, with single complete rings of scales, and no evident hairs, are very beautiful objects, each ring following the last, like a string of flowers (tulips or lilies) threaded one above another.

I cannot say how it happened that two rows of scales to a segment came to be so dominant a pattern. We have its first appearance in that I have described as belonging to *Incurvaria prælatella*, with two circles of scales to a segment, with two rows of hairs alternating. Probably that allowance was determined by the length of an antennal segment in the species that first developed it.

In *Tinea* (*tapetzella*, *granella* and *pellionella*, etc.) we find this form simplified into one circle of hairs and one circle of scales. The circle of hairs is so wide that the question at once arises, has not the basal row of scales disappeared from a two-ringed antenna? That this is a correct surmise is proved when we find in *Tinea fulvimitrella* and *ochraceella* portions of the first ring of scales still existing.

Tinea ochraceella is almost identical with the *pellionella* form noted above ; but there appear to be two lengths of scales, so that, though there is the appearance of there being only one row, there are really two. There is little or no orientation of the hairs or scales. The

passage from this form to *Gracilaria*, with one row of scales with a slight circle of hairs at their base, and *Lithocolletes*, with only a bristle or two peeping between them, is very direct.

In *Glyphipteryx* (*fuscoviridella*, *haworthana*) this same type has advanced by the disappearance of the ventral portion of the ring of scales, so that the antenna is clothed all over with hairs, except that at the dorsal apex of each segment are placed three or four short squat scales, diminishing to two on the further segments of the antenna.

The Nepticulidæ, with one row of scales to a segment completely encircling the antenna, are very like *Lithocolletes*, and may have a similar origin. They are extremely alike ; *Lithocolletes* is, perhaps, more slender. I have not been able to detect hairs on either. Though they may have a similar origin, they certainly have not the same origin, as *Lithocolletes* is clearly descended from the *Tinea* stem, whilst *Nepticula* is in many respects more generalised than *Tinea*. I should incline to place *Nepticula* on a special phylum of its own in this matter, and as having acquired an antenna with one row of scales because that was all it had room for, just as we imagine the two rows of scales originated in a question of dimensions. The scales of *Nepticula* are extremely large in proportion to the size of the moth, and this circumstance would have its effect when the scaling of the *Nepticula* antenna (ancestral) was differentiated from the hair clothing.

The specialisation in the Psychidæ and its lower allies, if these be not included in the restricted family, gives us very many of the forms that we find specialisation following in other groups.

In the Lypusidæ (Psychids with round cases and winged females) we find in *Lypusa maurella* two rings of scales to the antenna with hairs between them ; in the female the hairs are poorly developed and sparse, and the further ring of scales is always complete. In the male the scales are wanting ventrally, where the hairs are abundant and long, and quite of a psychid type ; dorsally the further ring presents a patch of large strong scales ; the nearer is nearly obsolete, presenting only a scale or two of reduced size, and the dorsal portions of the rings of hairs are fairly developed at both their proximal and distal margins.

In *Psilothrix dardoinella* and *Melasina lugubris* we find a divergent specialisation that we find in the higher Psychids taking already two separate directions. In these species the male antenna is pectinated. In *dardoinella* the shaft is scaled dorsally, but long psychid sense-hairs occur not only beneath the shaft and the pectinations, but occur on all aspects of the pectinations, whilst in *lugubris* the pectinations are scaled on their outer aspects. In *lugubris* female the scaling covers the whole antenna except some area at the base in front in each segment, where a few hairs (? tactile bristles) occur. The scales might be described as being in two rows, but so irregularly as almost to be without definite alignment.

In the Diplodomidæ (winged females, triangular cases) the female antenna appear to have complete scaling, with no area reserved to hairs, and in two complete circles. In the male the lower surface is free from scales and covered with hairs, which are, however, somewhat aggregated in a thickened base of each segment.

In the Talæporidæ (araneiform females, triangular cases). The female antennæ are, as in all the families that are more specialised, degenerating, and have practically lost all hairs and scales, not as a specialisation, but as a step towards the disappearance of the antenna altogether.

In the male the scales are definitely confined to the dorsum, the hairs to the ventral aspect of the antennæ. The scales appear to be always in two rows, easily distinguished, but the hairs, which are long, as in typical Psychids, and abundant, are sometimes uniformly distributed, *Solenobia inconspicuella*, *mannii*, etc., group, *alpestrelia*, etc. ; and in others are aggregated basally, or into two groups, *Talæporia* (*pseudobombycella*) and *Bankesia* (*conspurcatella*).

Dissoctena granigerella belongs to a group separate from any of these, but not very far separate from *Melasina*. It is essentially a *Melasina* with apterous female. Though apterous, the female has made none of the progress downwards of the Talæporiadæ ; it has acquired the long ovipositor required for placing the eggs in the larva case, but it retains a very complete hair clothing of the whole surface, and the antennæ are completely scaled in two rows of scales to a segment. The antennal characters, therefore, are those of *Melasina*, and appear nowhere else in the whole superfamily. The male antenna is grandly pectinated with pectinations dorsally scaled.

In the Luffiadæ (*L. lapidella* and *B. sepium*) with pupal and other characters intermediate between Talæporiadæ and Fumeidæ, the antennæ have four rows of scales across the dorsal aspect of each segment, and pectinations which, with the ventral aspects of the segments, are clothed with sense-hairs on all aspects.

In the Fumeidæ there are two very distinct sections, both follow the Luffiadæ in having four transverse rows of scales to a segment, but already the aligment is beginning to vary and become obscure. In the Proutiid section (*betulina*, etc.) the hairs affect all aspects of the pectinations ; in the Fumeid (*sensu stricto*), the dorsal aspects of the pectinations are scaled to the tips.

The two higher groups of Psychids follow the Proutiids and Fumeids respectively in antennal structure.

The Epichnopterygids (*Epichnopteryx* [*pulla*, *sapho*, etc.), *Bijugis* [*bombycella*, etc.]) have antennal pectinations, with sense-hairs on all surfaces and without scales.

The Psychids (restricted) have the antennal sense-hairs confined to the inner aspect of the segments and pectinations.

They divide into two very definite groups, viz. those that retain the dorsal scaling of the pectinations (Psychini) and those that lose it (Acanthopsychini) ; the latter may at once be known from the

Epichnopterygids, since, though they may possess no scales on the dorsa of the pectinations (a few species still retain a few), neither do they possess any sense-hairs, the dorsa being bare and smooth except perchance for an odd sensory bristle, stiffer and shorter than the sensory hairs, which in nearly all the Psychids, above and including Fumeidæ, are very long.

The Apteronidæ are a branch of the Psychini, but have very specialised antennæ; the pectinations are very short, the sense-hairs short and hidden away on the ventral aspect of the antenna, beneath a great development of the dorsal scaling, here consisting of hair-scales, which, projecting at the site of each pectination, give the antenna the appearance of being serrated.

It is curious that this differentiation of the highest Psychids into two groups by antennal structure, should coincide with a differentiation by the presence or absence of long anterior tibial spurs. The Acanthopsychini (*Œketicus*, *Lansdowni*, *Metura*, *Acanthopsyche*, etc.) possess the spurs and lose the scaling of the pectinations; they also have special elaboration of the venation of the opposed wing margins (generally). The Psychini that retain the antennal scales lose the tibial spurs, and as a rule have less elaboration of neuration.

The cochlidid antenna with complete scale covering might be treated in an off-hand manner as parallel with that of *Nepticula*, etc., as an immediate result of the plasticity of antennæ of the lowest families. This would, I think, be an erroneous method. No doubt it is a result of the plasticity of the antenna in the most generalised groups, for the Cochlidids, curiously and elaborately specialised as they are in some respects, are essentially a very primitive form.

The reasons for rejecting the ready method are that the forms having the completely scaled antenna are the higher and not the lower in the family, and that the scaling is abundant and irregular, and not in the two regular rows we find in so many forms.

This type of scaling is in so many places associated with pectination, that, if it seems reasonable to do so, one looks for association with pectination here.

Now the Cochlididæ are especially a family with pectinate antennæ, and are immediately or collaterally descended from the Megalopygids—a family with antennæ most fully pectinated. The megalopygid antenna is also a most fully scaled antenna, and one might say of it, and in some degree also of the pectinated antenna of the Cochlidids, that, if it were not pectinated, it would certainly be completely scaled. In *Lagoa crispata* the pectinations are not scaled internally (nor are they in Cochlidids), but they are not only scaled down their free outer borders, but are expanded at their tips, where they have a very dense mat of scales, such as I do not think I have seen in any other family, but reminding one very much of the thickened scaled end of the pectinations in *Incurvaria muscalella*.

In the Cochlidids, whenever there are pectinations, and whatever be their form, they are always free of scales internally and scaled externally, and every portion of the antenna not occupied by pectinations is completely scaled. This may be a scrap at the tip, half the antenna, the whole of it except a little irregularity at one point near the base. Or it may be, as it is in our English species, the whole antenna.

I speak with much diffidence, as my own acquaintance with Cochlidid species is very small; but so far as I understand the views of Dr. Dyar and others as to the phylogeny within the family, these simple antennæd species, like ours, which have also smooth larva when full-grown, are the most recently evolved. If this proves on further research to be correct, we have here a proved instance of a pectinate antenna reverting to a simple form.

Having done so, it retains the character of a completely scaled antenna, which belonged to it throughout, but which was obscured by the pectination. It retains also the irregular disposition of the scales, which is a character associated with pectination.

In *Plutella* (*annulatella*, etc.) the antenna has a complete coating of hairs except for the interruption of a ring of short scales at the distal margin of the segment, and of several placed dorsally representing the first ring. The scales are so small that the rows seem widely apart, and the clothing of sense-hairs is nearly as complete dorsally as ventrally, the difference being only by the interruption of the two or three scales of the first row.

In *Coleophora* there are two rows of scales; the second row is interrupted ventrally, giving place to hairs; in some species this interruption is so small and evanescent that the antenna appears to be one with a complete coating of scales.

In *Cerostoma* (*xylostella*) the arrangement is the same as in *Plutella*, except that the scales are much larger and overlap, and appear to have banished all hairs from the dorsal region.

In *Depressaria*, *Aplota*, *Hyponomeuta*, *Acrolepia*, and many other forms there are two rows of scales, with the first row deficient ventrally, leaving room for hairs, much as in *Coleophora*.

In *Œcophora* there is a ventral line of hairs from end to end of the antenna, but also a few hairs exist between the scales, which cover in two rows to a segment the dorsal and lateral aspects of the antenna.

In *Argyresthia* and *Elachista* the arrangement is the same, except that no hairs can be detected dorsally; so that here we have, practically, the obtect antenna, in the form in which the scales broadly clothe the dorsal aspect of the antenna.

The Pyrales in all their sub-families, including Phycids, Crambids, Scopariads, etc., have antenna scaled as in Obtectæ.

Orneodes has the scaling well advanced laterally, having some resemblance to that of *Argyresthia*. It is substantially a pyrale or obtect antenna.

The Pterophorids in a few cases, as *Pt. pentadactylus* and *M. phœodactyla*, have hairs between the scales dorsally, as in *Plutella*, etc. In the majority the hairs are dwindled and out of sight, or absent, so that the form is practically that of Obtectæ. The presence of the lower forms, however, adds to the improbability, already very great, that *Pterophorus* arises from any Pyrale or other form with obtect antennæ. The form in *pentadactylus* is a very unlikely one to be reached by further evolution, and is almost certainly ancestral from more generalised predecessors.

The Tortrices have not any scales ventrally in any species I have examined, and in some the dorsal scaling tends to be very narrow, as in *Cnephasia* (*virgaureana*, *bellana*). The scales are always in two rows; and in the great mass of the species there is a zone of sense-hairs right across the dorsum between each row of scales.

In a small minority of species, which do not group themselves together in any classification I have seen, these dorsal hairs are obsolete; the scales overlap, and there is substantially the obtect type of antenna. This occurs in *Tortrix* (*heparana*, etc., not *viburnana*) *Teras* (*caudana*) (not in *Peronea*); in *Antithesia* (*sororculana*, etc.) (not *salicella*), *Stigmonota* (*perlepidella*, etc.), *Batodes* (*angustiorana*), *Ditula* (*woodiana*).

There are a few intermediate forms, such as *Tortrix musculana*, which look at first sight as if belonging to the obtect group, but in which a few hairs can be detected amongst the scales.

Amongst the Geometers there is great uniformity throughout the group. There are two rows of scales across the dorsum of each segment, and hairs beneath, and there is not much difference from base to apex.

In *Oporabia* (*dilutata*) there are three rows of scales to a segment.

In a certain number of species there is a very definite modification, chiefly confined to those whose males have pectinated antennæ. In the females of these the scales are far from being definitely in rows, and they extend round the ventral aspect leaving only a narrow channel for hairs, which widens out apically, and in some apterous forms makes a wide brush-like pad on the seven or eight last segments, in strong contrast to the nearly evanescent haired surface of the proximal segments. This is the case in several Hybernias.

The species forming this group are the Boarmiadæ Hyberniadæ, Amphidasydæ and Fidoniadæ, all included in Meyricks Selidosemiadæ.

I have already alluded to *Psodos coracina*, whose antennæ for more than half their length apically have only one scale wide to a segment, and that closely encroached on by the haired surface.

The Noctuæ have nearly the same arrangement of scales as the Geometræ, viz. two rows of scales occupy the dorsal half of the segment, hairs the ventral half. I have referred to the exceptional condition in *Anarta*.

The existence of pectinations seems always to disturb the regular arrangement of the scale in two rows to a segment in all Obtectæ that I have examined, the dorsal surface probably partaking of the tendency to increased developments. In *Drepana* (*lacertinaria*) and in Notodonts this tendency seems to be best resisted, but the two rows in these cases are not smooth and regular as in the most typical *Noctua* antenna.

The Brephidæ have antennæ that show the effect of a day-flying habit in the strong tendency to a greater development of hair-surface apically.

The first thirteen joints are completely scaled, the ventral scales inclining centrally and overlapping. About the middle of the antenna, the gradual opening of these ventrally has proceeded till the nearly normal type of obtect antenna is reached, namely, the dorsal half scaled, the ventral haired. The haired surface continues to encroach on the scales, till there are only three or four scales to a segment on the four last joints, and the terminal one is scaleless.

The Cymatophoridæ have for the most part ordinary obtect antennæ, with very smooth scaling and very short regular hairs, but *P. ridens* presents most remarkable antennæ. The dorsal scaling rapidly narrows, till at a quarter of the length of the antenna. From the base there are two segments with only one scale each, and the remaining three-quarters of the antenna are without scales and densely clothed throughout with fine hairs.

This instance seems conclusive of the fact that the haired surface may invade the scaled one, and produce an antenna even more extreme than that of any *Lycæna*, and yet have no immediate connection with the primitive Lepidopteron. *Ridens* is certainly a peculiar form, but I have never heard any doubt thrown on its being a typical Cymatophorid, and its antenna must be derived from the ordinary obtect form which is characteristic of the other species. The cases we have considered show that scales can retreat before the advance of the sense-hairs to the same surface; but the scales can also disappear apart from any advance of hairs, leaving the surface naked. This takes place only in most specialised forms. The two most notable instances are the Saturniadæ at the summit of the bombycid stem, and the Danaidæ near if not at the summit of the nymphalid stem. We see in the case of the butterflies some steps in the process of the disappearance of the scales, as in some *Charaxes* (*jasius*, etc.) the scales still exist, but shrivelled to minute specks stranded at remote distances from each other. Dr. Jordan quotes one or two instances in Arctia, sp.. The case of the Hepialidæ seems parallel to these. In our own *humuli* and sundry other species there is a row of one or two scales extending along half the antenna, the rest of the antenna being hair-covered In other species with pectinated antennæ there is a larger area of scales. The disappearance of

the scales here seems to be parallel with the cases of the Saturnias and Danaids, but, as in *Hepialus* there were hairs and scales mixed all over the antenna, this disappearance of the scales leaves a hair-covered and not a naked surface. The Hepialids are certainly on their special stirps a very high family indeed.

The few scales that remain on the antennæ of our European Hepialids suggest to me that they are the (degenerated?) descendants of forms with pectinate antennæ.

I have above noted the disappearance of scales from the dorsal surface of the pectinations in the highest Psychids.

When we come to the butterflies we find quite different types of antennæ to those we have been used to in the moths, just as we find also different types of pupæ (and of other organs, structures, etc.).

There is first, perhaps, the circumstance of the scales being much more numerous than two rows—a condition very rare amongst the moths except in association with pectination.

Secondly, there is the very strong apical direction of the hairs. In moths the hairs have a ventral, the scales a dorsal, position, usually with tolerable uniformity from base to apex of the antenna, a tendency for the haired surface to be wider apically is not common, and a marked instance of such a tendency is decidedly rare. In butterflies the dorsal and ventral orientation of scales and hairs obtains throughout, but it is equalled and often exceeded by the tendency of the hairs to occupy the terminal joints dorsally as well as ventrally, yielding up the ventral surface basally to the scales.

Dr. Jordan has worked out the morphology of butterfly antennæ so fully that I have no further facts to add to his.

I think his facts rather confirm than throw further doubt on the hypothesis that the Castnias are an early foreshadowing of the butterflies, and that the Hesperids are not only the lowest family but possibly ancestral to the others.

The chief difficulty of making the Hesperids ancestral, at least of the Papilionid stirps, appears to me to be not in the dorsal so much as in the ventral scaling in the Hesperids. I see no difficulty in the necessary changes taking place, that is the small apical ventral sensory surface might spread in any direction, if natural selection approved, but the apical tendency of this surface is so strong in all the sections of the Rhopalocera, that I very much doubt its returning entirely to the base in any instance after securing so apical a position as it has in Hesperids.

Another remarkable feature of butterflies is the acquisition of depressions or grooves on the ventral aspect of the antennæ. This does not occur in Hesperids or Lycænids; but in Erycinids a longitudinal groove appears in the higher forms on the ventral aspect of the club, and extending up the stalk.

In the Papilionids a slight tendency of this sort occurs, which is very evident in its derivatives.

The Parnassininii have a row of rather irregular pits. The Pierina

have a similar row of pits, which enlarge till they meet across from segment to segment, and form a groove very like that of Erycinids, and accompanied by two other grooves or pits in the subfamily Dismorphiina.

The great Nymphalid family in all its branches has two grooves bounded by three very definite raised ridges or carinæ. This is a most unmistakable character, by which a nymphalid antenna may always be recognised.

Dr. Jordan derives the pierid antenna from that of the Erycinids. Apart from its general improbability, and the absence of any intermediate forms in other characters, which would certainly be found if Pierids sprung, as Dr. Jordan's theory requires, from the higher Erycinids, there are inherent difficulties.

One point is that the depression in Erycinids is always a groove, keeping its full width along the joints of the antenna, whilst the depressions in *Pieris* are pits that coalesce to form a groove, and almost always the groove shows traces of this by narrowing at the edges of the segments.

A feature of butterfly antennæ I have not alluded to yet is the differentiation in area of the hairs and the pits and rods of Bodine ("punctures" of Jordan), and the great abundance of the latter in the most specialised antennæ. This does not occur in Hesperids or Lycænids, but is very marked in Papilios, Pierids, and Nymphalids.

In Pierids and Nymphalids the hairs are always aggregated within the pits or grooves, and only punctures occur outside them, and the two areas are sharply defined from each other. The Erycinids show some of this differentiation, but it is rarely, if at all, complete; hairs and punctures are more or less intermixed, punctures are comparatively scarce, and hairs always occur outside the grooves.

These difficulties in the way of Dr. Jordan's classification of Pierids are not, perhaps, very conclusive in themselves, though they seem stronger than Dr. Jordan's case in support of it. But they seem to be overwhelming when we remember that we have, outside the antenna, nothing in support of it, and a phalanx of facts pointing the other way.

It may be useful to summarise the lines of antennal evolution here suggested:

1. The primitive pre-lepidopterous antennæ, with sense-hairs regularly distributed (*Panorpa*, etc.).

2. The primitive lepidopterous antennæ, with hairs as in 1, but with scales uniformly distributed amongst them.

3. From this various lines of evolution—as (*a*) *Lampronia capitella* and *rubiella*, in which the scales largely disappear except towards the base dorsally; (*b*) *Nepticula*, in which a single row of scales completely encircles the antenna, and hairs are not visible; (*c*) the main line, in which the hairs and scales separated themselves into alternate rows, two of each occupying each joint of the antenna, thus

forming two rings of hairs and two of scales on each joint (*Incurvaria prælatella*, female).

4. From this many variations occur. (*a*) The hairs disappear in the upper ring, leaving a basal ring of hairs and two rings of scales; and (*a'*) the basal row of hairs becomes evanescent, leaving two rings of scales only (Gracilariadæ). (*b*) Gradual disappearance of first ring of scales (*Tinea fulvimitrella*), leaving only a wide basal ring of hairs and one ring of scales. This continues (*Glyphipteryx*), by the loss of ventral scales, to there being only a dorsal terminal row of a few scales to a segment.

5. The *main line*, then, is a strong tendency for scales to disappear ventrally and for hairs to disappear dorsally. In some (as *Coleophora*) the dorsal disappearance of hairs has advanced greatly, whilst scales still persist ventrally. In others the scales have disappeared ventrally, whilst one or two rows of hairs still exist dorsally. This line is well illustrated in Tortrices.

6. The final tendency seems to be the usual form in obtect Heterocera, of hairs ventrally, two rows of scales dorsally.

7. Pectination appears to result from an effort to increase the antennal area, which does so dorsally as well as ventrally, so that the double row of scales dorsally is increased, usually throwing the scales out of alignment, whence the scales, instead of being in two regular rows, are an irregularly disposed thatch. This persists even after pectination has disappeared again (Cochlididæ).

8. There is a capacity in the final obtect form for hairs and scales to encroach on each other's territory, but they never apparently occur again mixed up together. The tendency is often seen for scales to disappear terminally (*Alypia*, *Psodos*, *Polyploca*, etc.).

9. Butterflies have followed a separate line of evolution. They begin with a strong tendency for scales to be basal and hairs terminal, and with scaling largely developed ventrally. The irregularity of their scaling suggests that their ancestry included some pectinated forms, notwithstanding that any tendency to pectination is now conspicuous by its absolute absence.

The Nature of Metamorphosis.

By J. W. Tutt, F.E.S. *Read March 9th*, 1899.

It is well known to all entomologists that the embryo of an insect passes through various changes in form before it hatches from the egg, and that after hatching other changes almost as remarkable take place, especially in those insects with a complete metamorphosis, each change essentially being an adaptation to, and fitting the insect for, a particular mode of life.

The life of the holometabolic insects is such that it may be conveniently divided into four distinct periods or stages—the egg, larval, pupal and imaginal stages. The term metamorphosis is applied to the post-embryonic changes, *i. e.* to those that take place after the larva has hatched from the egg. All holometabolic insects live, as it were, three distinct and different lives, in each of which its modes of life, of nutrition, and environment are entirely dissimilar. Hence its habits being different, it has to meet its enemies and to protect itself in various ways. The caterpillar is essentially a different animal from the pupa, and the pupa from the imago. Organs that are well-developed in the one stage may become obsolete in the succeeding ones, whilst ill-developed organs may become well-developed in later ones. The modifications of organs extend to their functions, and hence we find the habits possible to one stage quite impossible in the others.

In the Synaptera, development is direct, the young differing neither in form, structure, nor habits, from the adult. The primary form and general appearance of the animal is maintained throughout its existence, there is not even a tendency to a partial metamorphosis exhibited, and the insects are consequently termed Ametabola. This suggests strongly that metamorphosis took place after and not simultaneously with the first appearance of insects, and further that it was a phenomenon that was induced after the first winged insects appeared.

The Heterometabola and Holometabola comprise the winged insects. To the first group are relegated those insects in which the adult differs mainly from the newly-hatched young in having wings, and in being without an inactive resting or pupal stage. The wings of these insects are acquired after successive moults, the insect remaining active and seeking its prey in all its stages. The Heterometabola comprise the Orthoptera, Dermaptera, Platyptera, Ephemerida, Odonata, Thysanoptera and Hemiptera (except male Coccids, which have a quiescent stage preceding the winged form).

The difference between the first stage (*i. e.* the one following the egg) of the Heterometabola and Holometabola is so great that one feels that the term "larva," generally applied to this stage of the Holometabola, is quite unsuitable; similarly the term "pupa" applied to the resting or quiescent stage of the Holometabola is equally inapplicable. We still often speak of the "larva" of heterometabolous insects, although we generally apply the term "nymph" to the pre-imaginal stage. The larva and nymph, however, are quite undifferentiated in the Orthoptera, Odonata, Ephemeridæ, and Hemiptera, and hence many of our best authorities use the term "nymph" to designate all the stages between the egg and imago in these insects. In this sense, nymphs are the young of insects which lead an active life, and have the mouth-parts formed on the same general lines as those of the adult insect.

During the larval period of holometabolic and the nymph period of heterometabolic insects, the animal undergoes a certain number of moults or ecdyses of its skin. The intervals between two successive moults are called stadia, and since the various species moult a varying number of times (even the sexes of the same species sometimes vary in this respect), the number of stadia varies not only with the species, but sometimes even with the sexes of the same species. It is well known that even in the larval and nymph stages there is sometimes considerable difference in the appearance of the insect, the newly hatched larva looking a very different creature compared with its appearance after the first moult, and this again from its appearance after the second moult. The appearance of the insect at various stages of its larval existence is designated by the term "instar," the period from egg to the first moult being called the first "instar," and so on.

The metamorphosis, however, even of the heterometabolous insects, varies in degree, that of the Orthoptera, Dermaptera, Platyptera, etc., being very slight and gradual, without any resting-stage, the chief external difference between the adult and the newly hatched nymph being the presence of wings, the chief internal difference being the complete development of the sexual glands. In the Odonata, Plecoptera, etc., the changes are more marked, although there is no truly inactive pre-imaginal stage.

The Holometabolous insects comprise the Neuroptera, Coleoptera, Mecoptera, Trichoptera, Lepidoptera, Siphonaptera, Diptera, and Hymenoptera. These present a true larval and a distinct pupal stage. In these orders, too, the species present in each of the three later stages essential differences in form, structure, habits, and mode of life. In the heterometabolous insects the nymph obtains at each subsequent moult a greater likeness to the adult, whilst in the holometabolous insects the larva often differs much in each succeeding instar from its previous appearance, then suddenly assumes a quiescent, or pupal form (often protected by being enclosed within a cocoon), which always differs widely from the larval, and finally assumes the

imaginal stage, which is again markedly different from all the stages preceding it.

Originally it was supposed that the caterpillar had within it "the germ of the future butterfly;" that it had only to throw off a certain number of larval skins to disclose the pupa, and the pupal skin to liberate the imago, the latter being supposed to be within the various skins all the time. On this theory that the larva hid, as it were, the imago, the term "larva" (= a mask) was a very applicable one to the young of the holometabolous insects. This theory of the early entomologists, too, was largely founded on fact, for Swammerdam observed that in the full-fed larva of *Culex* he could point out all the limbs of the future nymph concealed beneath the skin; and he has also noticed that beneath the skin of the larvæ of bees just before pupation took place he could see the antennæ, mouth-parts, wings, and legs of the adults. Our views, however, on the nature of metamorphosis have undergone a radical change since Weismann discovered the imaginal germs within the larva, and since he pointed out the fundamental processes concerned in the change from larva to pupa, and pupa to imago.

Larvæ themselves have been divided into two classes: (1) The campodeoid form, resembling the active nymphs of the heterometabolous insects. (2) The eruciform larvæ, including those of saw-flies, Lepidoptera, Hymenoptera, Coleoptera, etc.

The campodeoid is considered on many grounds to be the older form, and it is urged that the larvæ of *Meloë* and of *Sitaris* prove the eruciform type of larva to be derived from the campodeoid, since these beetle larvæ when young are of the latter, and when fully grown of the former, type, the campodeoid form being lost as soon as the larvæ begin their parasitic mode of life. The eruciform larvæ appear to be due to the degeneration of the true legs, consequent upon living a comparatively stationary life, the prolegs having been developed later, when the competition for existence no longer enabled the species to compete successfully without a certain amount of comparatively rapid movement. The most specialised type of the eruciform larvæ may be seen in certain dipterous and hymenopterous larvæ which have lost the power of movement from place to place, and either bathe themselves in their food, or take no active part in obtaining it.

With regard to the origin of the eruciform larva, Packard considers that the first steps were taken in the Neuroptera (as restricted by Brauer), in which, though the larvæ are campodeoid, there is a true resting pupal stage. He states that in *Mantispa* there are two larval stages which give the key as to the mode in which the change was brought about. The larva of this insect has a true campodeoid form when newly hatched, with long four-jointed legs, which would enable it to move about freely after its prey. It begins, however, at once to live a sedentary life in the egg-sac of a spider, and, before its first moult, it loses the use of its legs, while the antennæ are partly

aborted. The result is that, owing to this change of habit and environment from those of its active ancestors, it changes its form, and the fully-grown larva becomes cylindrical, with small slender legs, and owing to the partial disuse of its jaws acquires a small round head. Other modifications afterwards take place, and with the result, as it appears, that a change of habit and an abundance of food close at hand have brought about the change of a campodeoid into an eruciform type of larva. In the meloid and stylopoid larvæ, as has been noticed, the first stage is campodeoid, the eruciform larva becoming apparently developed subsequently, owing to its changed conditions and as a result of their parasitism. In the final stages of these larvæ, as also in certain hymenopterous and dipterous forms, the larvæ become vermiform.

It was at one time considered that the periodical moulting of larvæ was due to the fact that the skin had become, as it were, too small for the rapidly growing insect, and that a larger skin was necessary for it. In spite of the rapidity of growth, however, the skin is really an elastic membrane when shed, its elasticity, however, limited by the hardness of the chitinous deposit. The chitin by which the skin is hardened is now looked upon as an excretory substance, and the phenomenon of moulting is considered by many to be merely a means of getting rid of the accumulated waste materials between two successive moults. During the process of moulting a fluid circulates between the old and new skins, and it is this that enables the larva, as it were, to slip off the old skin, much as a finger is pulled from a glove. Not only is the integument shed with its hairs, setæ, and other armatures, but also the linings of such internal organs as had an original ectodermal origin; thus the larva sheds portions of the lining of the trachea and the alimentary canal. In the apodous larvæ of Hymenoptera that are reared in cells by nurse-bees the delicate skin breaks away in shreds, portions of the old skin remaining adherent to the new skin long after the greater part of it has been got rid of. The new skin appears to be formed by the secretion of a structureless chitinous layer from the hypodermic cells, the formation of the new layer drawing off the nutrition from the old skin, so that it dries considerably; the secretion of a surface fluid on the new skin helps more completely to separate them.

The "pupa" is a term which, as we have suggested, should only be applied to the inactive stage of holometabolous insects. The typical lepidopterous pupa has the appendages more or less closely folded about the body and soldered to the integument. Such a pupa was called by Linné a "pupa obtecta." On the other hand, the pupæ of certain Lepidoptera, such as *Eriocrania*, *Nepticula*, *Cochlidon*, *Anthrocera*, etc., have the appendages free from the body; they are known as "pupæ liberæ," or "pupæ incompletæ," dependent on the amount of freedom exhibited. The pupæ of Neuroptera, Mecoptera, and Trichoptera are in this manner "pupæ liberæ." When the pupa is enclosed in the old larval skin, as in certain dipterous pupæ,

the larvæ are said to be coarctate. Chapman has pointed out that although there is apparently no near relationship between the Coleoptera and Hymenoptera, they are very much alike in shape and general appearance, whilst both are helpless from their quiescence, and have resorted to the formation of a cell or cocoon for their protection. The general similarity between the "free" pupæ of certain Lepidoptera and the Trichoptera has been one of the factors in leading us to assume a close affinity between these orders. Poulton has demonstrated that the appendages of the lepidopterous pupa are not merely cases for the homologous structures of the imago, and he has further shown that there is often in the pupal structure no corresponding imaginal organ until shortly before the emergence of the imago. In some pupæ the imaginal organs are formed long before the emergence of the imago; in others their formation is delayed until a very short time before emergence, development then proceeding with great rapidity.

We have already stated that the early entomologists believed that the "encasement" theory of Swammerdam was the true explanation of the metamorphosis of insects, and it was not until Herold, in 1815, objected to some of the views that the theory involved, that any real doubt as to its correctness was expressed. Malpighi, as early as 1667, noticed in *Bombyx mori* that just before pupation the antennæ could be seen concealed in the head of the larva, and that the legs of the imago grew in those of the larva. Swammerdam, by throwing a full-fed caterpillar, just on the point of pupation, into boiling water, was able to show, by stripping off the skin, the immature form of the imago.

Réaumur in 1734, and Lyonet in 1760, both detected the organs in the process of formation; yet they did not appear to suppose that the organs were being formed, they only looked upon them as being liberated. Herold, however, in 1815, showed that the wings did not become visible in the lepidopterous larva until the very end of larval life; and that, as the larval organs disappeared, they were replaced by entirely new organs. In Herold's view the phenomena of metamorphosis were to be explained by the assumptions that the accumulation of fatty material went on in the larval state until the imago had attained its full dimensions or volume; that it then became a pupa, and in this stage the organs were developed and took on their definite form. Kirby and Spence, in 1828, however, maintained the old views, and state that "a caterpillar is not a simple animal, but a compound one," and further, that "a caterpillar, at first scarcely as large as a bit of thread, contains its own teguments threefold, and even eightfold, in number, besides the case of a chrysalis and a complete butterfly, all lying one beside the other." Of course there is some truth, mixed up with much error, in the views propounded by Kirby and Spence and those asserted by Herold.

In 1864 Weismann discovered the germs of the imago (imaginal buds) when he was at work on certain Muscidæ, and from these observations deduced his theory of "histolysis," *i.e.* the complete destruction

of the larval organs by a gradual process of degeneration, and the rebuilding of the new material thus produced by a process of "histogenesis" into the new organs, the germs of which he showed to exist within the organism. His views have since been applied to the whole of the holometabolous orders by other workers, and shown to be applicable to all of them. The imaginal discs, buds, or folds, are minute cellular masses, which arise from the epidermis; they are usually present in very young larvæ, and it has been shown that imaginal buds exist not only for the appendages, wings, and various organs, but for the different sections of the alimentary canal.

Preceding the change of the larva to a pupa there is a quiescent period, during which many important internal changes take place; and although the change in form from larva to pupa is at last sudden, this does not represent by any means an equally sudden development of the pupal structures. During this quiescent period the imaginal discs grow, and at the same time there is a destruction of the larval organs. The process of destruction is due to the leucocytes or blood-corpuscles, the larval organs thus broken up forming a creamy mass. In this mass the buds exist, resisting the influence of the leucocytes, and, on the other hand, utilising the material formed by this process of histolysis for their own growth. It must not be assumed that the destruction of all the larval tissues, or the building up of all the imaginal tissues, takes place simultaneously. The histolysis and histogenesis of a given organ is continuous, so that there is no distinct break between the existence of any given larval organ and the imaginal organ that replaces it morphologically; but the histolysis and histogenesis of some organs take place in the very earliest stages of pupal life, whilst others are not changed until the very end of the pupal existence, the last steps in the destruction of the larval organs taking place only after the imaginal organs have assumed their definite size and shape.

It must be quite evident that in some cases the imaginal buds serve for the formation of new organs where such do not exist in the early stages, or are gradually being built up during those stages; the wings afford an excellent example. In other cases they serve for the transformation of organs already in existence — legs, antennæ, maxillæ,— entirely different structures being formed as a result of their development, although morphologically equivalent to the organs preceding them.

The imaginal buds of the wings are not subjected to the disturbing influences engendered by the larval moults. They are at first entirely internal structures, and do not form a cuticle, according to Gonin, until towards the end of the last larval stage. As we have already elsewhere fully dealt with the formation of the lepidopterous wing, we will not enter into the subject here other than to say that, although the wings are present in the embryonic larva before it hatches from the egg, its growth is comparatively slow until towards the end of the last larval instar, when its rapid development makes it readily observable

in many full-grown larvæ. The permanent tracheæ of the wing appear usually during the third instar, the main trunks even then agreeing with what afterwards form the nervures of the wing; but they are not filled with air until the time of pupation. These trunks give rise in the pupæ to a new system of fine tracheæ, which replace those that have been active during the larval period. The imaginal legs, like the wings, are developed within hypodermal sacs, usually (but not always) remaining there until the end of larval life. In the Lepidoptera the imaginal leg grows from a disc, the part agreeing with the tarsus of which only enters the larval leg; consequently, if mutilation of a larval leg occurs, the only portion of the imaginal leg that can be injured is such part of the outgrowing disc that will form the imaginal leg that is, at the time of injury, contained in the larval leg. The view that the leg of the lepidopterous imago is entirely contained within the leg of the larva has been alleged to be erroneous, and should perhaps be abandoned. Similarly the maxillæ, labial palpi, and other imaginal structures are formed from imaginal discs, the resulting organs being very different in some instances from their morphological equivalents in the early stages.

Many modifications take place in the development of the Hymenoptera and Diptera, although it may be fairly said that the general principle underlying the development of the imago during the larval and pupal stages is in general very similar.

If now we summarise the facts connected with metamorphosis as observed in Coleoptera, Lepidoptera, Diptera, and Hymenoptera, and possibly all holometabolous insects, we find the following general conditions to exist. All and each of the external organs of the imago, and those of the internal organs that have an ectodermal origin, originate in single cellular masses called imaginal discs (or buds) which are already present in the larval (or even the later embryonic stages). There appear to be imaginal discs for each part of the body—head, legs, wings, ovipositor, and the different sections of the alimentary canal—that of the head being compound, and containing elements which give rise independently and individually to the various organs—antennæ, maxillæ, palpi, etc. Simultaneously with the formation of the imaginal organs by histogenesis, the larval organs under the influence of the leucocytes undergo a process of histolysis or destruction, the histogenetic process going on side by side with the histolytic, so that there is no break in the continuity of the organs, the final destruction of a larval organ only taking place with the complete formation of the corresponding imaginal organ.

It is quite clear that the sharp division of the holometabolous insect into larval, pupal, and imaginal stages is only applicable to the external body, and is not maintained in the processes of internal development, which form a continuous series of transformations in the case of each organ.

Although on the whole the form of the larva, pupa, and imago are kept distinct, and respond to the condition of their separate en-

vironments, yet we must agree with Pratt that the principal significance of the pupal period, and the attendant phenomenon of metamorphosis is that "it is the time when the larval characters which were adapted for use during a period of free life, and which would be valueless to the imago, are corrected or abandoned."

In conclusion, one may be asked what was the probable initial cause of metamorphosis. We see that it does not exist in apterous insects, and that it is confined to winged insects. There can be no doubt that the winged condition has enabled such insects to become the most successful type of life among the invertebrates, as up to a point birds are the most successful type of terrestrial Vertebrata. The existence of a period during which insects can retire from their ordinary environment, already provided with an abundant supply of stored food to last for a considerable period of time, and there undergo the changes which will enable them to take at once to a new environment, has given them an enormous advantage over their competitors in the struggle for existence.

There can be little doubt that insects were first driven to the air to enable them to compete successfully with other animals occupying the same ground, and in order to enable them to avoid the attacks of their numerous enemies. The mere development of wings, however, was only successful against certain classes of enemies; but the insects were competitors against each other, and hence those insects which could hide themselves during the critical period of their existence, *i. e.* whilst developing wings, had a very strong point in their favour, a point so favourable that it has ended, as we have said, in their becoming numerically the most successful type of life in existence.

Fresh-water Entomostraca.

By D. J. Scourfield, F.R.M.S. *Read April 13th*, 1899.

It is my desire to try and interest you for a short time this evening in a group of very common animals to which I have devoted most of my attention for some few years past. The animals referred to are the minute Crustaceans of our fresh waters known as Entomostraca, or more popularly as water-fleas.

Although this is not an entomological subject in the modern sense of the term, a paper on the Entomostraca would have been quite in order in days gone by, even before an exclusively Entomological Society. The very name Entomostraca, *i. e.* "shelled insects," suggests at once that these animals were probably at one time regarded as insects. So, indeed, they were, for we find that Linnæus and many later naturalists placed the Entomostraca, and in fact all the Crustacea, in the Apterous order of the Insecta, and in many of the older entomological journals papers will be found dealing with these animals.

The Entomostraca constitute the lowest of the chief subdivisions of the class Crustacea, which, as you are well aware, form with the insects, spiders, centipedes, etc., the great zoological group of the Arthropoda. The Entomostraca, therefore, are the near allies of such well-known animals as the crabs, shrimps, lobsters, etc. They are, however, very much smaller. The largest forms are rarely much over 1 inch long, and the vast majority are under $\frac{1}{8}$ inch; the smallest are under $\frac{1}{100}$ inch.

[A detailed description of *Daphnia pulex*, *Cyclops serrulatus*, and *Cypris fuscata*, illustrated by diagrams, was given here to show the differences between the three most important orders of the Entomostraca, viz. the Cladocera, Copepoda, and Ostracoda. The peculiarities of the two remaining orders of fresh-water Entomostraca, viz. the Phyllopoda and the Branchiura, were also briefly alluded to.]

In their development many of the Entomostraca exhibit two very distinct stages. The young hatch as little ovoid unsegmented free-swimming larvæ, provided with only three pairs of appendages. These larvæ are known as Nauplii. After moulting several times they suddenly change into forms having the essential characteristics of the adults of the species, or at least of the genera, to which they belong. The young of the Cladocera, however, hatch out very similar in appearance to their parents, though there is one curious exception to this, viz. that the young of the remarkable *Leptodora hyalina* hatched from the winter eggs have the form of Nauplii.

Reproduction among the Entomostraca, more especially among the Cladocera and Ostracoda, is very commonly parthenogenetic. In some species, and even genera, this is the only known method of reproduction. Usually, however, asexual reproduction does not go on indefinitely, because at certain seasons at least the males make their appearance. At the same time as the appearance of the males, the females among the Cladocera produce special eggs, known as winter or resting eggs, which require to be fertilised before they will develop. These eggs are also very frequently provided with protective cases formed from the shell of the mother, and known as "ephippia." By means of these peculiar structures the eggs are enabled to withstand, if need be, the cold of an Arctic winter, or the heat of an Australian summer. This accounts for the fact that from the sun-baked mud of dried-up ponds Professor G. O. Sars, working in Christiania, has been able to make a most magnificent series of additions to the known Australian Entomostracan fauna.

To the question "Where are Entomostraca to be found?" the general answer is "Wherever there is water." But of course all the different kinds of Entomostraca do not occur everywhere. There are, as usual, special forms in special places. There are some species, for example, which thrive only in the middle waters of lakes. These are the so-called "plankton" forms. They are all more or less transparent, and even glass-like. They are mostly provided with powerful swimming organs, and very often, also, with long spines and such like outgrowths, which serve probably to increase their power of remaining suspended in the water without undue effort. Other species go to the opposite extreme. Instead of always swimming, like the plankton forms, they never, or but rarely, swim at all. They live in or on the mud at the bottom of lakes, ponds, etc., and, as might be expected, they exhibit curious modifications of structure adapting them to this particular mode of life. Others again, and these form, perhaps, the majority of the Entomostraca, while good swimmers for short distances, usually prefer to cling to weeds and other objects in the water. Some few of this class have also found out how to take advantage of the peculiar physical properties of the surface-film of water, and they may be seen at times hanging from the under side of the surface like flies on a ceiling.

[Sketches and diagrams illustrating some of the above-mentioned species were exhibited and briefly explained.]

The *rôle* of the Entomostraca in nature may be best discovered by observing on the one hand what they feed upon, and on the other what aquatic animals (and plants) feed upon them. The Entomostraca live chiefly on minute Protozoa and Algæ, together with small organic particles derived from the decomposition of larger animals and plants. Seeing that they occur in enormous numbers, there can be little doubt that they play a very important part in keeping our ponds and ditches in good condition. In their turn they are preyed upon by a whole series of animals, ranging from the Protozoa to the

Vertebrates. They are also entrapped and digested by the aquatic plants known as Bladderworts. But the most important fact for us in this connection is that they form a large part of the food of nearly all young fishes. Some species of fish, indeed, feed principally upon Entomostraca during the whole of their lives. It is evident, therefore, that any rational system of fish-culture must take cognisance of the habits and needs of the Entomostraca.

From the point of view of experimental biology the fresh-water Entomostraca offer a wide field for research, and one, too, which has scarcely been touched. Their commonness in all parts of the country, their transparency, the ease with which they can be isolated and reared under all sorts of conditions, such are some of the facts which mark out the Entomostraca as particularly well fitted for observation in connection with even the most fundamental biological problems of the day. It was in a water-flea that Metschnikoff first saw the leucocytes (or phagocytes) trying to get rid of disease germs by swallowing them, and was so led to his epoch-making discovery of the part played by these minute amœboid corpuscles in the animal body. Weismann has also to some extent made use of the Entomostraca for experimental work in relation to heredity and variation.

Apart from such first-class biological work, there is a great deal that could be profitably undertaken by amateurs in connection with the British Entomostracan fauna. We badly want detailed studies on local faunas, on the seasonal distribution and variation of the different species, on the faunas of various types of ponds, on the food of the most abundant forms, and many similar subjects. And it may not be superfluous to point out that incidentally such work would certainly lead to the discovery of many species new to this country and perhaps to science.

In conclusion, I need scarcely say that if any members of this Society should be tempted to take up the study of the fresh-water Entomostraca, it will be a pleasure to me to give them all the assistance that lies in my power.

Orthoptera: with Special Reference to British Species.

By Malcolm Burr, F.Z.S., F.E.S. *Read April 27th*, 1899.

Orthoptera, although one of the most neglected orders of insects, are for many reasons more attractive, perhaps, than any other group. Among them we find bright and beautiful colours, bizarre and curious forms, an extraordinary amount of peculiar adaptation to environment, mimicry, seasonal dimorphism—in a word, all those qualities that invite attention as well from the *dilettante* collector as from the deep-thinking philosopher. Yet, in spite of these advantages, it is only within the last few years, comparatively speaking, that they have been carefully and systematically studied by entomologists.

In this paper I will endeavour to sketch a history of the study of Orthoptera, with special reference to our British species, and a brief glance at the more striking exotic forms.

Sixty years ago, like all other groups of insects, Orthoptera were in a state of systematised chaos. Simultaneously there appeared on the scene two well-known works—Burmeister's "Handbuch," and Audinet's Serville's "Histoire des Orthoptères,"—in the year 1839, the former remarkable for its comprehensiveness, the latter for the exactness of its descriptions. About the same time Fischer de Waldheim gave the world his great "Orthoptera Rossica," illustrated with many beautiful plates—one of the first and most successful attempts to elucidate the Orthoptera-Fauna of Europe. A few years later the Government of Holland published de Haan's account of the Orthoptera of the Dutch possessions, figuring and describing many new species.

Another ten years, and Fieber gave us his "Synopsis of European Orthoptera," erecting many new genera—well founded, it is true, but too briefly characterised. In the same year Fischer of Fribourg brought out his "Orthoptera Europa." This book, like Magna Charta, may be said to close one epoch and open another. With it the modern literature of Orthoptera may fairly be said to commence. Shortly afterwards there appeared on the scene authors who are still living and producing valuable works from time to time. In the following decade de Saussure began his series of volumes with the title "Mélanges Orthoptérologiques," in six parts, exhaustively treating the Blattodea, Mantodea, and, above all, the Gryllodea; in fact, his monograph of the Gryllodea then published has not yet been superseded. Brunner von Wattenwyl, too, appeared on the scene with descriptions of many new European Decticidæ and other papers which preceded his "Nouveau Système des Blattaires." This is the first of a series of

monographs which have since proceeded from the pen of this illustrious entomologist. A few years later it was followed by a "Monograph of the Phaneropteridæ," and these two works together have served as models for all more recent monographs. At the same time, Brunner's great disciple, Stål, did the good work of revising the types of the earlier Swedish authors—Linnæus, de Geer, and Thunberg,—adding also many new genera and proposing new systems. He attacks several groups in his own serious manner; but still, as Brunner remarks, the most experienced entomologist cannot follow out his tables, for his diagnoses are vague and ill-defined, and his dichotomic system defies the worker. Still he did actually establish good systems, which Brunner is enabled to clear up, owing to the fortune of being the possessor of the original types.

In 1882 there appeared Brunner's "Prodromus der Europaïschen Orthopteren," written in German, with admirable dichotomic tables and concise diagnoses and descriptions in entomological Latin, illustrated by eleven very good plates and a map to show the division of Europe into regions according to the distribution of Orthoptera. We are now quite in modern times, and many authors appear with monographs and faunistic lists,—Scudder, Bolivar, Krauss, Finot, Kirby, Karsch, Giglio-Tos, A. Pictet, and Pantel. Numerous other workers add monthly to the literature, and fresh monographs continue to appear.

It might be reasonably expected that the study of this order of insects in England should follow the progress of the Continent. But the reverse is the case. The earliest writers were naturally in a hopeless muddle. Berkenhout, Donovan, and Stephens improved slightly upon each other's work in order, but the latter entomologist was nonplussed by the intricacies of the genus *Stenobothrus*. This genus has always been the bane of British observers, who were always blind to the fact that in Orthoptera colour should be disregarded as a specific character. Curtis added but little improvement. His plates are good, but it is difficult to identify his *Locusta christii*. It is most probably *Pachytylus danicus*, L. (*cinerascens*, Fabr.), but the posterior tibiæ are coloured like those of *P. migratorius*.

Thus things remained for many years, and British collectors knew not how to identify their captures. Little or no notice was taken of the great works of Fischer and Brunner, until so recently as 1889 Mr. Eland Shaw actually wheeled our British things into line with those of the Continent, and since that time our knowledge has been kept up to date.

Orthoptera are represented in Great Britain in the "present state of our ignorance" by forty species, excluding accidental exotic visitors and reputed species, but including such foreigners as have bred and apparently become firmly established in our islands.

So far as we can tell, we have five indigenous earwigs. Of these three are common—*Labia minor*, *Forficula auricularia*, and we are now able to add, *Forficula lesnei*. *Labidura riparia*, Pall, has

occurred some half a dozen times on our south coast, and should be taken more frequently, and probably would if diligently sought. The first three need no comment. Our last indigenous species is *Apterygida albipennis*, Meg. This little earwig is common in Central Europe on flowers and shrubs, but was included on the British list for many years only on the strength of a few specimens—two, I believe, taken near Ashford sixty years ago by Professor Westwood. We have since recorded its capture at Norwich by Mr. James Edwards. I feel certain that diligent collecting will turn it up at several other localities, especially in our southern counties.

In native cockroaches we are still poorer, you may be relieved to hear. We have three indigenous species of *Ectobia*, of which *E. panzeri*, Steph., is the most interesting. Common in Europe generally, the southern examples are all pale-coloured; but in England we have also the variety *nigripes*, Steph., which, so far as I know, is peculiar. Our other cockroaches are all introduced. The longest established is *Blatta orientalis*, L., mentioned by Mouffet in the seventeenth century as common in the London cellars, though Gilbert White refers to it as "a strange insect." *Periplaneta americana*, L., *P. australasiæ*, Fabr., appear to have established themselves here, while several others are caught occasionally in the docks and in such markets as Covent Garden. Such are *Rhyparobia maderæ*, Fabr., *Leucophæa surinamensis*, L., *Blabera gigantea*, L., and *Blabera sp.* and *Nyctibora holosericea*.

No species of Mantodea or Phasmodea are known to have ever been captured in Great Britain, and it is highly improbable that such conspicuous insects should have been entirely overlooked by generations of collectors. It is, however, in the Acridiodea that we are richest. Our finest native species is *Mecostethus grossus*, L., once so rare, now known to be numerous in certain fen districts and in the New Forest and the west of Ireland. Six species of *Stenobothrus* are fairly common. The rarest is *S. elegans*, Charp., which seems to be very local throughout the Continent. It is very abundant on the sandhills at Deal. In the Hope collection at Oxford is an undoubted specimen of *Gomphocerus sibiricus*, L., the original specimen said by Stephens to have occurred at Netley; but as it is an Alpine species, and seldom or never occurs below a level of nearly 4000 feet, it is highly improbable that it should be found on our downs.

Four species of locust have been taken at one time and another in our country; but, though one species at least has been taken in some numbers, they never seem to breed here.

Of these four species, two belong to the subfamily Acridiodea. One, *Acridium ægyptium*, L., is not a migratory locust, and consequently is not known to do much damage, as is the other species. The long list of synonyms include the names, *tartaricum*, *lineola*, but it is absolutely wrong to call it *Œdipoda*. The genus *Œdipoda* belongs to a different subfamily, to which it gives its name. *A. ægyptium* is the largest European locust; it is dull grey in colour and the

lower furrow beneath the posterior femora is reddish purple; it is taken not infrequently at Covent Garden, imported in vegetables from Southern Europe, where it is common. An allied species is *Schistocerca peregrina* (Oliv.), the sole European representative of the genus. It is more slightly built than *A. ægyptium* and much paler in colour, with light stripes and markings, and varies from pale brown to yellow. It is notorious for the damage which it causes in Algeria and North-Western India, but has only occurred in England once. In 1869 the south eastern counties were visited in some numbers, but I am not aware that it has occurred since. In this connection I may mention that *Schistocerca paranense*, Burm., has occurred in this country, though not alive. It is an Argentine species. Large numbers are often found crushed in lucerne or in "alfaefa" imported from Buenos Ayres, and seem to disagree with the horses that eat them. This is curious, as in North West India *S. peregrina* is regular fodder for horses and cattle, when prepared in a certain way. The two remaining locusts that visit our shores are to be referred to the Œdipodidæ. These are *Pachytylus migratorius* (L.), and *P. danicus* (L.). In spite of the frequency of records of *Gryllus migratorius*, *Œdipoda migratoria* and similar names, I was for some time sceptical whether the true *migratorius* of Linnæus has ever occurred so far west, until I examined four specimens in the Hope Collection at Oxford, which are undoubtedly *migratorius*. Now this species is essentially an eastern insect; it is the locust of Southern Russia and Eastern Europe, and has but a restricted distribution. Closely allied but far more widely spread, I cannot tell why, is *P. danicus* (L.), (= *cinerascens* Fabr.). This occurs throughout Southern and Western Europe as far north as Belgium, right across the Palæarctic Region to Japan, south through the Malay Archipelago to Australia and New Zealand, and also in India, and throughout Africa. That an insect with so wide a distribution, and with such powers of flight, an insect which is a normal part of the fauna of Belgium, should occur in Great Britain is by no means unlikely. I think that it may be taken for granted that the majority of the locusts whose capture in England is recorded under the name *migratorius* (entomologists seem to be utterly indifferent to the proper use of generic names in Orthoptera), are really *Pachytylus danicus* (L.). It seems to have occurred in England more or less frequently for some years, but never has settled down to breed here. Those who wish to have a detailed account of its visits to this country I refer to Mr. Denison Roebuck's admirable paper on "Locusts in Yorkshire," reprinted from the 'Naturalist' (1876), Huddersfield.

To give a clear distinction between the two species I will again give the oft-repeated differences between them. In *P. migratorius* the pronotum is more or less distinctly constricted; in *danicus* it is not constricted: in *migratorius* the anterior border of the pronotum is produced slightly forwards, and the median ridge is but slightly elevated; in *danicus* the anterior border is well produced forwards,

and the median ridge is considerably elevated; in *migratorius* the posterior tibiæ are livid; in *danicus*, reddish; in *migratorius* the sexes are of about equal sizes; in *danicus* the female is about twice as large as the male. Before leaving locusts, I will again repeat that the correct names to use for them are as follows:—

Pachytylus migratorius (L.).
Pachytylus danicus (L.).
Acridium ægyptium, L.
Schistocerca peregrina (Oliv.).

The first two belong to the Œdipodidæ, and so to use the name *Œdipoda* for them, though wrong, is not so painfully inaccurate as it is when applied to either of the last two, which belong to the Acridiidæ, a totally distinct family: to speak of *Œdipoda ægyptiaca* is as bad as to speak of *Pieris io*, or *Vanessa machaon*.

Œdipoda cærulescens (L.) is the "langoute" of the French, the blue winged grasshopper which is so well known to those who collect on the Continent. *Podisma pedestre* (L.), alias *Pezotettix pedestris*, has never occurred in England, in spite of the statements of the early authors. Neither has *Psophus stridulus* (L.).

Of the curious family, the Tettigidæ, in which the pronotum is produced to an extraordinary degree over the abdomen, in the exotics twisted in many curious and bizarre forms, we have two species. Both are fairly common on dry places, and are our only *Acridiodea* that hibernate. Their ova are deposited in the spring to be hatched in the late summer.

The young grow, hibernate, and reappear in the following spring; they may be often taken among moss and leaves on a fine winter's day.

Of the extensive and numerous section the *Locustodea*, we have in England but ten species. *Phaneptera falcata* (Scop.) has occurred but once, and cannot be fairly included. *Leptophes punctatissima* (Bosc.) is common enough, though not often seen; it seems to frequent high trees, for it is more often found after a wind. *Meconema varium* (Fabr.) is little known, though quite a common insect. *Xiphidium dorsale* (Latr.) is rare, and seems only to occur in a few marshes; *X. fuscum* (Fabr.), the commoner species on the Continent, is erroneously said to have been taken in Britain. *Locusta viridissima* (L.) is well known to you, but *Thamotrizon cinereus* (L.) possibly less so. Still, it is quite a common creature, though somewhat hard to capture, for it sits and chirps in thick prickly brambles, that defy and torment the anxious collector. *Platycleis grisea* (Fabr.) so abundant on the Continent, is found with us only on the coast, especially on sand and chalk. *P. brachyptera* (L.) is somewhat local, but occurs on heaths and commons throughout the country. A prize that goes begging for a capture is *P. rœselii* (Hagenb.). I know of five records of its capture in England, two of which were in the neighbourhood of Herne Bay. *Decticus verruvicorus* (L.), the Wart-biter, should be taken more frequently. It has been captured com-

monly enough near Christchurch in Hants, in the New Forest, and once or twice in St. Margaret's Bay, where I have sought it in vain. The great meridional *D. albifrons* (Fabr.) has been taken as a straggler at Ramsgate.

In the Gryllodea we begin by renouncing our claims to *Œcanthus pellucens* (Scop.) as a British insect. The domestic field and mole crickets are doubtless familiar to you all, but probably the little wood cricket, *Nemobius sylvestris*, less so. It frequents leafy banks in woods, but in this country I have never heard of its capture outside the New Forest.

Having thus reviewed our British Orthoptera at some length, let us turn our attention to exotic species.

Of all the groups the least known are the Forficularia. It is a strange thing how all entomologists, orthopterists included, have fought shy of these interesting creatures. Brunner, de Saussure, Karsch, Bolivar, Scudder, and others have all described a few, but have all soon given up, leaving de Bormans a monopoly of the subject. To such an extent has this occurred, that in Bolivar's faunistic papers the earwigs are worked out and described by de Bormans. Similarly, although he possesses an excellent collection of Forficularia, Brunner never works at them himself, and all his specimens are sent to de Bormans for determination. The first systematic work on the group came from the pen of H. Dohrn, appearing during several years in the "Stettiner Entomologische Zeitung" in the early sixties. Since then Scudder has critically examined the generic names, and de Bormans and Kirby have drawn up tables of the genera. But at present the study of the group is very difficult, as the literature consists solely of a large number of papers and articles, all of which are necessary for the student. At last de Bormans has put together the results of many years' patient labour, and his monograph may be expected to appear during the summer.

Of the habits, haunts, life-history, and bionomics generally of earwigs but little is known. The observations of Mr. Green on the larvæ of *Diplatys* are of immense importance, and show the connection between Forficularia and Thysanura. There remains a field of work hitherto barely touched for any student who will give attention to the variation and habits of earwigs, especially in tropical countries.

Although so numerous with us, earwigs seem to be rare insects abroad; they are very seldom brought over by collectors, and when they are brought over they are usually in bad condition. The result is that the systematist has great difficulty in collecting material, which at the best is usually meagre and broken.

Of the manner in which earwigs vary our knowledge is vague. One common form of variation is in the colour of the pronotum, which may be indifferently red or black in one species. I have a variety of *Opisthocosmia forcipata*, de Haan, in which the head is clear red instead of black. *Labidura riparia* (Pall) varies to an extraordinary

extent in size and colour ; the length of forceps is very unstable. In *Spongophora parallela*, Westw., this organ varies from 4 mm. to 18 mm. in length, and the common *Forficula auricularia*, L., it may be a few millimetres or as long as the whole body.

It is not an uncommon thing to find examples of gynandromorphism. I possess two such *Chelisoches morio* (Fabr.), and de Bormans records the same phenomenon in *Forcipula pugnax* (Kirb.). So small a percentage—about 400—of the existing number of species is known to science that in almost every collection of earwigs received from abroad there are two or three novelties—a fact which is as encouraging for the collector as it is discouraging for the systematist.

Of Blattodea nearly a thousand species are known, but their classification is a matter of considerable difficulty. Again and again Brunner and de Saussure have published memoirs on them, but yet still the subject is not in a satisfactory condition. In his "Mélanges Orthoptérologiques," "Biologia Centrali-Americana," and several papers on Panæsthediæ, Epilampridæ, Perisphæridæ, and Heterogamidæ, de Saussure has advanced our knowledge, and the weighty contributions of Brunner von Wattenwyl are to be found in his "Nouveau Système des Blattaires" and "Revision du Système des Orthoptères."

Although cockroaches are now reckoned among our most lowly and plebeian insects, if length of pedigree goes for aught, they have a claim to be reckoned among the aristocracy of nature, for they can trace back their descent to the carboniferous period ; in fact, the present day is the period of their decline. The majority of existing insects are upstarts and parvenus, now in their golden age. Before these were evolved cockroaches swarmed in the carboniferous forests in numbers that would have put to shame any modern self-respecting London kitchen !

It is a very common mistake to regard cockroaches as ugly dull-coloured creatures. This is the fault of that much-maligned species, *Blatta orientalis*, L., which is, as has been so often pointed out, neither black nor a beetle, neither a cock nor a roach. That this claret-coloured, albeit sombre, fellow should be taken as representative of his whole section is a misfortune for his relatives, many of whom, so far from being modest in colour, like our friend in question, are bright and gaudy in stripes and spots of various tints.

A glance at one of de Saussure's coloured plates will dispel this illusion. In England we have the rich red *Periplaneta americana* (L.), and its near relative, *P. australasiæ* (Fabr.), which adds handsome yellow markings to the red. These are all, no doubt, familiar to you. But the species of *Phoraspis*, *Corydia*, *Hypnorna*, and others are of bright colours, variegated with spots and stripes. The huge *Blabera* are pale straw-coloured ; and oddest of all are *Panchlora*, clad, as their name implies, entirely in pale green, which fades to white after death.

Cockroaches are attacked by parasites of the groups Protozoa,

Vermes, insects, and Arachnida, while a species of *Sphex* prey upon them, and many birds and insectivorous mammals appear to eat them; so that it will be seen that cockroaches, like mediæval walled cities, have a long list of enemies, both internal and external.

We will now leave cockroaches; and as you have recently heard a most interesting account of the Mantodea and Phasmodea from Mr. Stanley Edwards, we will pass straight on to the Acridiodea.

The Acridiodea are a very numerous group, subdivided into several families, of which some are well monographed; but the system of the family Acridiidæ, the most numerous, is in a very unsatisfactory condition.

The Acridiodea is the first of the Saltatorial sections, and also the first section in which the insects have the power of stridulation. The posterior femora are furnished inside with a row of knobs; by the friction of these against the rough and thickened veins of the elytra the sound is produced. The male sits and calls to his mate when the sun shines, but when the collector is about he advertises his whereabouts, for with a sharp ear and a little practice it is not difficult to distinguish the various species by their song.

During the act of copulation the male stridulates violently, and in this connection we have noticed a curious fact. Professor Poulton has observed that the male of *Podisma pedestre*, in which the elytra are far too short to be reached by the legs, manfully attempts to stridulate, carried away by the excitement of the moment, with the result that he only succeeds in moving his legs in the air, pathetically endeavouring to reach his rudimentary elytra. If these insects are able to chirp it is but logical to assume that they can hear. The ear is a tympanum or opening on each side of the first abdominal segment.

One of the most curious families is the Pneumoridæ. In these insects the female is very considerably larger than the male, and possesses rudimentary wings. The male is remarkable for the extraordinary distension of the abdomen, which is swollen and hollow, resembling a balloon. This acts as a sounding-board for the creature's stridulation, which is said to be very loud and shrill. The family is peculiar to the extreme south of the African continent.

Two other peculiar families are the Proscopidæ, which have the appearance of Phasmodea, and the Eumastacidæ, which are generally odd in appearance, and mimic small dragon-flies and dried leaves in a wonderful manner.

Anyone who has collected on the Continent is familiar with those grasshoppers with bright blue and red wings. It is a common error to suppose that they belong to one species; as a matter of fact, it is a somewhat confused subject, but I will endeavour to make it clear.

On high woody mountains in Southern Europe there is a heavy black grasshopper with scarlet wings tipped with black. This is *Psophus stridulus* (L.). I have found it most common in the mountains of Savoy and Bosnia.

On sandy barren heaths there is a small grey little fellow, with a broad black band across the wings ; outside the band is clear hyaline, inside pink. This may be *Acrotylus insubricus* (Scop.), or *A. patruelis* (Sturm).

On barren rocky hills there is a dark fellow with crimson wings, with a black band near the apex of the wing ; the apex is either smoky or totally black. This is *Œdipoda miniata* (Pall).

Nearly everywhere is a similar fellow, with blue instead on the wings. It also differs slightly in structural characters, so that the species may be distinguished without opening the organs of flight. This is *Œdipoda cærulescens* (L.).

In barren patches in wood clearings in Central and Eastern Europe is a heavy grasshopper, dark in colour, with paling off towards a blackish apex ; the base is hyaline, yellow, blue, or red. This is *Celes variabilis* (Pall).

An albinistic form of *Œ. miniata* with deep sulphur wings occurs in Asia Minor.

A similar form of *Œ. cærulescens* with greenish yellow wings occurs rarely in Spain, but is common in Algeria.

A large grasshopper with bright yellow wings occurs in Algeria. This is *Œdipoda fuscocincta*, Luc.

All these grasshoppers with coloured wings belong to the Œdipodidæ.

A very remarkable group is the Pamphagidæ. These are heavy, desert insects, found only in Southern Europe, Western Asia, and all Africa. They are often hemiapterous or totally wingless, and wonderfully adapted to their surroundings. As each species has a most limited distribution, many are very rare.

The Truxalidæ badly require monographing. A large, but not unwieldy group of middle-sized insects found all over the world. One species, *Truxalis nasuta* (L.), with a curious pyramidical head, occurs practically throughout the palæarctic region, from France to Japan, and also in all Africa, India, Siam, and apparently in Australia. This group contains the chief musicians of the section.

The Acridiidæ are poorly represented in Europe, but nevertheless are a very extensive group, which also badly requires a monograph. To this group we refer the true migratory locusts of the genera *Acridium*, *Schistocerca*, and *Melanoplus*, with such well-known forms as *Caloptenus*, *Podisma*, and a host of less familiar tropical insects.

The most gaudy and bright coloured insects of this section belong to the Pyrgomorphidæ, an extensive and widely distributed group, containing the knobby *Phymateus*, brilliant in scarlet, green, blue, and yellow, and other similar forms.

Some of the oddest forms are to be found among the Tettigidæ. These insects are all small, with remarkably developed pronotum ; they are different from all other Acridiodea in having no visible pads between the claws of the tarsi. Some of the compressed forms were described by Fabricius as Membracidæ, and some resemble dead

leaves; some are all points and pricks, and earn such names as *belphegor*, *beelzebuth*, etc. *Scelymena* is semi-aquatic, and is furnished with dilated tarsi to swim the better.

The Locustodea are a very extensive section, and almost every family has been worked out in excellent monographs. The Locustodea stridulate in a manner quite different from that of the Acridiodea. The basal part of the elytra of the male is modified; the left or lower elytron is turned to a drum-like-cell, bounded by thickened veins, the centre occupied by a vibratile talc-like membrane; the right or upper elytron has the veins at this part hardened and thickened; by its friction on the lower the sound is produced. Apparently the sound is only made when the bow moves forwards, the return journey, so to speak, being silent. Only the modified parts of the elytra, the basal parts, overlap, the remainder, when fully developed, being folded in a roof-like manner, similar to the Acridiodea. The auditory organ is situated on the anterior tibiæ.

In many genera the elytra are so abbreviated that only this modified part remains, and that only in the male. It is represented in the female in such cases by a pair of small round lateral lobes. In the Meconemidæ the male possesses no such musical apparatus, and in the Ephippigeridæ both sexes have it. The chirp produced is much more shrill and sharp than in the Acridiodea, and often harsher and more easy to hear.

The delicate short-winged Phaneropteridæ produce, as a rule, a mere low *tss tss* that can be barely heard by human ears; the Locustidæ, on the other hand, give a loud, harsh, and prolonged chirp that betrays their whereabouts, so that they may be stalked down in spite of their ventriloquial powers. On the cliffs at Dover, and in Central Sweden, I have often followed up the clattering song of *L. viridissima* (L.), but it always seems to recede as the collector approaches, until at last it is run down to a thistle, and even then its green colour assimilates so closely with the green plant that it is only the vibration of the elytra that betrays it.

Its cousin, *Onconotus servillei*, F. de W., is less careful; the song is very similar to that of *L. viridissima*, but in Wallachia I have always found it on a tall thistle, on the plain stem, and not in the thick foliage, where its black colour shows up conspicuously. The female is harder to find; I have only taken it once, crawling slowly over long grass in the shade of a big tree in a forest clearing. It is an unusually inactive insect, but possibly its conspicuous dark colour and huge spiny pronotum protect it from its enemies.

Allied to *L. viridissima* is *L. cantans*, Fuessly, a mountain insect, which is shorter and thicker. I have taken it in Hungary, but only in the penultimate instar. *L. caudata*, Charp., is even larger than our British species. I have taken the female in a wooded hill in Bosnia.

The wartbiter, *Decticus verrucivorus*, L., is so common over all the Continent that it is doubtless familiar to you all. In Sweden the

natives catch it, and make it bite their warts. This is said to be an infallible cure, and it is possible that the wound caused by the powerful mandibles of the insect, and smeared with the formic acid which many Orthoptera exude from the jaws when angry, with the assistance of a goodly amount of faith, may cause these mysterious growths to disappear.

Another powerful biter is *Saga*. The Sagidæ are large carnivorous insects, occurring in Southern Europe, Asia Minor, and Southern Africa. They are nowhere common, and the males of some species are so rare that they were said to propagate by parthenogenesis ; only the South African forms are winged. They sit on a solitary thistle, and pounce with a clumsy somersault upon their prey ; their jaws are very strong, and their spiny legs are very powerful. I can personally testify to the power of the legs of even a nymph. Brunner has told me that he was once bitten by one, and it took out a piece of flesh. As they reach a size that is almost gigantic, they must be the lions and tigers of the Orthoptera world.

The Decticidæ, a group that is so rich in European species, is but poorly represented abroad. One small form occurs in South Africa, and *Anabrus* sometimes swarms in the Western States of America. A few other genera are found in North America, but rarely.

The Pseudophyllidæ are a large group which are confined to tropical regions ; they are usually of large, sometimes of considerable size, and have powerful jaws. Probably they are partly carnivorous, partly herbivorous.

The most extensive family is the Phaneropteridæ. In Europe we have a fair number of genera and species, chiefly with rudimentary wings. Throughout the tropics there are large numbers of fully-winged species, usually green in colour. *Scaphura* is black ; *Pardolata* is black, light red, and rich purple. *Myrmecophana*, again, the well known ant-mimic, is black and white. *Steirodon* and its allies from tropical America attains a tremendous size. In this group of genera, the pronotum is twisted and curved into great lobed crests. All Phaneropteridæ appear to be herbivorous.

The Conocephalidæ are a large group, containing many odd and large insects, often armed with a mass of spines pointing in all directions. Some are carnivorous, but the majority are probably vegetable feeders.

The Stenopelmatidæ are curious creatures, peculiar in possessing compressed, instead of depressed, tarsi. They are powerful, carnivorous, usually wingless insects, living in holes and caves. Some genera, *Dolichopoda* from South European caves, *Rhaphidiphora* from Eastern and Southern Asia, are cave insects, with small bodies and enormous elongated legs, palpi, and antennæ. *Stenopelmatus* from California resembles a mole cricket. *Anostostoma* from New Zealand is well known on account of the fantastic development of its great mandibles. None of this family chirp.

Somewhat similar are the Gryllacridæ, which possess certain

characters in common with crickets. They appear to live chiefly in holes in timber. Their elytra are broad, and wings very voluminous. Their jaws are powerful, and antennæ very long. None of them can stridulate.

You are probably familiar, either from pictures or from specimens, with *Schizodactylus monstrosus*, Drury, a great ungainly monster from West India and Burmah. The tarsi are very large and flat, and furnished with curious dilatations; the elytra are very broad, and the voluminous wings project far beyond them, the delicate ends resembling the wings of crickets, except in that they are curled and twisted into a spiral.

Orthopterists have long been puzzled whether to place this anomalous creature in the Locustodea or in the Gryllodea.

Gryllodea are poorly represented in Europe, but a large number of species are found distributed all over the tropical world. We have an excellent monograph by de Saussure, but since its appearance in 1869, little work has been done at the group. In various papers and faunistic works isolated species have been described, but the most important contribution to our knowledge of the section has been in the "Biologia Centrali-Americana."

The very curious forms of Gryllotalpidæ are found all over the world, which is curious, as it is a highly modified form, and the various genera resemble each other very closely in general appearance. Some crickets are semi-aquatic. Professor Gilson exhibited a cricket at the Zoological Congress at Cambridge, which he had taken leaping on the surface of a pool below a waterfall in the Fiji Islands. In this species the spines of the posterior tarsi were very considerably elongated. *Tridactylus* is a curious form, something like a tiny *Gryllotalpa*, which occurs on mud by the side of pools. They burrow in the soft stuff, and are very active and difficult to catch.

The stridulating apparatus of Gryllodea resembles that of the Locustodea, but each elytron is modified in a similar manner. The sound is produced on each movement of the bow, *i. e.* when the elytra cross in each direction. The broadest part of the elytra is the anal part, which is horizontally folded over the abdomen. The remaining part is perpendicular, and folded by the sides of the insect. It is only this anal part which is modified. In the female we see the normal condition of the elytra, but in the male the venation is modified to an extraordinary degree. As in the Locustodea, the auditory organ of the crickets is in the anterior tibiæ.

The majority of crickets are retiring insects, chiefly nocturnal in habits, living in holes and under logs. The Œcanthidæ are, however, flower-haunting creatures, very delicate in build, and light in colour. They are not a numerous family, but occur throughout the temperate regions.

Crickets are fierce and pugnacious animals; we read that in China the natives keep them in cages to make the males fight. They bet upon the result, and get very excited.

In Florence *Gryllus campestris* is sold on Ascension Day in little wicker cages for the sake of the song. This is very loud and shrill, but though it may possibly be agreeable to some ears, usually racks through and through the head, and gets on the nerves.

The Gryllodea are a difficult group to classify. The chief characters are the number and arrangement of the spines on the legs, the comparative length of the ovipositor, and especially the venation of the elytra of the male.

The necessary restrictions of time and space, which I feel that I have already abused, prevent me from referring to more than a small fraction of the peculiar forms of Orthoptera that are known from various parts of the world, to the strange cases of adaptation to surroundings, to one or two cases of mimicry, to the internal anatomy, embryonic, and post-embryonic development, to the reproduction of lost parts, to parthenogenesis, gynandromorphism, hypertely, and innumerable other interesting facts and phenomena, for the study of which Orthoptera afford more material, perhaps, than any other order of insects. I feel perfectly certain that if any of our coleopterists, rhynchotists, and other collectors, especially those who make use of the sweeping net, would only turn their attention to this neglected group, they would soon be absorbed with interest, possibly to the detriment of their original favourites, and almost certainly a little trouble and study would be rewarded with original discoveries far quicker than in more popular orders, which is possibly a satisfactory state of things, as it is obviously unfair that our knowledge of one order should greatly exceed that of another. It would be better if our knowledge of all the orders kept level, when "neglected orders" would cease to be a standing reproach to entomologists.

More Lazy Days by the Sea. (Being stray notes on a short holiday at Eastbourne.)

By Robert Adkin, F.E.S. *Read November 23rd*, 1899.

I should hardly venture to again take you over such well-trodden ground as the Eastbourne Downs had the past season not been an exceptional one.

The chief features of the summer of 1899 may be briefly stated as an excess of sunshine, a deficiency of rainfall, and, as one would expect under such conditions, a continuation for a considerable period of abnormally high temperatures. In one favoured spot within the limits of the British Isles the registered amount of bright sunshine for one of the summer months, July if my memory serves me rightly, was actually double the average. Of course so great an excess would not be possible in a district having so high an average as the South Coast of England, but even there, with a recorded rainfall for the summer quarter of, in round numbers, four inches below, and a mean temperature of three degrees above the average, it will be apparent to you that the summer was, to say the least of it, a very fine one.

We have been accustomed, and I think not without some reason, to associate warm dry summers with an abundance of insect life; cold and wet seasons with a scarcity. It will, therefore, be conjectured that I set out with the hope of finding the sun-loving butterflies in profusion, and in this I was by no means disappointed, but, as will be gathered from the following notes, the abundance was not universal; it did not apply equally to all species, or even to all those usually regarded as common.

The day on which I arrived at the sea was very fine and hot, but in the evening a slight thunderstorm passed over, and the following day, as is so often the case after a storm, was dull, in fact, the gloomiest I had during my stay; the sky was overcast, slight drizzling rain fell at intervals, and distant thunder was heard from time to time from morning till night. It being imperative for the maintenance of some larvæ that I had brought with me from home that I should obtain a supply of fresh oak leaves, and there being no trees of that species anywhere near the sea, I set out for Willingdon, a village some three miles inland, near to which there is an oak wood. It was about 6 p.m. when I arrived there, and taking a lane between the wood and some high hedges of mixed growth I noticed a number of butterflies flitting about. An examination proved them to be almost exclusively *Epinephele tithonus*, what few others there were being *E. ianira*. I was sur-

prised on such a gloomy evening to find butterflies on the wing, perhaps the electrical condition of the atmosphere may have enlivened them, but their number on this occasion, although remarkable, was as nothing compared with the abundance seen on the sunny days that followed, when every country lane one entered appeared to be full of them.

I shall not readily forget one particular afternoon when my way lay along what is known as the Lewes Road. Wishing to visit an acquaintance who lives on the heath at the back of Abbott's Wood, I took train to Polegate, and set out on the three or four miles' walk along that terribly straight and uninteresting lane. For a great part of the way the railway runs beside it, and is separated from it by a thick hedge of considerable height, the hedge being on the north side of the road, so that the sun shines upon it during the greater part of the day. The day in question (August 9th) was a very warm one, with hardly a breath of air stirring, the heat being very oppressive. When walking along one seemed to be meeting a continuous stream of brown butterflies, but when resting, as one was wont to do frequently on account of the fatiguing heat, the effect was of numerous individuals passing and repassing one another. I will not attempt to go into numbers, one is so apt to exaggerate; suffice it to say that there appeared to be a great crowd of them extending as far as the eye could reach. The bulk of them were, as before, *E. tithonus ;* a good many *E. ianira*, *Pararge megæra*, *Cœnonympha pamphilus*, *Lycæna icarus* and *Vanessa atalanta* were also present. On my return along the same road a few hours later the butterflies had all disappeared, the hedges apparently being deserted except for *Abraxas grossulariata*, individuals of which species flew out at every few yards.

Another species that attracted attention was *Vanessa atalanta* ; one met with it frequently and sometimes in considerable numbers. It was the chief item in one of the most brilliant butterfly-pictures—pardon the expression—I have ever seen. The day was bright, as usual, but a fresh easterly wind was blowing when we started from Pevensey railway station for the marshes, with the intention of working the ditches for water-snails, of which more anon. And by the way we passed a bit of thick hedge on which brambles were blossoming freely ; this and the shelter which it afforded from the wind no doubt proved a great attraction for butterflies, for it was literally alive with them ; many species were present, but the brilliancy of *V. atalanta* overpowered all the others. There was a great number of them, how many it is impossible to say, but enough to keep the whole length of the hedge alive with colour. On July 25th the veriest rag of a butterfly of this species was seen at Wannock sunning itself in the road, then flying round and returning to settle on the exact spot from which it had risen. On the 30th the species was seen on Beachy Head in the most perfect condition, and on August 2nd it was met with in profusion and perfection, as mentioned above.

It is notorious that in the early part of June worn specimens were common enough, and there is little doubt that the fresh specimens of late July and August were their progeny, but it seems incredible that any of the June individuals could have lingered on so late as the Wannock example of July 25th, or that any of the summer emergence could have assumed so battered a condition in so short a space of time. The solution of the question must, I think, be looked for in some other direction. It is now generally conceded that we are indebted to immigration from a district having a warmer climate than our own for the June imagines. In such a district the species would complete its metamorphosis more rapidly than it would here, and it is possible that some examples of a later brood might also reach our shores. In this suggestion I think we may probably find a reasonable solution of the matter.

Cynthia cardui was also common in June,—indeed, in my own experience it was somewhat more frequently seen than *V. atalanta*, yet during the whole time that I was at Eastbourne I saw but one example. In two species so similar in their habits one is at a loss to know why, under apparently identical circumstances, the one should produce abundantly and the other fail. This is a point to which I wish to call particular attention, in the hope that some of our members may be able to produce evidence that may throw some light on it.

Curiously enough, *V. atalanta* has been sufficiently common, even as far north as Moray, to attract special attention, but I hear no report of *C. cardui* from that quarter. *Vanessa urticæ* is often very common in the Eastbourne district, but this summer I met with it very sparingly; *Vanessa io* was not seen.

On more than one previous occasion I have commented upon the apparent decline in the number of the "Blues" met with around the downs adjacent to the town, and I ventured to express an opinion that the species were suffering by reason of the increased and continually increasing traffic over their haunts. What, then, was my joy at finding both *Lycæna corydon* and *L. icarus* in their former profusion! Nay, I think I may fairly say that I had never seen the former species in such abundance before. *L. icarus* was perhaps not seen so thickly about the town gardens and parade slopes as it used to be when the town was of smaller area; but when one walked through the long grass that grows so thickly in the little hollows under the downs after the sun had sunk below the hills, the two species rose in a cloud that quite bewildered one; but so far as I was able to ascertain, the percentage of individuals among them showing any marked variation from the type was even smaller than usual. A few *Lycæna astrarche* were among them, but *Lycæna bellargus* was not out. I hear, however, that it fairly took the place of *L. corydon* later on. *Lycæna argiolus* was met with almost everywhere in the town where there was any considerable growth of either ivy or holly, but not in large numbers at any one spot, and ova were found depo-

sited on ivy buds in a similar position to that which I have already described ("Proc.," 1896, p. 111).

You all know the old saying that "one may entertain an angel unawares." Well, although what I am about to relate certainly does concern winged things, and the incident did take place not far from that favourite hostelry, the Beachy Head Hotel, it has to do with nothing more dangerous to the human male sex than common white butterflies; but I must confess that, although I had carefully noted the whole details of what I had witnessed, it was not until I had returned home and heard what had been taking place there during my absence that I had any suspicion of the importance of what I had seen. The simple facts are as follows:—The morning of July 27th was very bright, with a light north-easterly breeze, and at about 2.30 p.m. I left home for a walk over the downs to Beachy Head. Before the foot of the downs was reached the wind had fallen away to a dead calm, and light clouds gathered in the south-west—not enough to obscure the sun, but enough to give an oppressive feeling to the sunshine. To the left of the footpath by which one ascends to the Head the downs slope away to the sea, and on the upper parts of them numbers of somewhat stunted furze-bushes grow. On passing these I noticed large numbers of white butterflies flying listlessly over them. On closer inspection they proved to be, I think without exception, *Pieris rapæ*, large in size, but poor in condition. There were a great many of them, half a dozen or more fluttering over a small patch of furze, and this repeated along the whole length of the down. None of them appeared to come further up the side of the down than where the bushes were growing, nor did they give me the impression that they were flying in any particular direction; but when I stood still, and watched them from a little distance, there seemed to be a general movement along the line of the bushes and round the northern end of the down inland. White butterflies had not been particularly common previously, and what few I had seen were chiefly *P. brassicæ*. On reaching the summit of the Head we appeared to have passed by the *P. rapæ*, the only butterflies seen there being a few "Browns" and "Blues," and the solitary example of *Cynthia cardui* already noted. Having refreshed ourselves with an admirable tea—which, by-the-bye, is a feature of the hotel,—we set out on the homeward journey *viâ* the "hollows" which lay along the sea front, and thus below the furze bushes already referred to. The sun was by this time well behind the hills, so that the hollows were in shadow, and the butterflies settled down for the night. Among those thus resting were a good many "Whites," and I examined a number of them, among other species, on the chance of picking up a variety or two. I found that they consisted of *P. napi* and *P. brassicæ*, both, for the most part, in very fresh order, and *P. rapæ*, which, however, were, with very few exceptions, worn. On reaching home—too soon for supper and too late to go out again before it—I sat down to write up my diary, and while so engaged my

daughter came in from a walk, and after her usual question, "Caught anything?" and the casual answer, "Oh, a few," she said, "I have seen such a lot of white butterflies, all flying in from the sea." This naturally led to a good deal of cross-questioning, from which I elicited that the species was without doubt *P. rapæ*. It seems that directly after I had started on my walk to the Head my daughter had gone out on to the Wish Tower grounds, a mound overlooking the sea in front of the town, and while sitting there, alternately reading a book and gazing at the passing ships, she had seen this swarm of *P. rapæ* travelling inland from the sea. Here, then, was the key to what I had witnessed, though unwittingly,—a vast immigration of this common species. It is worthy of mention that for some few days after this date *P. rapæ* was unusually common about the town and vicinity, but that after August 1st it had dwindled down to quite ordinary numbers.

Satyrus semele is so generally regarded as a ground-resting species that any variation of this habit is worthy of a passing note. In some localities it appears to have a liking for resting on the trunks of trees, but this applies chiefly to districts where it occurs on heaths as distinct from the chalk downs, I believe. On the side of the downs, about a mile back from the sea, is a large clump of timber, commonly known as "Paradise," the upper edge of which is encircled by a fence of some antiquity. A walk through the trees and round this fence may be regarded as a very satisfactory "constitutional;" and perhaps it was this that led me to frequently take this stroll in the late afternoon or early evening. On one occasion a storm was brewing, the western sky densely obscured by heavy clouds, on others the sun shone full on the fence; but whether the sky was cloudy or bright, each time that I passed this fence I noticed individuals of *Satyrus semele* fly on to it, close their wings, and settle down just as they are wont to do on the ground. As a rule they were quite as difficult to approach as when resting in their more usual positions, but in two or three instances they had settled down so securely that I was able to approach them and pick them off between my finger and thumb. *Pararge megæra*, which was fairly common about the fence, appeared to have a similar habit of resting on it. I also found several specimens of *Macroglossa stellatarum* resting there from time to time. It is hardly necessary that I should mention that this species was abundant in the Eastbourne district.

Bryophila muralis was, I think, more common than I have ever known it before, and occurred pretty generally on walls up to fully half a mile from the sea. It was out from the time I reached Eastbourne until I left; indeed, I took a couple of fine specimens on my way to the train to bring me back to London on the morning of August 14th. As an instance of how soon the species will detect a suitable breeding-place, I may mention that the gate-posts of one row of houses on the Parade had escaped the usual spring cleaning for a couple of years or so, and were therefore sustaining a fair growth of

lichen. I was not surprised to find the perfect insect resting on them, but I was somewhat so at finding a recently vacated cocoon or two ; there certainly was no vestige of a cocoon on these particular posts a year before. I again visited the bridge wall, where I had taken so many pupæ the summer before, to see if my rough handling had in any way affected the abundance of the species at that particular spot, and was pleased to find that cocoons were there as thick as ever. Two that I brought away produced, the one a fine full-sized imago, the other one of the most diminutive that I have seen. So small was the pupa that I fully expected it to produce *B. perla*, but that wall still remains without a record of that species. *Bryophila perla* was proportionately common, and, like *B. muralis*, showed a considerable amount of variation.

The broods of *Acidalia marginipunctata* appeared to overlap one another more than usual ; this was hardly to be wondered at in so favourable a season. On July 24th I found five examples, all a good deal worn, and several in similar condition on August 6th ; while on the 7th, of some dozen examined none were in bad order, and the majority were so fresh that they could not have been many hours out of pupæ. Unfortunately from this date fresh easterly breezes set in, precluding any further opportunity of finding them in their usual resting-places.

It is many years since I have met with *Melanippe galiata* so commonly as I found it last year, nor do I remember to have previously noticed so great a variation in the density of the colour of the central band. From a worn specimen taken on July 25th, evidently one of a second brood, I obtained ova which hatched on August 2nd, and all the larvæ but one pupated between the 18th and 20th of that month, the imagines emerging between September 5th and 10th, this being evidently the third emergence of the year. Ova were again obtained from a pair that emerged on the 7th, and they hatched on the 20th, and like the former brood were kept out of doors. About this time cool unsettled weather set in, and by October 15th the larvæ had grown so little, and appeared to be in such an unsatisfactory condition, that to save their lives they were brought into a warm room, and within a week had increased fully three times in size. With the advent of milder weather at the end of the month they were again put out of doors, and continued to grow rapidly. The majority went down between the 7th and 12th of November, the last on the 18th. The average time that the second brood of larvæ takes in feeding up in ordinary seasons appears to be from four to five weeks. In the present case the second brood occupied eighteen days from hatching to going down, but the time taken by the third brood exceeded eight weeks, although their growth was considerably hastened by their being brought into a warm room at a critical time.

What the effect of this third brood would be in a wild state it is impossible to say, but there is some reason for believing that it would

be disastrous. Under ordinary conditions of climate the second brood is on the wing during the earlier part of August, and the ova which they deposit hatch about the middle of that month. There is at this time an abundant fresh growth of *Galium*, on which the larvæ feed up comparatively slowly, and pupate about the middle of September, and the moths appear in the following spring. But with the larvæ leaving the egg at about, or perhaps after the time when they should have pupated, the chances are that at the time when they should be making their chief growth the weather would be unfavourable for the purpose; they would consequently progress less rapidly than they should, and would be unable to become full-fed during a suitable period, and, hybernation being unnatural to them, they would perish. Probably, even in an exceptionally warm season, some members of the second brood would appear sufficiently late to prevent the resultant larvæ becoming full-fed before their normal time, and thus preserve the species from so great a thinning down of numbers as might otherwise be the case.

Among other species met with, but which do not call for any special comment, may be mentioned *Zygæna filipendulæ*, one imago and a few empty cocoons, but the species appeared to have been anything but common; *Lithosia lurideola*, odd specimens; *Drepana cultraria*, one or two among the beech trees at Paradise, where also a larva of *Eugonia fuscantaria* was found suspended by a silken thread from an ash. *Eubolia bipunctaria* was, of course, met with plentifully in suitable situations on the downs, *E. limitata* and *Aspilates ochrearia* also occurring, but in smaller numbers. On a remote and almost inaccessible corner of the downs I was delighted to again fall in with a solitary example of *Odontia dentalis* and a few specimens of *Botys flavalis*, both of which species I had feared were lost to the immediate neighbourhood. *Stenia punctalis* was quite common, and there was no lack of *Nomophila noctuella* (*hybridalis*). *Rivula sericealis* was also taken, and the ditches on the marsh lands literally swarmed with *Cataclysta lemnata*.

The mention of the marshes reminds me that the Lepidoptera did not absorb the whole of our attention, and that although personally I was occupied chiefly by that order, my son, who accompanied me on most of my rambles, took some little interest in the Mollusca, and during our holiday he managed to get together some twenty species of land and fresh-water snails; not a very large number, perhaps, but the exceptional dryness of the season no doubt prevented him finding many species that would have been easy to get in a more suitable one. I have on a previous occasion ("Proc.," 1898, p. 56) reverted to the enormous hordes of *Helix aspersa* that infest the parades, yet it was remarkable how very few of them were to be seen in this dry weather. The dykes in the Pevensey marshes have long pictured to my mind a rich harvest of aquatic species, and my son readily accepted a suggestion that we should spend an afternoon in exploring them. I am not sufficiently well versed in the gentle

art of snail-catching to know whether a ditch is best worked when it is dry or when it has water in it, but on this occasion we found miles of ditches with the mud in them baked as hard as a brick, and so far as we could see, the snails, if there ever were any in them, had taken their departure, or may have buried themselves in the mud before it became so dry and hard. However, we at last succeeded in finding a place where a small sluice was fixed, and here was a small pool of water. A very cursory examination showed that there was no lack of creeping things in it, though the number of species proved to be small. The amphibious *Succinea putris* was crawling over the woodwork of the sluice and on the adjacent reeds in any numbers, and the "gravy-strainer" soon brought *Planorbis vortex*, *P. complanatus* (?), *Limnæa pereg. ea*, and *L. stagnalis* to the surface; but that was all. Continuing our walk along a dusty road between dry ditches, which, by-the-bye, I have never before known dry, we reached one of the larger "drains;" in fact, one may call it a small river, where there is at times a considerable current as the superfluous water finds its way down to the sea, but all that came to light here were a few immature *Bythinia tentaculata*, and a dead shell of *Valvata piscinalis*. But it was the down lands that received the greater part of our attention. Here there was no lack of material to work upon. *Helix ericetorum* lay about on them in millions, not evenly distributed over the whole surface of a down side, but so thick on a few acres that one could not move without continually treading on them, while the next patch would be absolutely bare of them. One interesting form, with a raised spine, was taken, unfortunately a dead shell, also a nice series of examples of a dull brown colour, with indistinct pale bands. *H. virgata* was also very abundant, and a good series was taken, including one individual in which the dark band was strongly dentate. *H. nemoralis* was not found on the downs near the town, but beyond Birling Gap their dead shells were lying about in great numbers; so stout and strong were they on this chalky soil, that when one trod on them in walking it simply drove them into the turf without in the least injuring them. Other species that we came across in one way and another included *Helix hortensis*, *H. cantiana*, *H. rufescens*, *H. hispida*, *H. caperata*, *H. rotundata*, *Zonites cellarius*, *Cochlicopa lubrica*, *Bulimus obscurus*, and *Pupa secale*. The last-mentioned species, so abundant a year or two ago, adhering to the bare chalk of the cliffs, or to the under sides of fallen pieces of chalk in great numbers, appeared to be quite a rarity this summer, no doubt driven into deeper hiding by the excessive dryness of the soil.

I have altogether exceeded the bounds to which I originally intended these notes to run. That the enjoyment of my holiday was greatly enhanced by the matters which came under my notice in the course of my daily rambles, and which I have endeavoured to here set forth, I can honestly say, and it will be a cause of much further gratification to me if, in the recapitulation of them, I have succeeded in imparting to you any small fragment of that enjoyment.

AN ADDRESS TO THE MEMBERS

OF THE

South London Entomological and Natural History Society.

Read January 25th, 1900.

GENTLEMEN,—Custom has decreed that at the end of his year of office your President shall deliver an address to you, and, however diffident he may feel when he remembers the many excellent addresses delivered by his predecessors, he would be a bold innovator who would attempt to break through this custom.

Before referring to the year's work in Natural History, I must mention the loss we have sustained by the death of two of our members.

B. H. Walters, although comparatively a new member, was well known to most of you. He was a regular attender at our meetings, and was always keenly interested in any subject of Natural History (other than Entomology) which came before us. He was especially a student of Ornithology. His genial manner made him a pleasant companion in the field, and at our meetings his removal has left a gap.

Samuel Stevens was one of the original members, and also, I believe, the oldest member of this Society; of late years, owing to his advanced age, he was seldom present at our meetings, but he maintained a deep interest in Entomology to the end of his long life.

I have little to say concerning the financial position of the Society; our Treasurer's report, and the Balance-sheet, make that sufficiently plain to you. In order that the Society may prove in the future to be of the same use to its members as in the past, it must continue to publish its "Transactions" as fully as heretofore, and as promptly as possible. Unfortunately our rather modest annual subscription is nearly all required to cover working expenses other than printing transactions; it is practically all swallowed up in rent, stationery, printing, and other incidental expenses; therefore we have to depend on donations to a special

publication fund, in order that our "Transactions" may be printed. Hitherto these donations have been obtainable, but I feel that the Society would be established on a surer basis if its income from annual subscriptions were sufficient to cover all its expenses, without our having to solicit help from the members whenever we wish to publish. To bring about this very desirable condition, several courses are open to us: (*a*) To limit our expenditure on publishing, to what can be afforded from the general fund would, perhaps, commend itself to some members, but I fear this would seriously limit our usefulness. (*b*) To raise the subscription to such a point as would cover publication expenses is another possible course; but whether our present subscription is already as high as some members are willing or able to pay would have to be considered, and before any change could be made, an expression of opinion from the members should be invited. It would have to be considered also whether the higher subscription would interfere with our obtaining new members. (*c*) Another course, and one on which I think we shall all be agreed, is for all of us to make a special effort to obtain recruits for our ranks in sufficient numbers, that the present subscription may then cover all expenses.

To suppose this possible is perhaps to take too optimistic a view; but still much might be done towards it, and our Treasurer would then only have to appeal for a modest donation to the fund, instead of for a serious amount, as at present. I trust that the new council, elected to-night, will be able during the coming year to devise some scheme to meet the difficulty.

The work done by the Society during the past year has been of very great interest, and the subjects brought before us of a most varied character. A mere enumeration of the titles of the papers read to us, would be sufficient to prove this, ranging as they do from microscopy to meteorites.

The exhibits, though hardly so numerous, have been quite up to the high standard of previous years.

The new species added to the list of British fauna during the past year are fairly numerous; the following are what have come under my notice. Four new species of Annelids have been discovered by the Rev. Hilderic Friend.

Fridericia magna, a species new to science, found in moist places near Cockermouth, where the rivers Cocker and Derwent meet ("Zoologist," 1899, p. 212).

Enchytræus pellucidus, also new to science, found among

old stable manure at Heaton Moor, Stockport ("Zoologist," 1899, p. 264).

Limnodrilus hoffmeisterei, Claparède, found at Sutton Park, Birmingham ("Zoologist," 1899, p. 262).

Enchytræus argenteus, a species new to Britain, is reported from Kew; but whether, like so many of the new animals discovered at Kew, it may be regarded as an accidental importation, or whether it is really a native, I am not aware ("Zoologist," 1899, p. 265).

Probably there is no group of animals more likely to repay careful study than the worms; I mean as regards new discoveries, not merely of new species, which after all is a matter of secondary importance, but of the life-history of many species already known. The workers in this field are few, and there is much practically virgin soil.

To the list of the Crustacea, a new Isopod, *Poxellio ratzburgi*, Brandt, has been added. This woodlouse was discovered at Warley, in Essex, by Mr. Wilfred Webb ("Science Gossip," January, 1900, p. 254).

As usual, it is in the class Insecta that we find the most numerous additions. We have four new species of Coleoptera recorded, all by Mr. G. C. Champion.

Stichoglossa semirufa, Er., a genus and species of Staphylinidæ both new to the British list. It was found amongst some insects obtained by Mr. Harwood in the neighbourhood of Colchester, and was taken last May, when beating oaks for larvæ ("E. M. M.," 1899, p. 55).

Ceuthorrhynchus querceti, Gyll., an addition to the list of our British Rhynchophora. Two specimens were taken about thirty years ago from Horning Fen, Norfolk, by Mr. J. A. Brewer; and others more recently from the same locality by Mr. Edwards and Mr. Elliman. These were not distinguished from *Ceuthorrhynchidius terminatus*, Herbst, until last year ("E. M. M.," 1899, p. 142).

Phytosus nigriventris, Chevr. Mr. Champion has pointed out that what has hitherto been regarded by British Coleopterists as a form of *Phytosus balticus*, Kraatz., is in reality specifically distinct and easily separable from it. In so doing he is in accord with the Continental authorities. *P. nigriventris* has been taken from the Chesil beach by Mr. J. J. Walker, and some specimens taken at Mablethorpe, Lincolnshire, in the collection of Canon Fowler, probably also belong to this species.—"E. M. M.," 1899, p. 1.

Phytobius muricatus, Ch. Bris.—Specimens taken at Lee, in Kent, in 1870 and 1871, and hitherto regarded as *P. qua-*

drinodosus, Gyll., have now been shown by Mr. Champion to be really *P. muricatus*.—" E. M. M.," 1899, p. 143.

No less than twenty-nine species of Diptera have been added:—*Dolichopus agilis*, Mg.; *Hylemyia grisea*, Fln.; *Pegomyia palliceps*, Zett.; *Cordylura rufimana*, Mg.; *Norellia nervosa*, Mg., p. 31; *Cleigastra nigrita*, Fln.; *Scatophaga fontanalis*, Rnd.; *S. villipes*, Zett.; *S. heteromyzina*, Zett.; *Fucellia muscaria*, Zett., p. 32; *Scimyza lata*, Schin., p. 95; *Helomyza inornata*, Lw.; *H. fœda*, Lw.; *Allophylla atricornis*, Lw.; *Scoliocentra villosa*, Mg., p. 100; *Blepharoptera flavicornis*, Lw.; *B. humeralis*, Zett.; *Tephrochlamys magnicornis*, Zett.; *Thelida oculata*, Fln., p. 101; *Phœomyia nigripennis*, F.; *Sciomyza dubia*, Fln.; *Palloptera ambusta*, Mg., p. 102; *Phytomyza nigripennis*, Fln.; *P. zetterstedtii*, Schin.; *Oscinis frit*, L., p. 103; *Trichopalpus fraternus*, Mg., p. 95; *Cordylura biseta*, Lw., p. 172; *Macronychia polyodon*, Mg., p. 115; *Amaurosoma tibiella*, Zett., p. 218 (" E. M. M.," 1899). For these additions we are indebted to Mr. R. C. Bradley for one species, to Mr. F. C. Adams for two, and for the remaining twenty-six species to Dr. Meade.

There are two new species of Hemiptera—*Æthus flavicornis*, Fab., taken by Mr. W. Holland at Freshwater, Isle of Wight, in 1895, and recently identified by Mr. Saunders. Both species and genus are new to the British list.—" E. M. M.," 1899, p. 155.

Corixa saundersi, Kirkaldy, a species of aquatic Rhynchota new to science, taken at Chobham, Surrey, by Mr. Saunders. —" E. M. M.," 1899, p. 2.

There are five new species of Hymenoptera:—*Crabro saundersi*, Perkins, " E. M. M.," 1899, p. 261; *Andrena niveata*, Friese; *A. ruficrus*, Nyl., p. 154; *A. lapponica*, Zett., *Colletes montanus*, Mor., p. 262. For the addition of the latter four species we are indebted to Mr. Saunders, and for *C. saundersi* to Mr. R. C. L. Perkins.

Six new species of Lepidoptera are recorded. *Aristotelia unicolorella*, Dup., a species closely resembling *A. tenebrella*, from which it has been separated by Mr. E. R. Bankes. It is widely distributed in Britain.—" E. M. M.," 1899, p. 33.

Coleophora tricolor, Wlsm., taken near Merton, in Norfolk, last July, by Lord Walsingham.—" E. M. M.," 1899, p. 201.

Lithocolletis concomitella, Bks.; *L. oxyacanthella*, Frey.; *L. pyrivorella*, Bks. The various species of the genus Lithocolletis have been much confused, and Mr. E. R. Bankes, who has been working at the subject, separates out the above

three species as being distinctly new to our list.—"E. M. M.," 1899, pp. 246—52.

Bankesia (*Talœporia*) *staintoni*, Wlsm. This species, hitherto confused with *Solenobia conspurcatella*, *Z.*, has been separated by Lord Walsingham.—" Entom. Record," 1899, p. 258.

Nine species of Neuroptera conclude the additions to our list:—*Oxyethira simplex*, Ris., "E. M. M.," 1899, p. 55; *O. tristella*, Klap., p. 281; *Ameletus inopinatus*, Etn.,; *Leptophlebia meyeri*, Etn., p. 69; *Hemerobius limbatellus*, Zett., p. 151; *H. mortoni*, McLach., p. 79; *H. orotypus*, Wallengr., p. 131; *Orthotrichia tetensi*, Kolbe, "E. M. M.," p. 281; *Ectopsocus briggsi*, McLach., p. 277. Mr. C. A. Briggs has contributed two, Mr. K. J. Morton three, and Mr. McLachlan four of these.

There seems to be no limit to the issue of books on natural history subjects. The student who desires to work on any particular group of animals or plants naturally turns to the books that have been published on that group to supplement his own observations in the field and to guide him generally in his study, to tell him where and when to find the material or specimens he requires, and how to deal with that material when obtained.

The chief difficulty nowadays that a student has to contend with is to select from the multitude of books the best and most suited to his purpose. There are so many to choose from—good, bad, and indifferent—that the task is not an easy one; and one of the useful purposes that such a Society as this serves for the beginner is that it brings him into contact with men who have advanced far in the study of the same subject, and who are well able and willing to advise him as to the best literature for his purpose.

Following the example of some of my predecessors, I propose to mention a few of the more important books published during the year, without in any way attempting to make a complete list.

"The Larvæ of British Butterflies and Moths," by (the late) Wm. Buckler; edited by G. T. Porritt, F.L.S. Vol. VIII, concluding the Geometræ.

"The Lepidoptera of the British Islands," by Charles G. Barrett, F.E.S. Vol. V has been completed during the year, and the work has been carried on a good way through the Noctuæ.

We have also had the first volume of "A Natural History of the British Lepidoptera," by J. W. Tutt, F.E.S. The number of species dealt with in this volume is so small, and

the amount of detailed information concerning them is so large, and must involve such an immense amount of patient labour in its compilation, that one wonders whether even such an indefatigable worker as we all know Mr. Tutt to be, can possibly carry on this work on the same scale right through the British Lepidoptera.

"British Dragon-flies," by W. J. Lucas, B.A., F.E.S. This important work should certainly tend to popularise the study of this strangely neglected group of insects. Now that workers have an authoritative text-book to which to refer, with descriptions of all the British species, with accounts of the habits and life-history of many of them, with excellent coloured figures of both male and female of them all, and also with full directions how to prepare specimens for the cabinet, there is no doubt the group Odonata will attract many more students; and with more students we may hope that the life-history of more of the species may be worked out, even if we may not expect many additional species to be discovered.

"Insects, their Structure and Life," by Geo. H. Carpenter, B.Sc. This is a primer of entomology of undoubted value to the student of insect anatomy and classification. It contains a useful bibliography of recent works on entomology.

Two more volumes of the Cambridge Natural History have been issued. Vol. VI., "Insects," Part II., by David Sharp, F.R.S. This volume concludes the insects, dealing with the Hymenoptera (concluded from Part I.), the Coleoptera, Strepsiptera, Lepidoptera, Diptera, Aphaniptera, Thysanoptera, Hemiptera, and Anophera. Vol. IX., "Birds," by A. H. Evans. A work dealing with the birds of the whole world, and necessarily, therefore, much compressed.

"Flash-lights on Nature," by (the late) Grant Allen; illustrated with a fine series of drawings by F. Enock.

"Wonders of the Bird World," by R. Bowdler Sharpe. A capital popular work on ornithology.

"Wild Life at Home: How to Study and Photograph it." By R. Kearton. "Our Rarer British Breeding Birds: their Nests, Eggs, and Summer Haunts," by R. Kearton. Both these books are beautifully illustrated by photographs taken by C. Kearton, often apparently at considerable risk to life and limb.

"The Rabbit," Fur, Feather, and Fin Series, by J. E. Harting.

"The Penycuik Experiments," by Professor Ewart. Of the subject of these experiments I shall have something to say later on.

"Catalogue of Lepidoptera of Northumberland, Durham, and Newcastle-on-Tyne," Part I., by J. E. Robson. This is not, as the title would suggest, a mere list of species found in the districts named, but is full of observations on their habits and life-history.

"History of the European Fauna," by R. F. Sharff.

"Flora of Kent," by F. J. Hanbury, F.L.S.

"Romance of Wild Flowers," by E. Step, F.L.S.

"The Flowering Plants and Ferns of Great Britain," by Anne Pratt. A new edition, revised by E. Step.

One cannot help noticing in going over these names how large a proportion of the authors are members of this Society, a fact on which we may congratulate ourselves, as showing that we have amongst us our full share of the more active naturalists of the day.

Biologists owe a debt of gratitude to Professor Ewart for the experiments he is conducting at Penycuik to endeavour to throw some light on the vexed question of "telegony." By telegony is meant the influence of a previous sire on after-progeny from the same dam by other sires; it is sometimes described by breeders as "throwing-back" to a previous sire. The belief in telegony among naturalists and breeders is wide-spread, and the evidence in support of this belief appears at first sight most convincing. What may be regarded as the classical instance is that known as Lord Morton's experiment. The facts in this case were described in a letter he wrote in 1820 to Dr. Wollaston, then President of the Royal Society. Perhaps you will forgive me if I quote some paragraphs from this letter.

"Some years ago I was desirous of trying the experiment of domesticating the quagga, and endeavoured to procure some individuals of that species. I obtained a male, but, being disappointed of a female, I tried to breed from the male quagga and a young chestnut mare of seven eighths Arabian blood, and which had never been bred from. The result was the production of a female hybrid, now five years old, and bearing both in her form and in her colour very decided indications of her mixed origin. I subsequently parted with the seven eighths Arabian mare to Sir Gore Ouseley, who has bred from her by a very fine black Arabian horse. I yesterday morning examined the produce, viz. a two-year-old filly and a year-old colt. They have the character of

the Arabian breed as decidedly as can be expected when fifteen sixteenths of the blood are Arabian, and they are fine specimens of that breed; but both in their colour and in the hair of their manes they have a striking resemblance to the quagga. Their colour is bay, marked more or less like the quagga in a darker tint. Both are distinguished by the dark line along the ridge of the back, the dark stripes across the fore-hand, and the dark bars across the back part of the legs. The stripes of the colt are confined to the withers, and to the part of the neck next to them. Those on the filly cover nearly the whole of the neck and the back as far as the flanks. The colour of her coat on the neck adjoining to the mane is pale and approaching to dun, rendering the stripes there more conspicuous than those on the colt. The same pale tint appears in a less degree on the rump; and in this circumstance of the dun tint also she resembles the quagga. . . . . Both their manes are black; that of the filly is short, stiff, and stands upright; and Sir Gore Ouseley's stud groom alleged that it never was otherwise. That of the colt is long, but so stiff as to arch upwards and to hang clear of the sides of the neck, in which circumstance it resembles that of the hybrid. This is the more remarkable as the manes of the Arabian hang lank and closer to the neck than those of most others. The bars across the legs, both of the hybrid and of the colt and filly, are more strongly defined and darker than those on the legs of the quagga, which are very slightly marked; and, though the hybrid has several quagga marks which the colt and filly have not, yet the most striking, namely, the stripes on the fore-hand, are fewer and less apparent than those on the colt and filly.

"These circumstances may appear singular, but I think you will agree with me that they are trifles compared with the extraordinary fact of so many striking features which do not belong to the dam being in two successive instances communicated through her to the progeny not only of another sire, who also has them not, but of a sire belonging probably to another species, for such we have very strong reason for supposing the quagga to be."

Dr. Wollaston adds the following note:—"By the kindness of Sir Gore Ouseley I had an opportunity of seeing the mare, the Arabian horse, the filly, and the colt, and of witnessing how correctly they agreed with the description given of them by Lord Morton."

Darwin was evidently perfectly satisfied that this was a

case of telegony; he said in his work on "Variation of Animals and Plants under Domestication," Vol. I., p. 435 (1885 ed.), "There can be no doubt that the quagga affected the character of the offspring subsequently begot by the black Arabian horse." He quotes two other cases of supposed telegony, one from information supplied by Mr. Jenner Weir of a horse, belonging to Mr. Lethbridge of Blackheath, bred from a mare which had previously borne a foal to a quagga. This horse possessed several quagga characters, being faintly striped and having hoofs proportionately longer than in the horse. A farrier shoeing this animal said, "Had I not seen I was shoeing a horse, I should have thought I was shoeing a donkey."

The other case was that of a sow of the black and white Essex breed, which was first mated with a chestnut-coloured wild boar, producing a litter partaking in appearance of both boar and sow, some being chestnut-coloured. Subsequently the sow had a litter to a boar of her own black and white breed, and some of these young pigs were chestnut-coloured.

It is said that chestnut-coloured pigs are not known to be produced by the Essex breed.

So common is the belief in the effect on subsequent offspring of a previous pairing, that breeders are careful to avoid allowing pure-bred females to pair with inferior males, on account of the injury expected to the later offspring.

Herbert Spencer, who is a believer in telegony, suggests that, during gestation, germ-plasm passes from the embryo into the body of the parent, and becomes incorporated therewith, ultimately reaching the germ-cells; this may be called *indirect* infection of the germs.

Romanes believed that unused germ-plasm from the first sire *directly* infects unripe ova; but that the phenomenon is of rare occurrence.

Agassiz believed that the whole system of the dam, and especially the sexual system, is so modified by the first mating that subsequent offspring are affected by it.

Weismann, on the contrary, considers telegony unproved; and, while accepting as true the evidence in Lord Morton's experiment, he does not admit that this is sufficient to prove that the later foals were in any way affected by the dam having previously borne a foal to a quagga, and is of opinion that the truth must be proved by new experiments.

If the evidence in Lord Morton's experiment be trustworthy, and apparently no one questions it, then what

alternative have we to the telegony theory as an explanation of the facts in that case?

There can be no doubt that the colt and filly were each of them marked with stripes. Weismann's suggestion is that these markings were due to atavism or reversion to an ancestral type. This is assuming that the ancestors of the horse were striped animals, and that reversion, which is well known to occur among pigeons, occurs also among horses.

Such stripes as were possessed by these foals are nowadays known to occur in foals borne by mares which have been mated only with males of their own species.

Weismann says "they are not very uncommon on purely-bred foals, and ordinarily disappear as the animal grows older." Professor Ewart says, "I have seen eleven pairs of stripes on a Shetland foal." Darwin also tells us he bred a foal with many stripes; and he was well aware that such stripes appear on horses of many breeds, consequently it is supposed his opinion as to telegony having occurred in Lord Morton's experiment was due in part, at any rate, to the description of the manes of the two foals. In the filly the mane is described in the celebrated letter as "short, stiff, and standing upright," and in the colt as long, but stiff and arching upwards. Oil paintings of these animals by Agassé, now in the museum of the Royal College of Surgeons, made, it is supposed, about a year later than the letter was written, do not show the manes as described.

This does not, however, throw any discredit either on the truth of the description in the letter, or on the fidelity of Agassé's paintings. Manes of horses alter. Professor Ewart has an Arab whose mane was short, stiff, and upright, like that of the filly; six months later it was longer, and arched upwards from the neck like that of the colt; and as it grows longer he says it will hang lank and close to the neck.

The question as to whether telegony is a fact or a myth, is obviously one for direct experiment, under carefully arranged conditions, and Professor Ewart in 1894 decided on conducting a series of experiments in the hope of once for all settling it.

It is a question of profound scientific interest, and at the same time of great practical importance to the fancier and the stock-keeper.

The results obtained up to the present are given in the book recently published, called the "Penycuik Experi-

ments," to which book I am indebted for most of the facts given here on the subject.

Professor Ewart has been successful in breeding a number of hybrids, the sire being a Burchell's zebra, and the dams mares of various breeds.

A West Highland pony mare, after giving birth to a hybrid, was mated to an Arab horse and bore a foal, which in all respects but one was just such a foal as might have been expected from his parentage. The exception was the presence of stripes, very indistinct, and not to be seen except in certain lights, and difficult to photograph. Later this same mare bore another foal, the sire being a West Highland pony from the Island of Rum, and called "Loch Corrie;" this third foal was striped in a very similar manner to the second, and had the experiment been carried no further there is no doubt that these two striped foals would have been considered as lending strong support to the theory of telegony. But since the birth of these two foals, two other Highland ponies have borne foals to the same sire, "Loch Corrie." Neither of these ponies had been previously mated with a zebra, yet their foals are both striped in a similar way. The Arab sire of the second foal had also other offspring, one of which, from a New Forest pony, had a number of stripes. This New Forest pony, however, though never mated with a zebra, had borne a mule foal.

A Shetland mare bore first a foal to a sire of her own race, and this foal was very plainly striped. It is described as being nearly as much striped as the filly in Lord Morton's experiment. Then the mare bore a zebra hybrid; and afterwards a third foal, the sire being a Welsh pony. This third foal had only the faintest appearance of stripes at birth, and these disappeared before twelve months.

Thus the foal produced *before* the hybrid was well striped, and that *after* it hardly striped at all.

An Iceland pony, after having given birth to a zebra hybrid, was mated to a Shetland pony, and the foal produced has no stripes or other indication of having been "infected" by the previous union with a zebra.

Two Irish mares, after producing hybrids, bore foals, one to a thoroughbred horse, and the other to a hackney pony, and neither of these bore any traces of stripes or other zebra-like characteristics.

An Arab mare bore twin zebra hybrids, and the following year had a foal, the sire of which was a thorough-

bred, and again this foal was quite free from any zebra infection.

The conclusion that one must draw from these results is, that so far no support is afforded to the telegony theory.

In support of the idea that the stripes are due to reversion to an ancestral form of the horse, it may be noted that in several of the cases the foals were the result of union of parents of widely different strains or races. This was so in the case of the striped foal bred by Darwin; and in that bred by Professor Ewart from the West Highland pony by an Arab sire; and also to a less extent in that from the same mare by an Island of Rum pony. Again, this was the case in the foal from the New Forest pony by an Arab sire. Now it is well known that the crossing of very distinct races of pigeons tends to reversion to the ancestral blue rock. Professor Ewart crossed pigeons of the owl and Archangel breeds, and the result was more like the owl parent than the Archangel. This owl-Archangel cross was mated with a white fantail cock, and two young birds were bred which, in colour, form, and movements, showed almost complete reversion to the blue rock pigeon. A similar result follows similar crossing of certain breeds of domestic fowls; a bantam hen was mated with an Indian game—Dorking cock, and a cockerel was produced, almost identical with the jungle fowl, believed to be the ancestral stock. If, therefore, crossing of dissimilar races causes reversion, then we must conclude that the striping of these foals may be due to this cause, rather than to telegony.

There was no crossing of dissimilar races, however, in the case of the first foal borne by the Shetland mare mentioned above.

Professor Ewart considers that his experiments show that telegony, if it occurs at all, occurs but seldom; and in this view he is in accord with the opinions of mule breeders on the Continent.

He adds that, should he find that out of about fifty pure-bred foals, from mares which have previously produced zebra hybrids, there is no undisputed case of infection, then telegony must be discredited, at any rate, as being of any importance to breeders of horses.

Further experiments are certainly necessary, and biologists will await with interest an account from Professor Ewart of more "Penycuik Experiments."

There is another subject that will probably prove of great practical importance on which a good deal has been written

during the past year, viz. the part played by the mosquito in connection with malarial fever. The chief difficulty which is met with in many parts of the tropics lies in the attacks of malaria which are suffered by nearly all the Europeans who have to live there.

For many years the cause of these attacks was attributed to some state or other of the immediate surroundings—miasma arising from the swamps, turning over or breaking of new ground, as in making the canal at Panama, decomposition of luxurious tropical vegetation, germs in the drinking water, or some similar cause. Persons were specially liable to fever if they slept out at night, so the night air was supposed to be especially hurtful. In extra-tropical countries, such as Italy, residents during the summer months were very liable to certain kinds of fevers, and these also were considered as arising from the air (especially night air) or the water.

In the year 1880 Dr. Laveran discovered certain parasites in the red corpuscles of patients suffering from malaria, and he assigned to them the cause of the disorder. In 1885 Golgi established the fact that these parasites multiplied by endogenous reproduction by means of spores, which give rise to sporocytes.

Later on several Italian observers noted that some of the spores produced were crescentic in shape, but failed to understand the nature and object of this kind. In 1894 Dr. Manson, in this country, concluded that the function of these particular spores was to continue the species outside the vertebrate host, and that they escaped into the stomach of a suctorial insect, where they developed into flagellulæ, which in turn developed in the tissues of the insect. Dr. Laveran had already surmised that the mosquito is the alternative host of the human parasite, and Manson now claimed the mosquito as the suctorial insect referred to. By his suggestion and advice Major Ross undertook an investigation of the subject in India.

In 1897, by the study of two species of the genus Anopheles, Ross traced the malarial parasite into the walls of the stomach of the mosquito after it had fed on malarial patients whose blood contained the crescentic gametocytes. Following this, Professor Grassi, in Italy, attacked the problem from another direction : he studied the distribution of the mosquito in different parts of the country where malaria was common. He found that malaria was absent where only *Culex pipiens* was present, but that it was rife

where the larger mosquitoes of the genus Anopheles abounded.

He obtained a number of striking coincidences in which these mosquitoes and the disease were confined to the same limited and well-defined regions. He found that *Anopheles claviger* confines its attacks chiefly to the evening, after sunset; and in this fact a simple explanation is afforded of the idea that it is dangerous to fall asleep in malarious regions just after sunset.

Drs. Bignani and Bastianelli, two other Italian workers on this subject, had been trying to infect a person by letting mosquitoes bite him. They attributed their want of success to the use of the wrong kind of mosquito; and, acting on the advice of Grassi, they obtained some mosquitoes from a malarial district and tried again.

This time they were successful in infecting the man with malaria of the same type that prevailed in the district from which the mosquitoes came. They came to the conclusion that *A. claviger* was the most common intermediate host of the parasite of malaria in Italy. Their experiments all pointed to the conclusion that inoculation by the mosquito was the only mode by which infection was acquired; certainly it was the only method which had been demonstrated experimentally. They traced the development of the crescentic bodies in the medial intestine of *A. claviger* after these insects had drawn blood from malarial patients, and also observed later stages of the parasite in the mosquito.

The life-history of the parasite is, then, as follows:

1. Parasites exist as amœbulæ within the red blood-corpuscles of the vertebrate host. They possess the usual power of movement common to this form; they increase in size, and as they do so, tend to lose their movements and to accumulate in the ectoplasm certain black granules, which are the product of the assimilation of the hæmoglobin of the corpuscle. In from one to several days the parasites reach their highest development within the vertebrate host, and become either sporocytes or gametocytes.

2. The sporocytes, which are produced asexually, contain spores, which vary in number according to the species. They do not possess any appreciable cell wall. When they are mature the red corpuscles which contain them burst, and allow them to fall into the blood-serum. They then attack fresh blood-corpuscles, and continue the propagation of the parasites indefinitely in the vertebrate host.

3. The gametocytes, on the other hand, while in the blood

of the vertebrate host are still contained in the shell of the red corpuscles. In some species they present a special crescentic form. They circulate in the blood for some days, or even weeks, according to the species, without change; but when they are drawn into the alimentary canal of certain mosquitoes they undergo further development.

Very shortly they break from the enclosing corpuscles, swell up slightly, and then become, some of them male gametocytes and some of them female gametocytes. The male gametocytes emit a variable number of microgametes which escape into the serum of the ingested blood. The individual microgametes are delicate motile filaments, sometimes with a slight swelling in the middle. The female gametocyte gives rise to a single motionless macrogamete.

One microgamete now passes bodily into a macrogamete and fertilises it, fusing with it, and producing a zygote. This possesses the power of movement, and works its way through the wall of the stomach, or middle intestine, and fixes itself to the outside of this organ. It grows rapidly, acquires a thick cell wall, and protrudes into the body-cavity of the mosquito. The nucleus divides into a number of portions which become spherical, and each of these bears on its external surface a large number of delicate filaments, each affixed to it by one extremity. When mature the cell wall bursts and the filaments are liberated. Each is a delicate flagellula, bearing two opposite tapering flagella. These are carried by the blood-stream into all parts of the insect, and they especially accumulate in very large numbers in the cells of the salivary glands, from which they pass into the duct which runs to the extremity of the middle stylet, and thence escape when the insect bites, into the blood of a new vertebrate host. When a mosquito attacks a vertebrate animal it punctures the skin, and injects a small quantity of a fluid secreted by its salivary glands. This is said to prevent coagulation of the blood, and to increase its fluidity as it is drawn through the insect's suctorial apparatus. Having thus gained admission to a vertebrate host, the flagellulæ attack the corpuscles, and become the intra-corpuscular amœbulæ with which we started.

Another interesting and important series of experiments was carried out by Grassi on the subject of the hereditary transmission of the disease among the mosquitoes themselves. These all led to negative results. Specimens of *A. claviger* were bred from parents taken in malarial houses,

but no flagellulæ were observed in their salivary glands; also several observers allowed themselves to be freely bitten by newly bred mosquitoes taken from malarial districts, but in no case were any ill effects experienced. All the evidence so far tends to show that those Anopheles which have not bitten malarial patients are not infected, and are not capable of inoculating the disease.

Professor Koch last year was the head of a German commission appointed for the study of malaria in Italy. He found the characteristic parasites in the blood in all the cases examined.

Apart from the blood of human beings the parasite was only found in some species of mosquitoes which were only met with in the summer. He also proved that the mosquito conveyed the parasite from one person to another.

It was found that the parasite required a temperature of 80° F. to develope in the mosquito, therefore it was only found in these insects in the summer months. He found also that *Culex pipiens* was concerned in propagating the disease in Tuscany, but only to a very small extent. He found that the infection was maintained and propagated during the nine months of the year when the temperature is below 80° F. by the relapsing cases which continue all the year round, and form the link between one fever season and the next; so that in the beginning of summer mosquitoes can always find parasites, which undergo the series of changes described above in their bodies, and then, later, may be injected into some new host, and so the fever is spread.

If no relapse occurred in any of the cases of malaria in any given district, the mosquito would find no parasites in the beginning of summer, and consequently, malaria would become extinct there.

Koch found certain species of mosquito in the houses, and noted that they only bit at night, therefore the inhabitants became infected at night in their own houses.

Drs. Monaco and Panichi have studied the effects of solutions of quinine of varying strength in causing the exit of the parasites from the red blood-corpuscles, when they are in the adult stage. Very dilute solutions only excited them, while in less dilute solutions they were compelled to go out of the corpuscles; while strong solutions paralysed them. If now it is found possible that relapses may be entirely prevented by the proper use of quinine, malaria would be stamped out in those countries where

the temperature was not high enough all the year round to let the parasite develop in the mosquito. In hot countries, however, this means could not stamp out malaria.

Last year also Major Ross went as the leader of an expedition to Sierra Leone, sent by the Liverpool School of Tropical Diseases to investigate the malaria question in that part of the world. Here he found that the local species of Anopheles carried malaria, and that these species bred in a few local puddles. He confirmed his previous observations that the genus Culex did not carry the parasite. Now Culex sp. breed in tubs of water, cisterns, wells, etc., all artificial collections of water; while he found that Anopheles sp. rarely occur in these, but usually in small natural ponds and puddles. The possibility of eradicating malaria in a locality by the extermination of the dangerous mosquito thus depends on the simple question, Do these mosquitoes breed in sufficiently isolated and rare spots to be dealt with by public measures of repression? This was one of the points which it was Major Ross's design to obtain information on. His report was to the effect that most of the malarial fever could be got rid of at almost no cost, except a little energy on the part of the local authorities.

In the barracks at Wilberforce, a suburb of Free Town, Sierra Leone, out of four hundred men there was a daily average of forty ill with malaria. The place was infested with mosquitoes; but only the genus Anopheles was found, and of these one third contained Zygotoblasts. The larvæ of these insects occurred chiefly in small stagnant pools in which green algæ were growing. One drachm of kerosene oil was put on the surface of one of these pools, one square yard in area, and all the Anopheles larvæ were found dead after six hours.

Already, as you will have seen, a great advance has been made by those engaged in the work, but much more remains to be done.

The lines to be followed are plainly indicated. Before we can rest satisfied we should have a collection of mosquitoes from all parts of the world, and have accurate and trustworthy determinations of the species, and know what is possible about their distribution and life-history. This certainly should be the work of the entomologist. The Natural History Museum authorities are alive to the importance of this work, and they have issued instructions

which are available for collectors, for the proper preservation of these fragile objects.

The work of the medical men will be to compare the occurrence of the different varieties of fevers with that of the different mosquitoes, and to study the effect of various drugs in combating the disease.

Local authorities must help in getting rid of the breeding grounds of these insect pests.

It used to be said that Sierra Leone required three governors, one was on the way home to be buried, one was at his post, and the third was on his way out to take up the duties of number two. This may be a slight exaggeration, but it impresses very forcibly on the mind the unhealthy condition of the West Coast of Africa.

Malaria is one of the chief causes of its unhealthiness, nor is West Africa alone in this respect; it is common in most parts of the tropics, as also in Italy and elsewhere.

In time we may hope that this dreadful scourge will be immensely lessened in every part of the world, and perhaps in some districts entirely removed.

Before vacating this chair I wish to thank you for the honour you conferred on me when you elected me your President. When I accepted the position, I determined that whatever might be my shortcomings in other respects, I would at least be regular in my attendance at the meetings. Early in the year, however, I had to leave London for some weeks on business; and a little later I commenced what proved to be a long and tedious illness. I mention these personal details to show that it has not been lack of interest that has kept me away from my duties here. To the gentlemen who fulfilled those duties in my absence, I am much indebted.

I wish to take this opportunity also of expressing my thanks to the officers, council, and members generally, for the ever-ready help and unfailing courtesy I have received from one and all.

It is a subject for congratulation that all our officers, the Secretaries, Treasurer, Librarian, and Curator, have accepted office once more; serving the Society is with all of them a labour of love.

In my successor, Mr. W. J. Lucas, you have chosen an earnest and careful student of nature, a gentleman possessing knowledge of many branches of natural history, one also who has taken for a long time the greatest interest in the work of our Society.

Gentlemen, I feel that the welfare of the Society could not be committed to better hands, and it is with pleasure, therefore, that I ask Mr. Lucas to assume the presidential chair.

A. HARRISON.

ABSTRACT OF PROCEEDINGS.

FEBRUARY 9th, 1899.

Mr. A. HARRISON, F.L.S., *President*, in the Chair.

Mr. Russell exhibited a specimen of *Plusia moneta*, which he had captured on the wing at dusk in his garden at South-end, near Catford, July 17th, 1898.

Mr. Tutt remarked that he knew of no new species which had spread so rapidly as this.

Mr. Hall said that the young larvæ fed in a web two or three together, but that when larger they fed independently, and could be easily shaken out of their food-plant.

Mr. Robert Adkin exhibited a short series of *Hadena pisi* from Aberdeenshire, with specimens of the same species from South England for comparison. The Aberdeen insects were very dark, with the white submarginal lines showing in strong contrast with the ground-colour, giving them a very blackish-brown appearance in comparison to the dull reddish colour of the English examples. Both series were bred, but he believed not in either case from selected parents.

Mr. W. J. Lucas exhibited a short series of *Rhyparobia* (= *Panchlora*) *maderæ*, and contributed the following note: "The four specimens, which arrived at Kew Gardens alive on October 18th, 1898, in a package from the Belgian Congo State, are rather above the usual size, and the elytra are spotted with white, which, I believe, is not usually the case. The species is occasionally introduced into this country in shipping, and has been taken more than once in the London Docks and in Covent Garden. Mr. C. A. Briggs has two from the latter place. As with so many cockroaches, increased intercourse between countries is causing it to spread. It is a native of Madeira and the West Coast of Africa, and from the former locality obtains its specific name."

Mr. Main exhibited specimens of the brilliant metallic-coloured coleoptéron, *Aspidomorpha sanctæ-crucis*. They were taken on the island of Elephanta in December, 1897, brought to England, and lived till September, 1898, when they were preserved in a dilute solution of formalin. It was stated that

about 4 per cent. of formalin was the usual solution strength, and that the use of this spirit was to sterilise the water. The insects so preserved seemed to lose more or less of the brilliancy of their colours, although it was stated that spiders seemed to keep their tints admirably in this solution. A suggestion was made that 1 per cent. of formalin would, no doubt, be sufficient in a solution.

Mr. Harrison exhibited a remarkable variety of the egg of the common blackbird, pale blue for the greater part, but a deep brown at the broad end. For comparison a number of more ordinary eggs were exhibited. These showed some slight variations in size, shape, and markings. All were from the Delamere Forest district.

Mr. Fremlin read a note he had received from Mr. Chadwick, in Devonshire, stating that he had observed an imago of *Amphipyra pyramidea* swim across a stream at least thirty yards wide. Mr. Tutt said that it was well known that *Calamia phragmitidis*, *Leucania straminea*, and *L. impura*, when disturbed, ran over the surface of the water from one reed to another. *Pyrameis cardui* had been observed crossing the Mediterranean in vast swarms, alighting in clouds on the surface of the sea, and again rising in the air, leaving only a small percentage drowned in the water. No doubt the fringes of these victims had become clogged and prevented their escape. Of course the butterflies' wings were much stiffer, and therefore less likely to be sucked down by the motion of the water. Mr. Lucas said that dragon-flies were well known to dip their abdomens in the water, and some species were stated to go completely under the surface. In these cases a certain amount of air would be carried down entangled in the body-hairs of the insect immersed, as in the case of the aquatic spiders. Mr. Tutt remarked upon the larva of *Phorodesma smaragdaria* and the little there was known of its method of outliving the frequent periodical immersion which it must undergo in the marshy situations in which it is found in this country. Incidentally he referred to the fact that its habitat on the Continent is altogether different, for there it is found several thousand feet up the Alpine slopes. Dr. Chapman said that some time ago he experimented with larvæ as to the length of time they would undergo immersion and then recover. Some species would remain immersed for several hours, and get much bloated from absorption of water, and yet, when dried on blotting-paper, would regain their pristine health and vigour. Mr. Hall thought that larvæ with hairs would no doubt remain

for a much longer time under water than smooth larvæ, which would the sooner succumb, as they would not be able to entangle any quantity of air to sustain them during their immersion.

Dr. Chapman read a paper entitled "Some Points in the Evolution of the Lepidopterous Antennæ," illustrating his remarks by black-board diagrams and the plates of antennæ sculpture by Dr. Karl Jordan in "Novitates Zoologicæ" (p. 1).

In the ensuing discussion Mr. Tutt said that this was one of the most important of the long series of evolutionary papers which Dr. Chapman had contributed to various societies and magazines, and which would for many years to come revolutionise our ideas of insects.

FEBRUARY 23rd, 1899.

Mr. A. HARRISON, F.L.S., *President*, in the Chair.

Rev. Francis Henry Wood, Brabourne Cottage, Bromley Park, Kent, was elected a member.

Mr. Sauzé exhibited a hybernated specimen of the heteropteron *Acanthosoma hæmorrhoidale*, taken a few hours before in Brixton.

Mr. Harrison exhibited a long series of *Parnassius apollo*, including captured and bred specimens. The large central spot of the hind wings of both males and females showed considerable variation in the amount of white in the middle. There was also a female specimen of a *Parnassius* from Vancouver Island.

Mr. F. Clark exhibited specimens of the fresh-water shrimp, *Gammarus fluviatilis*, one of the Sandhoppers.

Mr. West, of Greenwich, exhibited long series of the four species of the homopterous genus *Philænus*. *P. spumarius*, the common garden "spit-fly," a very long and extremely varied series, showing all shades of yellow, brown, and black, with and without markings; *P. campestris*, also a varied series; *P. exclamationis*; and *P. lineatus*.

Mr. Moore exhibited a preserved specimen of the larva of *Papilio cresphontes* of N. America.

Mr. Step read a series of notes of the observations he had made during the last few years on our larger British Crustaceans, and he illustrated his remarks with lantern slides made from photographs of most of the species obtained by him on the Cornish coast.

MARCH 9th, 1899.

Mr. R. ADKIN, F.E.S., in the Chair.

Mr. Main exhibited two specimens of the sea-spider (*Pycnogonum littorale*), taken crawling on wooden piles in the Medway at Port Victoria. The sexual organs of this creature are situated in both sexes in the fourth or fifth joint of the legs, so that there are eight of them. In the females, however, the eggs are extruded from an aperture in the second joint.

Mr. Adkin exhibited male imagines and cases of *Psyche villosella*, from Bournemouth; also a case of *P. opacella*, from Aberdeenshire.

Mr. Stanley Edwards exhibited cases of and females of *Psyche villosella*, *P. graminella*, and *P. opacella*, all from Fontainebleau.

Mr. Tutt communicated an interesting paper on "The Nature of Metamorphosis" (p. 20), and a short discussion ensued.

MARCH 23rd, 1899.

Mr. J. W. TUTT, *Vice-President*, in the Chair.

The following communication from Mr. T. D. A. Cockerell was read, with a request that the ideas therein expressed might be discussed by the Society:—

An examination of Skinner's Synonymic Catalogue of North American Rhopalocera, published in 1898, recalls and emphasises certain interesting features of our butterfly fauna. Certain portions are of tropical origin, while other groups belong to what has been called the holarctic region. In the tropics conditions have been relatively uniform for ages, and in consequence we have a large number of organisms in a condition of considerable stability—in other words, "good species."

The writer has found, when working with Coccidæ, that the tropical species are, as a general rule, much more easily separated than those of temperate regions. The same is true, apparently, among the butterflies. Take the Hesperidæ and Lycænidæ, which are so numerous in tropical America. The tropical groups of Hesperidæ, in particular, have largely invaded the United States, and very many species have been catalogued. Now Dr. Skinner himself has told us in another connection that these species are, as

a rule, well defined, though frequently superficially similar. But there is one characteristically holarctic series of Hesperidæ—the series of *Pamphila comma*—and here at once we meet with innumerable local races or weak species, with difficulty to be separated from one another. So in *Lycæna* the holarctic group of *pseudargiolus* and its allies is especially polymorphic. When we come to the typically holarctic genera, such as *Argynnis*, we find a wilderness of plastic forms, which may be called species or varieties according to the taste of the student.

It thus happens that for the evolutionist temperate regions, lately subject to glacial desolation, are in many respects more interesting than the luxuriant tropics. Here, especially, are species in the making; here is Nature's kitchen, and the cook at work. In the tropics, on the other hand, we often find more numerous and more finished products and wonderful adaptations, the origin of which is past our comprehension. The naturalist in South America might well think species were created as he found them; the naturalist of the northern United States could hardly imagine such a thing, unless convinced on *a priori* grounds.

Yet when changes have occurred in tropical lands we find such phenomena as are common in the north. The snails of the Greater Antilles, islands that have undergone great changes of level in recent geological periods, are almost as confusing as the North American Argynnids. So it seems we may in some measure learn the past history of a group by studying its species. If the species are well defined and show elaborate adaptations to the environment, the group has long existed under relatively uniform conditions. If, on the other hand, the species are defined with difficulty and connected by numerous races, it may be presumed that the environment of the group has changed in recent times, and especially that it is undergoing expansion and differentiation in new territory. In northern regions the retreat of the ice has exposed much such territory; in the Antilles it has been the elevation of the land; in other cases a type may have found new lands by migration, and may thus exhibit incipient new species in the midst of a stable ancient fauna. As an example of the last-mentioned class may be mentioned *Danais berenice jamaicensis* in Jamaica, as against the old Jamaican type *Papilio homerus*.

In the ensuing discussion Mr. Carrington remarked on the tendency with some naturalists to specify weak species, and to allow but little for local circumstances and environ-

mental effects. He instanced many Japanese species, which were almost, or exactly, identical with our British species.

Mr. Tutt said that in the Palæarctic Region there were many groups of species, composed of very closely allied and sometimes almost indistinguishable individual species, and instanced the Anthrocerids (*Zygænids*) of Europe, which might be termed one species or many according to the student's particular point of view. He considered the naming of the various forms was a matter of convenience, and a necessity for study, reference and inter-communication. The present plan of lumping recently adopted by the British Museum authorities he strongly condemned. With regard to *P. comma*, he stated that it was in England a remarkably stable species in its variation, whereas on the Continent it showed a very considerable range of variation at different altitudes. It did, however, vary in this country, but the aberrations were few and rare. In North America, however, this species attained its extreme of variation, for it formed as it were a centre, around which many local races and weak species were grouped. *L. argiolus* represented in North America by *L. pseudargiolus* he regarded in a similar light to the last species, as showing like characteristics tending to produce more or less well-defined specific forms.

Mr. Montgomery exhibited a long series of *Pieris napi*, and read the following notes:

"The specimens in the first four rows are selected from twenty males and twenty-two females, which emerged between April 21st and May 14th, 1897, and seventeen males and eleven females, which emerged between July 4th and 7th, 1896; all these are the progeny of one female taken at Harefield, Middlesex, May 25th, 1896. They may be taken as typical of the seasonal dimorphism of the species in the home counties.

"The examples in the next two rows are from twenty-two males and eighteen females, the result of forty eggs deposited by a female received alive from Enniskillen on June 14th, 1897, and which emerged between May 4th and 17th, 1898. These specimens do not seem to vary to an appreciable degree from the spring specimens of Harefield parentage. They are somewhat larger, which may be the result of a change of food-plant and a more roomy cage, and the males are on the whole better marked, the palest being equivalent to the darkest Harefield male. The females appear to be identical, and it will be noticed, by comparing them with the captured female, that they have

not been in any way affected by being bred in the London district.

"The last two rows are from sixty-nine males and forty-seven females, bred from eggs deposited by five females received alive from Enniskillen May 23rd, 1898. The only difference noticeable between these specimens, which emerged July 12th to 16th, and the summer emergence of Harefield parentage is the presence of a larger number of grey scales in the former. This may result from their North Irish origin, or from the excessively hot weather during their pupal stage. Mr. Merrifield states, on the authority of Fischer, in his paper printed in our "Transactions," that the result of extreme heat applied in the pupal stage is the same as extreme cold. One or two females may be said to approach the var. *bryoniæ*, not only in being suffused with grey scales, but in the ground-colour being of a decided yellow tint.

"The green veining of the under-side seems to have the same range of variation in both lots, but the yellow ground-colour is very perceptibly brighter in the Irish than the English specimens.

"The subject of the seasonal variation of this species seems to have received scant attention, even in standard works. Mr. Barrett figures as typical a spring male, without the black spot of the fore-wing, and a summer female. What from the plate appears to be a spring female, he refers to as "var. S. Wales," and another spring female which might belong to the same brood, "var. N. Scotland." A summer male and a rather "smudgy" summer female represent "N. Ireland." It appears from the letterpress that the summer emergence has been called var. *sabellicæ*, and is reputed to occur in the earlier (!) emergence.

In the discussion which followed, Mr. Tutt said that he had noticed considerable intensity of colour in this species in the south of Europe. Mr. Carpenter said that he had a larger number of ova of this species from the same source as Mr. Montgomery, and that of the resulting pupæ about one half produced imagines in the summer and the remainder were lying over the winter. He was anxious to see the form which they would take when they emerged. Mr. Tutt said that the pupæ which go over the winter did so in a very low condition of vitality, and the imaginal development took place very late in the pupal life. Mr. Carrington remarked how necessary it was in such experiments as these that every resulting individual should be preserved and

properly labelled. He said that on one occasion, near Toulon, he observed a large number of *P. brassicæ* pupæ on a wall facing the sun, at a time very near to their period of emergence. On revisiting the spot a few days subsequently, there having been in the interval showers of cold driving rain, succeeded by a sharp frost, he found every individual pupa, without exception, rotten. Mr. Tutt remarked that no doubt this was because their vitality was not sufficiently low to withstand such climatic severities as they had done in the depth of winter. Mr. Carrington suggested that the molecular action causing this disintegration of the pupal tissue was due to the rupture of the vessels, owing to alternate contraction from the extreme cold, and expansion, more or less sudden, from the daily increasing heat of the spring sun. This action was comparable to the bursting of the cellular tissues of plants when killed by frost. Mr. Adkin said that he had always found sudden changes of climatic conditions extremely fatal. Mr. Carrington observed that many hybernating larvæ were but little affected by extreme cold.

Mr. F. N. Clark exhibited specimens of *Psoroptes longirostris*, described by Megnin (Paris), an acarid parasitic on the horse, ox, sheep, and rabbit. The example was from the latter animal.

Mr. R. Adkin exhibited a wasps' nest of several cells found in a "hand" of tobacco from Kentucky. It was made of mud, and no doubt the inhabitants were killed during the process of drying the tobacco over wood fires.

Mr. Montgomery exhibited numerous coloured drawings of the eggs and first stages of the larvæ of several species of British butterflies.

April 13th, 1899.

Mr. A. Harrison, F.L.S., F.E.S., *President*, in the Chair.

Mr. B. H. Crabtree, F.E.S., Levenshulme, Manchester, was elected a member.

Mr. Edwards exhibited male and female specimens of *Dytiscus punctulatus* taken at St. Ives, Cornwall.

Mr. Scourfield then gave an interesting description of the group "*Entomostraca*," illustrating his remarks by diagrams, blackboard sketches, and examples under the microscopes kindly furnished by members and friends (see page 28).

April 27th, 1899.

Mr. A. HARRISON, F.L.S., *President*, in the Chair.

Mr. Smith, of Tresco Road, Linden Grove, Peckham, was elected a member.

Mr. Drury presented to the Society's collections a large number of species of the smaller Lepidoptera.

Mr. Ashdown exhibited several earwigs, *Forficula auricularia*, showing considerable variation in the shape and size of the forceps. One specimen, which had unusually small aborted forceps, was stated by Mr. Burr to be a very rare aberration, hitherto only obtained from North Persia.

Mr. A. Harrison exhibited a series of six photographs of a Brazilian butterfly, *Morpho epistrophis*, taken at short intervals, from one minute after emergence from the pupa case up to one hour, when the wings were fully expanded. These photographs were subsequently published in the May number of "Science Gossip."

Mr. Edwards exhibited several species of *Papilio*, including one male and four forms of the female of the polymorphic species *P. memnon*, a very fine *P. segonax*, with a specimen of the closely allied form *P. ulysses*.

Dr. Chapman exhibited several species of Psychids and their cases, with numerous other species of Lepidoptera, including two very brilliant specimens of *Lycæna orion*, female specimens of *Setina aurata*, with the black markings very pronounced, but not run into lines, *Gnophos variegata*, *Acidalia marginepunctaria*, *Titanis schrankiana*, *T. pollinalis*, etc., taken the first week in April, at Locarno, North Italy.

Mr. Enoch exhibited a specimen of the locust *Acridium tartaricum* taken on March 10th, 1898 at Wembley Park. Mr. Burr, referring to this exhibit, said that it was the largest European species, and fairly common. According to the law of priority it should be called *A. ægypticum*.

Mr. F. Clark exhibited specimens of the common fritillary or "snake's-head," *Fritillaria meleagris*, from Oaksey and Leigh, Wiltshire, where it is locally known as the "toad's-head." In a wild state it is found in moist meadows, and grows usually with one flower on a stem, but when cultivated it frequently has two flowers on a stem. A white variety is known, but is rare. Between Mortlake and Kew lies a meadow known as Snake's-head Meadow, where this plant was formerly found. Several members knew localities for this plant, the nearest to London being Pinner.

Mr. Malcolm Burr read a paper entitled "*Orthoptera*, with special reference to British Species" (page 31).

Mr. Tutt, in proposing a vote of thanks, urged Mr. Burr to continue the useful work he had so well begun. There were many problems still to be investigated, and he instanced how little was yet known as to the migratory habits of some species of Orthoptera. He said that so far as yet known there seemed to be no parallel between the migration of birds and the migration of locusts. The former phenomenon no doubt was influenced by climatic conditions, the results of glacial periods; but as to the latter, there was an almost total absence of reliable data upon which a theory could be based. Mr. Enoch remarked how miserably ignorant we yet were of vast numbers of even well-known insects. With regard to bees, he had found it quite possible to tell the genus of a specimen by the hum it made, and he wished to know if such were possible in the case of the Orthoptera. Mr. Burr said that it was quite possible to tell some species by their chirp if sufficiently isolated to be distinguished.

MAY 11th, 1899.

Mr. A. HARRISON, F.L.S., *President*, in the Chair.

Mr. J. Archer Harrison, of Forest Gate, was elected a member.

Mr. Lucas exhibited specimens of the rare plant *Claytonia perfoliata*, from Woking, and contributed the following note:—"This is really a garden outcast, of American origin, which is establishing itself in many parts of England. It occurs to my own knowledge at Weybridge and Woking, and I believe I have seen it as a weed in Veitch's nursery at Kingston Vale. North-west America is its home. The generic name is derived from that of an American named Clayton; the origin of the specific name is obvious. The peculiar leaves and succulent growth should be noticed."

He also exhibited flowers of *Viola palustris*, from a marshy common at Esher, and remarked that the plant grows amongst the sphagnum on very wet ground. During the winter it is not in evidence.

Mr. West exhibited specimens of the aquatic hemipteron *Plœa minutissima*, from Blackheath.

Mr. J. W. Tutt exhibited a number of lantern slides to illustrate the subject of "Mimicry," which he discussed at some length from various points of view.

Among the objects illustrated and discussed were *Mantis religiosa*, *Euchloë cardamines*, *Phalera bucephala*, *Amphidasys betularia* (normal, extreme, and intermediate forms), *Kallima inachis*, *Limnas chrysippus* and its mimic *Hypolimnas bolina*, a *Heliconius* and its Pierid mimic, *Papilio merope*, male and different forms of the female which mimic forms of *Danais*, a wasp and *Trochilium crabroniformis*, and the twig-like larvæ of *Uropteryx sambucata*.

In the ensuing discussion it was generally considered that much further observation on this subject was needed, especially by those who were qualified to fitly judge the facts observed.

MAY 25th, 1899.

Mr. A. HARRISON, F.L.S., *President*, in the Chair.

Mr. Ashdown exhibited specimens of both sexes of the coleopteron *Osphya bipunctata*, from Huntingdonshire, shewing also the two forms of the male—with and without the incrassate hind femora. The forms of the two sexes of this species are very distinct. The specimens were captured in May, 1899.

Mr. Lucas exhibited the following plants:

Menyanthes trifoliata (the buckbean or bogbean), from the quaking bog at the foot of Horseshoe Clump, on West End Common, Esher. On May 13th the plants were only represented by a few odd leaves in a ditch; on the 22nd of the month not only was there a bed of foliage, but several specimens were in blossom—a very rapid development.

Hottonia palustris (water-violet). A somewhat scarce plant, belonging to the Primulaceæ, which was found in one or two places near Byfleet on May 23rd. Thrum-eyed and pin-eyed blossoms occurred as in the common primrose. Numbers of small shells were clustered amongst its submerged leaves.

Listera ovata (twayblade), obtained near Effingham Station, May 23rd. Some were very large: one plant was in blossom.

Mr. Lucas also reported the following dragon-flies, noticed on or before May 23rd, *Libellula quadrimaculata*, *Cordulia ænea*, *Calopteryx splendens*, *Erythromma naias*, *Pyrrhosoma nymphula*, *Ischnura elegans*, *Agrion pulchellum*, *Agrion puella*, and *Enallagma cyathigerum*; but specimens were not numerous. The season, he stated, was about three weeks

behind the early one of 1893, but a trifle earlier than last year. On May 23rd, at Byfleet Canal, the May-fly (*Ephemera vulgata*) was emerging in numbers.

Mr. West exhibited a specimen of the rare hemipteron, *Drymus pilicornis*, obtained by shaking moss at Boxhill.

Mr. Edwards exhibited a large number of "Cicadidæ," chiefly from Borneo and India, and contributed notes. He observed that about eighty-two genera and some seven hundred and twenty species are known to science.

JUNE 8th, 1898.

Mr. J. W. TUTT, F.E.S., *Vice-President*, in the Chair.

Mr. Main exhibited a considerable number of large and brilliant Coleoptera from West Africa, among the species being the remarkable *Rhina amplicollis*, which has the "rhynchus" much produced beyond the insertion of the antennæ, and covered with bristles for about half its length. He made a few remarks as to the uses of the peculiarly developed frontal armatures possessed by several of the species, and said that they were of service as a means of defence, and also enabled the insect to break the bark and wood of trees to extract the juices.

Mr. Alfred Sich exhibited living specimens of an *Ephestia* (which Mr. Tutt and Dr. Chapman identified as *elutella*) from a maltings in Hammersmith. Mr. Tutt remarked on the great variation exhibited by this species.

He also exhibited ova laid by a female *Hepialus lupulinus*. Most of these ova were probably laid on June 7th, about 8.30 p.m. At 9 p.m. they were of a pale ochreous colour; at midnight some of them had changed to a deep purplish tint, and at 5 a.m. on June 8th they were all black. Thus some of the ova changed from ochreous to black within the period of five hours. During the meeting the above *H. lupulinus* deposited more ova, which appeared when placed under a microscope to be of an ivory colour.

Mr. Edwards exhibited a specimen of the hive-bee pest, *Galleria mellonella*, and remarked on the damage the species sometimes caused to bee-keepers. Mr. Tutt considered *Achræa grisella* to be a still greater pest in the hives.

Mr. F. Noad Clark exhibited ova of the fresh-water fish parasite (*Argulus foliaceus*). He remarked that the parasites had been in abundance during the past two or three weeks, and had been taken from sticklebacks in the Grand Junction Canal.

Over six hundred eggs were laid by one female, being placed in one layer of regular rows three or four deep. They were oval in shape and of microscopic size; white when freshly laid, but becoming pale yellow and covered with adhesive matter, which soon coagulated. He briefly described the manner of ovipositing, and said he had also observed copulation under the microscope.

An article by Mr. Clark on the *Argulus* appeared in the April number of "Science Gossip," and he hoped at some future time to give the members a detailed account of his observations.

Mr. R. Adkin read the following report of a Field Meeting at Chatham, May 27th, 1899.

"The first field meeting of the season was held at Chatham on Saturday, 27th May. Several members journied from London Bridge, S. E. R., by the 1.32 train, and were met on their arrival at Chatham Station by others, bringing the total to thirteen, including Mr. J. J. Walker, R,N., who took charge of the party. The route taken was by the Maidstone road for a mile or so, and then by a lane on the left to the "Hook and Hatchet;" and continuing along the same lane for approximately another couple of miles to a beech wood occupying the hill-side on the left hand, where the greater portion of the afternoon was spent. A return was ultimately made by the way which we had come to the "Hook and Hatchet," where a meat tea of a decidedly substantial character was waiting, to which ample justice was done, and a hearty vote of thanks passed to Mr. Walker for conducting the party over a very promising and interesting locality, and the admirable arrangements that he had made for their comfort. The district worked was wholly on the Chalk.

For a country walk the prevailing meteorological conditions were eminently satisfactory; fitful sunshine tempering the keenness of the northerly breeze that had been blowing for several days; but from an entomological standpoint a much more genial state of affairs could have been desired. Under these circumstances it is not surprising that the number of species that came under the notice of the party is remarkably small, even for so early a date. Diurnal Lepidoptera were particularly scarce; an occasional *Pieris rapæ* and possibly *P. napi* flitted over the adjacent meadows; a single example of *Euchloë cardamines* was found resting on a hornbeam hedge, resembling in appearance sundry small flowerheads of an umbelliferous plant that protruded themselves

through the hedge so closely that it might well have been passed by unnoticed, had not some other circumstance drawn attention to the particular part of the hedge on which it was resting; and a solitary *Nisoniades tages*, that rested in a cart-rut so sleepily that it was easily boxed, were the only species reported. Nor were the night-flying species found in any more encouraging numbers, although the beating-stick was applied with no lack of assiduity to the under-growth along the route, and a diligent search made of the tree trunks and other likely resting places. Fair numbers of *Asthena candidata* fluttered out of the disturbed under-growth, and was the only species met with at all commonly. The beech woods produced odd specimens of *Drepana cultraria* (*unguicula*) and *Zonosoma linearia;* while *Coremia furrugata*, *Cidaria suffumata*, and *Phibalapteryx vitalbata* were found along the hedge-rows. *Ephippiphora nigricostana*, *Tortrix ministrana*, *Adela viridella*, *Nemophora swammerdammella*, *N. schwarziella*, *Micropteryx thunbergella*, *Nepticula ruficapitella*, and *N. atricapitella* were also noted. Of the many plants of burdock searched, only a few produced larvæ of *Aciptilia galactodactyla*, which is often so common at this season. Larvæ of *Gelechia sequacella* and *G. tæniolella* were reported to be fairly common.

The Coleopterists of the party met with somewhat better success. Beetles were by no means uncommon on flower-heads, and the sweeping-net was seldom tenantless; the following among other species being reported by Mr. Walker: *Harpalus puncticollis*, *Homalota brunnea*, *Brachinus crepitans*, *Leistus spinibarbis*, *Mycetophagus atomarius*, *Malthinus frontalis*, *Telephorus clypeatus*, *Luperus flavipes*, *Gonodera luperus*, *Polydrusus pterygonialis*, *Brachysomus echinatus*, *Ceuthorrhynchus nigrinus*, *C. constrictus*, *C. cochleariæ*, *Chrysomela distinguenda*, to which Mr. Ashdown adds *Rhagium inquisitor*, which he took on flowers of *Vibernum lantana*.

A small bee, taken by Mr. Walker and passed on to Mr. Edgar of Maidstone, proved to be the rare *Andrena proxima*, Kirby.

Snails were not easy to find, owing no doubt to the unusually dry state of the atmosphere, and it was but few examples of even such common species as *Helix nemoralis*, *H. cantiana*, and *H. aspersa*, that were met with. Of *Cyclostoma elegans* there was an abundance of dead shells scattered about, an examination of which suggested the probability of a considerable amount of colour variation in the district, but a sufficiently large number of live ones were not obtain-

able to verify this opinion. An hour's search of the beech trunks in the wood produced better results, the following species being taken, viz. *Clausilia laminata*, *Bulimus obscura*, *Helix lapicida*, and a dead shell of *H. rotundata*.

Among the plants that came under notice may be mentioned some eight species of Orchideæ, viz. *Aceras anthropophora*, *Orchis purpurea*, many very fine examples; *O. mascula*, *Neottia nidus-avis*, *Cephalanthera pallens*, *Ophrys muscifera*, *Listera ovata*, and *Habenaria viridis*; also *Daphne laureola*, *Chelidonium majus*, *Hippocrepis comosa*, *Galeobdolon luteum*, *Lepidium draba*, *Ajuga reptans*, *Aquilegia vulgaris*, and many other species.

Mr. Adkin also reported on the Congress of the S. E. Union of Scientific Societies, which had been held this year at Chatham, and which he had attended as the Society's delegate.

Mr. Hall proposed, and Mr. Clark seconded, a hearty vote of thanks to Mr. Adkin, both for his report of the field meeting and his attendance at the Congress. Mr. Tutt in putting the motion to the meeting remarked upon the great assistance rendered by the Rochester N. H. Society to those attending the Congress, and to the magnificent collections exhibited by Dr. Clements during the week.

JUNE 22nd, 1899.

Mr. J. W. TUTT, F.E.S., *Vice-President*, in the Chair.

Mr. Montgomery exhibited the following larvæ:—1. *Pararge megæra*; 2. *Epinephele tithonus* from ova, showing both green and brown forms; 3. *Enodia* (*Epinephele*) *hyperanthus* from ova. He stated that they were all easy to get through the winter, feeding on any ordinary grass, and continued feeding more or less the whole time. He also exhibited a new arrangement of postal box he had had made especially for sending larvæ.

Mr. Turner exhibited a cluster of large ova deposited on a spray of heather, which had been found by Mr. Lucas in Woolmer Forest, and which closely resembled a head of the dead flowers of the heath. They were not recognised at the meeting, but were afterwards ascertained to be those of *Bombyx quercûs*.

Mr. West exhibited a specimen of *Stauropus fagi*, bred from a larva found at West Wickham in 1898.

Mr. R. Adkin exhibited a very fresh specimen of *Syrichthus*

malvæ, variety *taras*, taken at Milton Hide, near Hailsham, Sussex, on June 2nd. Also a cocoon of *Hylophila bicolorana* (*quercana*), and called attention to the special construction which gave it great power of resistance to external pressure. He compared it to a boat turned upside-down, thus having the keel uppermost, and with the bilge-pieces continued along and joining the keel. The usual position selected for preparation appeared to be the back of an oak leaf, the head of the cocoon, which is its strongest part, pointing towards the tip of the leaf. He suggested that possibly this special form of cocoon was a protection to the enclosed pupa from damage, by the leaf to which it was attached being blown by the wind against other leaves or branches of the tree.

Mr. Adkin further mentioned that whilst walking along a road between Amersham Common and Chalfont Road Railway Station on the evening of 15th June, at about 8 o'clock, he observed a *Hepialus*, probably *H. lupulinus*, wallowing in the dust of the road, just as sparrows sometimes do before rain. There had been some twenty days absolute drought at the time, and the evening was very warm. He at first thought that the insect was in some way damaged and therefore unable to fly, but on his attempting to box it it flew away with the greatest of ease. He did not think it was engaged in egg laying, as it would hardly select a dusty road for such a purpose, seeing that the young larvæ on hatching would be at a considerable distance from any possible food supply, and therefore would undoubtedly perish even if the egg avoided destruction; and he was quite at a loss to give a solution of the phenomenon, unless the same causes, whatever they might be, which operated in the case of the sparrows also actuated the moth.

Dr. Chapman exhibited a few *Fumea intermediella*, bred from cases taken at Norwood, of a deep brown black colour, so that they might be described as brown or black according to the fancy of the describer, brown being more likely to be selected if the specimen was a little worn. Also a female pupa of a large *Psyche* from Chili, exhibiting new points in the structure of Psychid pupæ, the posterior dorsal hooks on intersegmental membrane being especially well developed in this specimen. He also exhibited cases and male specimens of *Fumea crassiorella*, pointing out the differences from *F. intermediella*.

Mr. Tutt commented on the difficulties which a student of this group found, in that the species were so little known,

and that the records were most unreliable, owing to the slight amount of divergence of the various species.

Mr. Tutt exhibited specimens of *Ephippiphora grandævana* from Hartlepool, received from Mr. Gardner. He commented on the long sand tubes formed, the movements of the pupa therein, and the emergence of the imago, bred June 22nd.

Mr. F. N. Clark read a short paper on "Photomicrography as applied to Entomology," illustrating it by his own photographs.

JULY 13th, 1899.

Mr. J. W. TUTT, F.E.S., *Vice-President*, in the Chair.

Messrs. J. R. Pickin, of Brixton; A. A. Buckstone, of South Norwood Park; S. W. Gadge, of Brixton; and G. W. Tombs, of Dalston, were elected members.

Mr. Lucas exhibited a very finely marked specimen of *Libellula quadrimaculata*, var. *prænubila*, taken at the Black Pond Esher.

Mr. R. Adkin exhibited specimens of *Pachnobia hyperborea* (*alpina*), bred last year from pupæ taken at Rannoch.

Mr. E. Step exhibited specimens of the hermit crabs *Eupagurus pubescens*, Kroyer, *Eupagurus sculptimanus*, Lucas, and *Anapagurus hyndmanni*, Thomps., and read the following note:

"The small hermit crabs exhibited are among the least known of our indigenous crustacea, and are not very frequently seen in collections. Too frequently, no doubt, they are passed over by collectors as juvenile specimens of the common species (*Eu. bernhardus*).

"*Eu. pubescens*, the downy hermit, appears to have been first recorded as British by Mr. Hyndman, who obtained a specimen lodged in a whelk-shell by dredging at a depth of fifty fathoms at the entrance to Belfast Bay. Thompson sent this specimen to Bell, who figured and described it in the Appendix to his "Stalk-eyed Crustacea," under the name of *Pagurus thompsoni*; but it had been previously named by Kroyer *Pag. pubescens*. The limbs are all furnished with spines and densely clothed with hairs, which are far more evident in the living crab than in a dry specimen. Bell gives a tolerably close description, but one very distinctive feature he omits, *i. e.* the antennæ are furnished with long, pellucid, spreading hairs, and are annulated with dark reddish-brown and white. The carapace is reddish-brown

marked with white spots; the eyes pale greenish, their stalks mottled above, white and yellow below. My first specimen I obtained by dredging in Gerrans Bay, Cornwall, at a depth of fifteen fathoms, and brought it up in the dredge with a number of *Eu. prideaux*. It was housed in a shell of *Trochus magus*. This was on September 13th, 1897, and I kept it alive until the following May, when I killed it (inadvertently) by changing the water. I have at various times since taken several others, and found them very amenable to the conditions of aquarium life, their pabulum consisting of fine weeds, such as confervæ and *Bryopsis*, as well as minute débris of both animal and vegetable nature. The specimen exhibited was taken June 18th, 1898, in the shell of *Turritella*, which is completely covered by a colony of the hydroid *Hydractinia*, whose hard basal spines form a good protection to the crustacean.

"*Eupagurus sculptimanus*, Lucas, is another of Bell's unfortunate attempts to render well-deserved honour to his friends. He discovered this species among a parcel of small hermits received from Falmouth, and named it *Pag. forbesii* after Professor Edward Forbes, but here again the law of priority insists on the name *sculptimanus* previously given by Lucas. My specimen was obtained by dredging in Gerrans Bay on the 18th September last, and as I took it in company with several specimens of *Eu. pubescens*, I regarded it at the moment as of that species; but closer inspection at home showed me that it was much less hairy, that the hand was proportionately broad and the carapace shiny, and the antennæ hairless. The specimen exhibited housed itself in a shell of *Mangelia* which had afterwards become completely invested by the sponge *Suberites ficus*.

"*Anapagurus hyndmanni*, Thompson. This beautiful little hermit was first obtained by Thompson at Portaferry. It has since been taken in Belfast Bay, the Firth of Forth, the Rev. Alfred Norman has recorded it from Weymouth and Falmouth, and Mr. Boswartha dredged it near Plymouth. Whilst out with the oyster dredgers at the mouth of the Fal last October, I found the left-hand specimen running over the sorting board, and on two separate days just before Christmas I took the others at low water (spring tide) at the foot of the Bass Rock in front of my house at Portscatho."

Mr. Step also exhibited the marine hemipteron *Aëpophilus bonnairei* from Portscatho, Cornwall (see E.M.M. 1899, p. 283).

Mr. Hy. J. Turner exhibited several species of dragon-

flies, eight of which were taken during the field meeting at Byfleet on June 10th, including *Pyrrhosoma nymphula* (*minium*), with *P. tenellum* for comparison; *Enallagma cyathigerum*, and a variety with the longitudinal portion of the black mark on the basal segment undeveloped; *Ischnura elegans* and a red-bodied female variety; *Agrion puella*, *A. pulchellum*, *Erythromma naias*, *Brachytron pratense*, and *Calopteryx splendens*. He also exhibited a male specimen of *Anax imperator* (*formosus*), and both sexes of the very local *Orthetrum cancellatum*, from Woolmer Forest.

Mr. Lucas read a report of the Field Meeting held at Byfleet on June 10th.

"Splendid weather favoured those members of the Society who, with a few visitors, assembled for the field meeting at Byfleet on the afternoon of June the tenth. The train arrived a little late, but so close is the canal to the station that but a short time elapsed before collecting commenced in earnest. Swarms of dragon-flies were amongst the first objects that met the view of the party, and the most lepidopterous of them could not help for the nonce becoming ardent odonatists. May the infection have sunk deep, and may some at least have taken up for good the fascinating if arduous pursuit of those interesting and gorgeous animals! Three of the little blue Agrionines were out in swarms, the ubiquitous *Agrion puella*, and with it in fair numbers the less common *Agrion pulchellum*, while their very near relative, *Enallagma cyathigerum*, was equally common with the former, and apparently by some of the party with difficulty distinguished from either. *Ischnura elegans*, a small black dragon-fly with a single blue segment near the end of its abdomen, was out in good numbers, and with the typical form was not seldom taken the variety with orange thorax. Easily mistaken on the wing for the last-named species was the usually scarce—but in the Byfleet locality common—*Erythromma naias*, a sturdy insect with crimson eyes and blue extremity to its abdomen. *Pyrrhosoma nymphula* was occasionally netted, its crimson abdomen adding variety to the general blue tints of the insects mentioned before. Amongst the larger species a few specimens of *Calopteryx splendens*—an easily distinguished dragon-fly with body of metallic lustre, intensely blue or green according to sex, and possessing in the male a large blue patch across the middle of all the wings—were occasionally taken; but the centre of its haunts was not quite reached. Several individuals of the

swift-flying *Brachytron pratense* were on the wing, generally well out of reach; but two or three, including at least one female, were secured, Mr. Tarbat making the first successful stroke. A few *Cordulia ænea* were hawking backwards and forwards along the canal, close to the margin, unless a net was near, when a bold sweep out of the usual course as a rule occurred. More than one, however, were outwitted in the end. *Libellula quadrimaculata*, though seen, was not captured. While most were giving their attention to the living insects, Mr. Clark was seeking for the empty nymph cases, and obtained material about which we shall see and hear more perhaps in connection with his forthcoming demonstration. A few Neuroptera belonging to other divisions were noticed. The common May-fly, *Ephemera vulgata*, was indulging in its airy dances in the sun, and as dusk came on a few examples of a much smaller species were seen. The alder fly (*Sialis lutaria*) was common, and a couple of specimens, one living, the other dead, of *Phryganea grandis*, and one of *Limnophilus rhombicus*, were found. Amongst the less easily distinguished species were a few specimens of a yellowish-brown Trichopteron, *Molanna angustata* I believe, while very common on the herbage along the margin of the canal was another, a black one, whose name, with those of one or more other Trichoptera, were not determined.

"A single specimen of *Ranatra linearis*, a water-bug, and resembling a piece of broken grass-stem about four inches long, was noticed by Mr. Clark. It was not, as is usually the case, crawling on the mud, but was swimming near the surface of the water. It was sent to our curator, Mr. West, and by this time, no doubt, adorns his cabinet. Many other aquatic bugs were "measuring" the surface of the water, but there was not one of the party who could identify them. Consequently they were passed over, as were also the Coleoptera, Hymenoptera, Diptera, etc., for a similar reason.

"Byfleet Canal is noted for the large number of species of the Mollusca it contains, and on several occasions I have tested its capabilities in that connection, but our party on the 10th seemed to be too fully occupied to attend to them. Mr. Sich, however, found *Succinea putris* on the herbage. I have taken what I consider *Succinea elegans* from the same locality; perhaps one or other of us has mistaken the species. Mr. Sich also paid some attention to the flora of the district. He found, *Impatiens fulva*, the new beautiful

and extremely succulent balsam, a North American plant, which is spreading with extreme rapidity throughout Surrey. *Briza media* was growing by the canal side, and *Genista anglica*, the badge of the Plantagenets, in the damp ground beyond, where also was a bed of *Carduus pratense*, a not-common thistle, which was just coming into flower. Like the Mollusca, however, the Flora of Byfleet requires a day to itself.

"But I must not neglect the Lepidoptera, which, however, did not thrust themselves upon our notice during the afternoon; they were more in evidence during the evening. For what I have to say in connection with this order I am chiefly indebted to the notes forwarded by Messrs. Sich and Kaye. Others were promised, but the Kingston postman must have been remiss in his duties. The only butterflies, whose names were returned to me, were *Pieris brassicæ*, *P. rapæ*, *P. napi* and *Hesperia sylvanus*. The moths were as follow:—*Hepialus lupulinus*, large and well-marked forms; *Ectropis* (*Tephrosia*) *punctularia*, one specimen on a pine-trunk; *Eupisteria obliterata* (*heparata*), plentiful at dusk near alder, its food-plant; *Hydriomena* (*Hypsipetes*) *trifasciata* (*impluviata*), one specimen on pine-trunk; *Mysticoptera* (*Lobophora*) *sexalisata*, one specimen on one of the lamps at Byfleet station; *Leucophthalmia* (*Zonosoma*) *pendularia*, one specimen; *Euclidia glyphica* abundant in one meadow by the side of the canal; *Euclidia mi*, worn; *Nymphula stagnata*, *N. stratiotata* (one), *Hydrocampa nymphæalis*, and *Cataclysta lemnalis* over water plants by canal; *Hadena dentina*, one at rest on a fence; *Cabera pusaria* (two); *C. exanthemaria*, both females; *Cidaria corylata*, netted after 7 p.m. by Mr. Sich (Mr. Turner took a well-marked form with a slightly yellow tinge); *Crambus pratellus* (one); *Halonota scutulana;* eight species of Tortricina taken by Mr. Sich and not yet named; one *Dasycera oliviercella; Micropteryx calthella*, two males in flowers of Ranunculus; one *Symæthis fabriciana;* three or four *Alucita polydactyla* about the hedges.

"Larvæ noticed were *Porthesia similis* on sallow and other food plants; *Pseudoterpna pruinata* on broom; *Eucestia* (*Chesias*) *spartiata*, both yellow and green forms, on broom.

"Tea was taken early, that an hour or so might be spent afterwards by the side of the canal. Not only did this prove profitable as far as the collection of Lepidoptera was concerned, but the fine summer evening was most enjoyable. And it was worth catching a later train to see the canal and its surroundings under a new aspect. When after sunset

the shades began to fall, and the air became cooler, a mist arose from the surface of the water, and slowly moved along in the nearly motionless air, setting off by contrast the dark water, and the dense growth of alder that lined the opposite bank, and looked like a mangrove swamp by the side of some tropical river. The slender crescent of the moon, as it neared its setting, was just visible above the trees, and if the sad moaning of the night-jar was heard on the left hand, the sweet song of a nightingale, sweeter perhaps by contrast, issued from the trees on the right. No wonder that under these circumstances all were loath to turn their back on nature, and make for the railway station, and all the other common places of a work-a-day world."

Mr. Adkin read a Report of the Field Meeting held at Chalfont Road, on July 1st.

"The third field meeting of the season was held at Chalfont Road, on Saturday, July 1st. In an address which it was my privilege to read before the Society some little time since, I suggested that the chief factors in the successful carrying out of a field meeting were thorough organization and fine weather. On the occasion now under notice, the former, I willingly admit, may have been at fault, but however bad the organization may have been, the weather with which we had to contend was decidedly worse. Nearly half-an-inch of rain in the twenty-four hours (or to be exact 0·48 inch) and a fresh north-west breeze were enough to damp the ardour of any but the most enthusiastic, and there is little wonder that the ten members who had signified their intention of being present, had dwindled to a bare half dozen at the time a start was made. These venturesome spirits had, however, no reason to regret their rashness; and although insect life was conspicuous by its scarcity than otherwise, some other orders were plentiful enough, and the delightful freshness of the woods and pastures after the heavy rains was in itself an ample reward. Nor did a couple of sharp showers that fell during the afternoon cause any inconvenience, indeed, so complete a covering did the heavy foliage of the beech-woods provide, that, had it not been for the pattering of the rain-drops on the canopy overhead, they might well have passed by unnoticed, and it was with feelings that so pleasant an outing had been all too short that at about 7 o'clock the party adjourned to the 'White Lion,' Amersham Common, where tea awaited it.

"It has already been mentioned that insects were decidedly scarce. Unfortunately no coleopterist was of the party, and therefore it is impossible to say what treasures in the way of beetles might have been unearthed, had diligent search been made for them; but so far as I am aware nothing of any special moment was noted on the move, in that order. Lepidoptera on the other hand was well looked after. The only butterflies seen were a single example of *Hesperia sylvanus* asleep on a bramble leaf in a lane, where the like of *Epinephele ianira* was disturbed from the hedge-row, and another in the wood. Beating was of no avail, the wind and rain had done all that was to be done in that way in a far more business-like way than our beating-sticks could do it, long before we came on the scene. But despite the severity of the elements, the larvæ of *Euchloë cardamines* were found stretched at full length on the seed pods of *Sisymbrium alliaria*, resembling them so closely, both in form and colour, as to almost evade detection. Such moths as were met with were found chiefly on the tree trunks, more particularly those that afforded good shelter from the breeze. On such we found *Hecatera serena*, tucked so snugly in a cleft in the bark that it was not without the aid of a twig that it could be hooked out of its retreat; *Acidalia aversata*, a banded form; *Larentia viridaria*, *Melanippe montanata*, *M. albicillata*. *Bapta temerata*, *Scoparia ambigualis*, *S. dubitalis*, *Tortrix ribeana*, etc., were also found in similar situations; and it may be mentioned that *Asthena blomeri* was taken in these woods a few days earlier. *Abraxas sylvata* (*ulmata*) was resting in fair numbers on the leaves of dog's-mercury (*Mercurialis perennis*) and nettle, looking just like some bird's dropping. This is probably one of the nearest localities to London for the species.

"But the wet weather that had driven the insects so close into their hiding places had quite the reverse effect upon the Mollusca, of which considerably over a dozen species were met with. In certain portions of the woods *Clausilia laminata* literally swarmed upon the moistened beech trunks, accompanied by a fair number of *Clausilia rugosa* and *Bulimus obscurus*, while among the moss at their roots, *Zonites alliarius*, *Z. cellarius*, *Z. nitidulus*, *Z. glaba*, and *Helix rotundata* abounded, and *Cyclostoma elegans* was found on the chalky earth in the woods. In the lanes *Helix cantiana*, *H. rufescens*, *H. aspersa*, *H. nemoralis*, *H. hortensis* were met with; while crawling on the damp ground a very beautiful

variety of the black slug, *Arion ater*, having the body greenish-white and head and foot-margins bright orange, was found.

"We are indebted to Mr. Step for the identification of the foregoing Mollusca, also for the following botanical notes.

"Nothing out of the ordinary came under our notice speaking botanically. The beech-woods in which our time was chiefly spent are very like those on the Surrey chalk hills, with which most of us have a more intimate acquaintance. Yet for the guidance of others contemplating a visit some of the plants may be here recorded. The ground beneath the trees was pretty well carpeted in places with woodruff (*Asperula odorata*), dog's-mercury (*Mercurialis perennis*), melic (*Melica uniflora*), and a little woodsorrel (*Oxalis acetosella*). Among the larger constituents were the wych elm (*Ulmus montana*), a very large-leaved form of hazel (*Corylus avellana*), probably due to close cutting, some fine examples of the gean (*Prunus avium*), buckthorn (*Rhamnus frangula*) in flower, and dogwood (*Cornus sanguinea*). There were a few patches of *Clematis vitalba* in flower among the wild roses, and the wood spurge (*Euphorbia amygdaloides*) was plentiful. A solitary wild gooseberry bush (*Ribes grossularia*) was noted; a few plants of perforated St. John's wort (*Hypericum perforatum*), cow wheat (*Melampyrum pratense*), the sanicle (*Sanicula europea*), and a number of the white helleborine (*Cephalanthera pallens*). On railway banks near the station the beautiful musk mallow (*Malva moschata*) was abundant, and with it were the long-stalked geranium (*Geranium columbinum*), the yellow vetchling (*Lathyrus pratensis*), the field scabious (*Scabiosa arvensis*), and bittersweet (*Solanum dulcamara*). By the railway arch was discovered the skullcap (*Scutellaria galericulata*), and on the Chalfont side of the line a colony of the broomrape (*Orobanche major*) was found on a bank. Along the road to Amersham Common the figwort (*Scrophularia nodosa*) was growing in the hedge, also the barberry (*Berberis vulgaris*), the older leaves well sprinkled with patches of the orange cluster-cups (*Æcidium berberidis*) —one of the stages in the tri-morphic history of the corn-mildew (*Puccinia graminis*), yellow bedstraw (*Galium verum*), white bryony (*Brionia dioica*) and (*Carex remota*) were other plants noted along this road. Little was done with cryptogams in addition to the *Æcidium* already mentioned, but in the woods we noticed many male ferns (*Nephrodium filix-mas*), and a few fungi. The well-named stinkhorn (*Phallus impudicus*) was there in abundance, the honey-combed glebe

swarming with dung-flies (*Scatophaga*) feeding greedily upon the vile-smelling spores. Numerous examples of *Amanita rubescens* were up, also *Russula heterophylla* and *R. ochroleuca*."

Mr. Carrington gave an account of a visit he had made to Bradwell-juxta-Mare on the Blackwater, near Southminster. Opposite was Mersea Island, which had been explored and described some time ago by the Essex Field Club. In the neighbourhood was Brightlingsea and extensive salt marshes. The sea walls in many parts has been recently repaired, after the damage done by the storms of 1897, although much of the land which had then been submerged had not yet been reclaimed. *Artemisia maritima* and the samphire were most abundant plants, but the *Silene maritima* was very rare. The species of the family Chenopodiaceæ were most common. *Hesperia lineola* was present in the district, and the abundance of ruined stems of sparganium raised hopes of *Nonagria sparganii*. Herons, gulls, terns, redshanks, and plovers he had noticed in plenty. The broad dykes, with their fringes of reeds and luxuriant growth, gave good promise of Odonata and Neuroptera. The spot was interesting also from an archeological point of view.

JULY 26th, 1899.

Mr. F. Noad Clark in the Chair.

Mr. Fremlin exhibited a store-box of insects from Stornoway, including numerous interesting series and forms of common species, taken during several weeks' holiday in June and July of the present year. He stated that it was light enough to read the whole twenty-four hours. The lark often commenced to sing at one o'clock in the morning. There was but little opportunity for collecting on account of the weather. It was exceedingly damp, and the sun rarely appeared until two o'clock in the afternoon, going again behind the clouds by six. At half-past nine one might begin dusking, and small Lepidoptera might be taken for an hour or so. Sugar was a complete failure; only three moths came to it. As regards Lepidoptera, there were not many species to be obtained, but those that were noticed were in some numbers. There was no wooded district in Lewis, but an alternation of bleak moorland, rugged mountain, rock, and lake. The country was most interesting from an archæological point of view, and Druidical stones were common. The industry of the place was all connected with the herring

fishery. He made a most interesting excursion to Flannan Islands, which lie in the Atlantic, west of the Isle of Lewis, and saw there the puffin (*Fratercula artica*) in countless numbers.

Mr. West exhibited a specimen of the snake-fly (*Rhaphidium*), and also the homopteron, *Pediopsis fuscinervis*, both from West Wickham.

Mr. Clark exhibited a photograph of the egg of *Eubolia cervinata*.

AUGUST 10*th*, 1899.

Mr. T. W. Hall, F.E.S., in the Chair.

Mr. Malcolm Burr exhibited a large number of species of the Orthopterous family Eumastacidæ, and contributed the following note:

"The Eumastacidæ are a curious family of Acridiodea confined to the tropics, characterised *inter alia* by the short antennæ; but one anomalous genus has long clavate antennæ, and is also peculiar in that it occurs in Palæarctic Asia. The family includes many strange forms, imitating dried leaves and other insects, even small dragon-flies. (See *Erucius agrionides*, etc.). They seem to be rare insects, and are only brought home by collectors in small numbers. The African forms, *Thericleis*, are, with one exception, quite destitute of organs of flight. The *Chorœtypi* are almost entirely Asiatic, a few species being found in Africa. One genus alone is Australian. The Eumastaces are found in the Neotropical portions of America, Africa, and Asia. Two years ago little over thirty species were described; now almost one hundred are known to science."

The exhibit was admirably illustrated with detailed drawings by Mr. E. H. J. Schuster, of Oxford.

Mr. Burr also exhibited the specimens of Orthoptera which had been brought from Socotra by Mr. Ogilvie Grant, being a portion of the result of the recent expedition. The exhibit was interesting from a geographical point of view rather than from the number of new species. There seemed to be strong evidence of an overlapping of the Ethiopian and Palæarctic regions.

Mr. Sauzé exhibited a large number of insects of all orders taken during his holiday in July at Bournemouth and neighbourhood. The species were:—*Cupido* [*Lycæna*] *minima*, from Totland Bay; *Hesperia actæon*, from Lulworth and

Swanage; *Limenitis sibylla*, from New Forest; *Gonopteryx rhamni*, New Forest, July 15th; *Zephyrus* [*Thecla*] *quercûs*, from New Forest; *Melanargia galatea*, from Corfe and Lulworth; *Calligenia miniata*, from oak in New Forest; *Lithosia lurideola*, from Boscombe; *Cleora lichenaria*, New Forest; *Pseudoterpna pruinata*, in Durley Chine; series of female *Lampyris noctiluca*, with one male, by assembling, from Boscombe; *Tabanus bovinus*, New Forest; a specimen of the rare homopteron, *Ledra aurita*, from oak in New Forest; and *Mysia oblongo-guttata*, from pine, New Forest.

AUGUST 24th, 1899.

Mr. Robt. Adkin, F.E.S., in the Chair.

Mr. Edwards exhibited a number of insects of various orders from Borneo and India, including the large bee *Xylocopa latipes*, the enormous digging wasp, *Triscolia procera*, with two other species of digging wasps, *Eumenes dimidiatipennis*, and *Eumenes latreillei*; a specimen of the giant ant *Camponotus gigas*, the beautiful hymenopteron *Ampulex compressa*, several species of Rutelidæ, together with two species of the curious crab spiders (*Gasteracantha*), an immature *Tarantula*, and specimens of the rare *Thelyphonus*, a genus allied to the scorpions, and forming a connecting link between the latter and the true spiders.

Mr. West exhibited the following Hemiptera:—*Oncotylus viridiflavus*, found on *Centaurea* at Wisley; *Trichopsylla walkeri*, found on buckthorn at Box Hill; *Serenthia læta*, obtained by sweeping, at Reigate, in August of this year.

Mr. Patteson, of Limpsfield, reported that *Deilephila livornica* was taken in that locality last week. This specimen came to light.

Mr. Robt. Adkin exhibited a series of *Acidalia aversata*, bred from ova deposited by a moth taken in his garden at Lewisham in the summer of 1898. The parent, he said, was a somewhat undersized, dull, obscurely marked example of the non-banded form, and the offspring followed it very closely throughout the whole of the brood, they being all dull in colour, and no banded forms were among them—a fact which he thought interesting, as banded forms are of very frequent occurrence in the garden where the parent was taken. Examples of the usual plain forms from the same locality were shown for comparison.

SEPTEMBER 14th, 1899.

Mr. J. W. TUTT, F.E.S., *Vice-President*, in the Chair.

Mr. Colthrup, of Barry Road, East Dulwich, was elected a member.

Mr. Montgomery exhibited two series of *Spilosoma mendica*. In the first series all the specimens were large, with few spots, and closely resembled the female parent. In the second series black longitudinal lines were well developed in the specimens of both sexes.

Mr. Colthrup exhibited a long series of *Bryophila perla* from Eastbourne, including several very nice yellow varieties; a series of *B. muralis* (*glandifera*) from the same place, including several very pale (naturally) specimens; together with a variety of *Spilosoma menthastri*, with a fringe of black round all the wings. It was taken at rest at East Dulwich in 1899.

Mr. Buckstone exhibited two males in copulation at the same time with one female of the coleopteron, *Telephorus nigricans;* a very blue female of *Polyommatus corydon*, taken some years ago at Riddlesdown; and an example of *Chrysophanus phlæas*, var. *schmidtii*, taken at Beckenham in 1886.

Mr. Edwards exhibited a long bred series of *Bombyx castrensis*, bred from larvæ taken at Rochester, together with preserved larvæ, ova, and pupæ. The males were, as a rule, very pale, some of them being quite without trace of markings on the fore-wings. Those exhibited were selected from some one hundred and eighty specimens which emerged.

Dr. Chapman exhibited a representative collection of the species of Lepidoptera taken in August at Arolo, in Switzerland, a spot some 7000 feet above sea-level. Some of the contrasts were remarkable, such as the truly lowland *Cupido minima* being found with the Alpine *Erebia glacialis*. Among the other species found there were *E. mnestra*, *E. epiphron*, *E. gorge*, *Setina aurita*, and *Catharia pyrenæalis*.

Mr. Robt. Adkin exhibited a long series of an *Acronycta*, taken at "sugar" at Abbott's Wood in June and July last, and bred series of *A. tridens* and *A. psi* for comparison. The captured series showed a good deal of variation both in colour and intensity of markings, some of the individuals being lighter than the lightest of the bred examples (which occurred among the *tridens*), while others were as dark as any. He was unable to say with certainty whether they were all referable to one species, but was of opinion that the majority

of them were *A. psi*, although some few, he thought, were *A. tridens*. Dr. Chapman said that although no special character could be pointed out for differentiating these two species, it was not difficult to separate them by their general facies. Some of the specimens exhibited were undoubted *tridens*, but by far the greater proportion of them were with equal certainty *psi*.

Mr. E. Step exhibited male and female specimens of *Atelecyclus septemdentatus*, Mont., from Portscatho, Cornwall, and said they had been brought up from a depth of twenty fathoms, clinging to the bait on a spiller-line. It is distinctly a deep-water form, and this fact no doubt explains another —that it remained quite unknown to science until the beginning of this century, when the indefatigable Colonel Montagu discovered it on the Devonshire coast. Leach described it soon after as being found in plenty in deep water along the south coast of Devon; but Ed. Parfitt, in 1870, declared it was no longer plentiful there. Couch, in his "Cornish Fauna," says it abounds in between twenty and fifty fathoms of water off the Cornish coast, and that almost every Ray opened for several days in succession had specimens in its stomach, one fish containing as many as thirty of the crabs.

The species is allied to the masked crab (*Corystes cassivelaunus*), Penn, and, like it, bears a more or less striking human countenance engraved upon the carapace, so that in Devonshire it is known as the "old-man's-face crab." Like *Corystes* also, it is fitted for living beneath the sand at the bottom, but apparently not so deeply buried. The hairy antennæ can be brought together to form a tube for the passage of water to the gills, and the very hairy limbs, when drawn up close to the body, protect the opening along the edge of the carapace into the gill-chamber, so that whilst water may pass readily, grains of sand cannot. The eyes are mounted on long stalks, which enable them to see above the surface of the sand, whilst the crab is hidden beneath. *Atelecyclus* is apparently an older form, from which probably *Corystes* has been evolved.

Mr. Tutt exhibited a few bred specimens of *Porthesia chrysorrhœa*, showing traces of the black dot at the anal angle of the fore-wing, which is a characteristic mark of *P. similis* (*auriflua*). One specimen in particular had the spot well developed, and in addition had a few black dots scattered over the fore-wings. He also exhibited a pair of *Lampides* [*Lycæna*] *bœtica*, taken in copulation at Fontainebleau, and referred to the abundance of this species in Europe during the

present season. Numbers of specimens had been taken as near as the Channel Islands, and around Paris it had been abundant.

Mr. Carpenter reported that on August 27th of this year he had seen, and subsequently captured, a newly hatched coot (*Fulica atra*) on the Thames at Marlow.

SEPTEMBER 28th, 1899.

Mr. A. HARRISON, F.L.S., F.E.S., *President*, in the Chair.

Mr. Dennis exhibited photographs of the larvæ of *Mamestra persicariæ* and *Chœrocampa elpenor* to show their resting habit.

Mr. Jäger exhibited some of his more important captures in South Devonshire this year, including series of *Caradrina ambigua* and *Acontia luctuosa;* also specimens of *Lithosia caniola*, *Leucania albipuncta*, and *Synia musculosa*.

Mr. A. Harrison exhibited long and variable series of *Agrotis vestigialis* (*valligera*) and of *A. tritici* from the sand-hills of Wallasey.

Mr. R. Adkin exhibited specimens of the Lepidoptera taken at Wisley on the occasion of the Society's Field Meeting in July.

Mr. Edwards exhibited a pupa of *Deilephila euphorbiæ* and the slight cocoon the larva had made in the small box in which it pupated. The larva was obtained at Macunagna. Dr. Chapman said that he had a number of larvæ of this species which pupated about the first week of September, and, very much to his surprise, an imago emerged about eighteen days after the last larva had gone down. Mr. Tutt said that individual specimens often came out in this way.

Mr. Turner exhibited a bred series of *Cabera pusaria* showing very extreme variation in the position, relative position, intensity, and suppression of the transverse lines. He also showed a very fine variety of the female of *Bombyx quercûs*, v. *callunæ*, in which the area inside the transverse bar was much suffused with the dark male coloration, and the broad marginal area was very pale, and either poorly scaled, or the scales on that area were semi-diaphanous. The series was bred from larvæ taken near Carlisle.

Mr. Manger exhibited a number of crustaceans and small starfish taken on the north coasts of Europe and Asia by some members of the expedition which is annually sent to attempt the navigation of the rivers Obi and Yenesei. He

also showed specimens of moss, a species of cotton-grass, and the lichen *Cladonia pyxidia*.

Mr. Gadge exhibited a specimen of *Bombyx neustria* which had only three wings, the left fore-wing being totally absent.

Mr. Colthrup exhibited a larva of *Odonestis potatoria*, which was only about half-grown. It was taken in May. He also showed a male specimen of *Bombyx quercûs*, v. *callunæ*, in which the transverse line on the fore-wing was remarkably straight.

Mr. Lucas exhibited specimens of the dragon-fly *Sympetrum flaveolum*, and contributed the following note:

"This species has appeared again this season at Ockham Common, in Surrey, in some numbers; but, as last year, no females have been taken or noticed either by myself, who visited the spot on four occasions (three out of which, however, were not favourable days), or by Mr. Turner, who visited it on August 11th. They were found at the two ponds with three other species of the same genus—*S. sanguineum*, *S. scoticum*, and *S. striolatum*. The examples of the species exhibited must be looked upon as part of a migration, but the strange point is that there should have been a migration in two successive years. At St. Osyth, on the coast of Essex, Mr. Harwood caught a female of the same species and sent it to me for inspection. I don't know whether we are to conclude that it breeds there or that some females joined in the migration. I might say that in 1871 (? 1872), when a large swarm visited the London district, females certainly accompanied the males, for we have in one of the magazines a circumstantial account of their method of oviposition, as observed near Croydon. The subject is an interesting one, but we need more reports of captures before we can come to any satisfactory conclusion."

Mr. MacArthur exhibited several specimens of *Dianthœcia carpophaga*, bred from the neighbourhood of Brighton, two or three of which were very beautifully marked with snowy-white patches.

The following report of the Wisley Field Meeting was communicated by Mr. Ashdown:

"The fourth Field Meeting this year of our Society was held on July 15th last, when about a dozen members and friends visited Ockham Common, near Wisley. The route taken was from Effingham Station, past Martyr's Green, and through the lanes as far as the larger pond, known as Boldermere or the Hut pond, returning by a slightly different way which led between the smaller pond and a third pond,

or rather its site, for it has been dry for many years. The locality, being on the Bagshot sand, consists of a heathy tract of country, interspersed with ponds, marshes, and pine woods, characteristic of all this part of Surrey. From notes supplied by several of the members present this report has been drawn up.

"Lepidoptera were by no means common during the earlier hours of the afternoon. An occasional *Pieris napi* flitted along the hedge-banks, two or three *Epinephele ianira* and *E. tithonus* busied themselves by the waysides, and *Hesperia sylvanus* rested on the wild mint and brambles, and was plentiful at the end of the smaller pond. An *Acronycta*, which, in the absence of larval evidence, would perhaps with greater safety be recorded as *A. psi*, was found at rest on a pine trunk, and a few *Scoparia dubitalis* also occurred in similar situations. *Macaria liturata* and *Bupalus piniaria* (both white and yellow males) lingered among the pines, as did *Ematurga atomaria* and *Aspilates strigillaria* among the heather, over which *Lithosia mesomella*, *Leucania impudens*, and *Anarta myrtilli* were taken, as well as *Pseudoterpna pruinata*, *Lomaspilis marginata*, *Nomophila noctuella*, *Pyrausta purpuralis*, and *Acipitlia tetradactyla*. Larvæ of *Euchelia jacobææ*, *Panolis piniperda*, and *Anarta myrtilli* were also met with.

"But with the advent of evening moths became much more plentiful. *Cataclysta lemnata* swarmed over the ponds and their banks with the utmost profusion, accompanied by numbers of *Hydrocampa nymphæata* and *H. stagnata*, and a few *Crambus culmellus*. *Hepialus hectus* pursued its merry dance over the bracken, and numerous Geometers and micros formed an endless procession along the lanes in the twilight, the following species being taken:—*Zanclognatha grisealis*, *Rumia luteolata*, *Pericallia syringaria*, *Phorodesma pustulata*, *Hemithea strigata*, *Acidalia dimidiata*, *A. bisetata* (including a pretty dark-margined specimen), *A. dilutaria*, *A. imitaria*, *A. aversata*, *Cabera pusaria*, *C. exanthemata*, *Larentia didymata* (a rather dark male form), *L. viridaria*, *Eupithecia pulchellata*, *Melanthia albicillata*, *Melanippe sociata*, *Camptogramma bilineata*, *Cidaria dotata*, *Eurrhypara urticata*, *Scopula prunalis*, *Tortrix viridana*, and many others. The most notable capture of the meeting, however, was a specimen of *Camptogramma fluviata* by Major Ficklin.

"Of course dragon-flies were particularly in request, but only eight species were met with—a small number for this usually prolific locality. *Sympetrum scoticum* was just coming out and in the teneral state, with bright yellow markings.

S. striolatum occurred in considerable numbers, but was immature in colour, and many nymph-skins were found; one *Æschna grandis* was taken at rest. Amongst the Agrionidæ *Lestes sponsa* was common, and nymph-skins—recognised by their large lamellæ, each resembling a thin lamina of tortoiseshell—were also secured. In addition to these were found *Erythromma najas*, *Ischnura elegans*, and the two common blue ones, *Agrion puella* and *Enallagma cyathigerum*.

"Of the other orders of insects very few species were obtained, the Coleoptera being *Lucanus cervus*, *Lampyris noctiluca*, *Leptura livida*, *Zeugophora subspinosa*, and *Prasocuris phellandrii*; Orthoptera, *Stenobothrus parallelus* and *Tettix bipunctatus*; Hemiptera, *Heterotoma merioptera*; and a specimen of the dipteron *Volucella pellucens*.

"Shell-collecting received some attention, the best find, perhaps, being about a dozen *Zonites nitidus* along a portion of the margin of one of the ponds. One or two *Cochlicopa lubrica*, a single *Succinea elegans*, and a small *Zonites* (apparently *Z. alliarius*) were taken at the same place. Of the aquatic mollusca, *Planorbis vortex* was common, while *P. corneus*, *P. carinatus*, *P. albus* (one), *Limnæa palustris*, *L. peregra*, and *L. stagnalis* were also found.

"Vegetation was luxuriant round about the ponds, though the heath was not yet well in blossom, and the marsh St. John's-wort, *Hypericum elodes*, was plentiful near the water. A few tufts of wall-rue, *Asplenium ruta-muraria*, were found growing on a sun-dried wall. *Drosera rotundifolia* and *D. intermedia* were observed in some marshy places. During the walk homeward to the station in the cool of the evening the nightjar, *Caprimulgus europæus*, was heard, and the olfactory organs of the party were unpleasantly assailed by the odour of the common stinkhorn fungus, *Phallus impudicus*. A careful search for the fungus was rewarded with success, as it was found in the wood some yards from the road."

OCTOBER 12th, 1899.

Mr. A. HARRISON, F.L.S., F.E.S., *President*, in the Chair.

Mr. F. Bennoch-Carr and Mr. F. M. Bennoch-Carr, of Lee, were elected members.

Mr. Montgomery exhibited long bred series of *Epinephele hyperanthes* and read the following note.

"Ova were deposited by females taken in Abbott's Wood,

on tufts of *Poa annua* in a glass jar, on July 21st. They were semi-transparent, shining white, tapering towards base, closely resembling a pear-shaped "seed pearl." No sculpturing of the shell was apparent under a two-thirds inch objective. Most of the ova seemed to be scattered broadcast; but some few were attached to the grass stems, so lightly as to be easily brushed off. They hatched August 8th.

"The larvæ fed well on tufts of grass in the jars till after the second moult, when they were removed to a large larva cage with living plants. When small they bear a striking resemblance to a grass seed just beginning to germinate; colour, shape, and marking being remarkably exact. This would probably not protect them much from birds, but might deceive parasites. These young larvæ when disturbed fall from the food and remain perfectly rigid for some time. The moults were—first, August 22nd; second, October 9th; third, March 13th; and fourth, April 30th. They pupated June 23rd.

"The pupa was enclosed in a rough cell formed by spinning together a few withered blades at the roots of the grass plants. In not a single case did a larva attempt to attach itself by its tail, as is generally described, and invariably figured. Some thirty per cent. of the pupæ died; but by damping them well overnight, and placing them in the morning sun for a couple of hours, the rest emerged successfully between July 12th and 31st, without a single cripple.

"The imagines display a considerable amount of variation in colour, size, and number of ocelli; and out of seventy-two no less than twenty are asymmetrical."

Mr. R. Adkin exhibited five specimens of *Syrichthus malvæ* taken in the neighbourhood of Abbott's Wood during the last summer. Two of them were referable to var. *taras*, the other three being intermediate between that form and the type.

Mr. Carpenter said that this form was frequently found at Abbott's Wood, and in 1893, the year noted for its fine summer, it was fairly common there. Mr. Adkin said that in the interval between 1893 and the present year the form had failed to appear there.

Mr. A. Russell exhibited cocoons of *Eriogaster lanestris* constructed by larvæ taken at Polegate Junction on May 21st, 1899; some of the cocoons were of a composite nature.

He also showed a bunch of six cocoons of *Saturnia pavonia*

constructed by larvæ taken at Fleet, Hampshire, in August, 1898, and a separate cocoon of *S. pavonia* with contents, viz.: pupa, and pupa and imago of a species of Diptera.

Mr. Carpenter said that the composite character of the *E. lanestris* cocoons was often due to overcrowding.

Dr. Chapman exhibited larvæ of *Leioptilus lienigianus* in the spun-up leaves of wormwood.

Mr. Kaye exhibited bred and captured specimens of *Pseudoterpna pruinata* from Byfleet, obtained during the Society's Field Meeting there.

Dr. Dixon exhibited a large number of the spines and dried specimens of cactus plants mounted and named.

Mr. Hy. J. Turner read a paper on "Cactaceous Plants," illustrating it by a short series of lantern slides; also by a considerable number of dried specimens of Cacti and mounted clusters of spines, kindly lent by Dr. Dixon, of Bermondsey. After describing the general characters of Xerophytic plants, as nearly all Cacti and Succulents are termed, he described the nature of their habitats in the hot, dry regions of Central and South America and Africa, and referred to the areas of distribution of the various groups. He stated the chief botanical families to which these plants belong; and showed how differently constituted groups of plants had responded to their environment, and overcome the absence of water for a lengthened period by various contrivances, both morphological and physiological. The absence of functional leaves, and even branches, necessitated the carrying on of the vital actions by the stem. The absolute necessity for the retention of moisture, and the various methods by which this was attained, were discussed at length. The extremes and variety of spinous development were described, and their effectiveness in preserving these juicy inhabitants of the desert from animal depredators was well shown. A few remarks were made as to the curious and attractive features of many species, and it was stated that they required little care under cultivation, often thriving best when but irregularly attended to, and thus were well suited for the greenhouse of an active entomologist.

OCTOBER 26th, 1899.

Mr. A. HARRISON, F.L.S., *President*, in the Chair.

Mr. Tomlinson, of Kingston-on-Thames, was elected a member.

Mr. Montgomery exhibited a bred specimen of *Bombyx quercús*, in which the right fore-wing was entirely absent.

Mr. Barnett exhibited a bred series of *Cidaria truncata* (*russata*) from ova laid by a female captured on June 10th, at West Wickham. They were all of them remarkably smoky and approaching var. *perfuscata*.

Mr. Merrin communicated a paper entitled "Colour in Nature."

Mr. Claude Morley, F.E.S., communicated a paper entitled "Insects and the Balance of Nature: Elementary Notes on Ichneumons."

NOVEMBER 9th, 1899.

Mr. A. HARRISON, F.L.S., F.E.S., *President*, in the Chair.

A Special Pocket-Box Exhibition was held.

Mr. McArthur exhibited a series of *Triphæna comes*, var. *curtisii*, from the island of Hoy, the most northern locality in the British Isles where it is known to occur; a series of *Epunda lutulenta*, var. *luneburgensis* and var. *sedi*, from the Orkneys; a series of *Agrotis cinerea* from near Brighton, including the darkest female he had ever seen; a very dark variety of *Arctia caia*; and several specimens of *Dianthæcia carpophaga* of the form, with snowy-white ground moderately mottled with ochreous and fuscous markings.

Mr. Robert Adkin exhibited a series of *Boarmia repandata* from the Hebrides, the Isle of Man, various parts of Scotland, England, and Ireland. A wide range of variation was represented.

Major Ficklin exhibited a short series of *Dianthæcia luteago*, var. *ficklini*, one or two specimens showing a tendency to the yellow form, var. *lowei*, of Guernsey.

Mr. Kaye exhibited a long and varied series of numerous species of Sphingidæ taken by himself in Jamaica, Trinidad, and South America, including Macroglossinæ: *Enyo lugubris*; Chœrocampinæ: *Chœrocampa nechus*, *Chœrocampa* (*Deilonche*) *tersa*, *Deilephila lineata*, *Argeus labruscæ*; Ambulicinæ: *Ambulyx strigilis*, *A. rostralis*; Sphinginæ: *Cocytius antæus*, and var. *anteas*, *Amphonyx cluentius*, *Phlegethontius rusticus*, *Protoparce cingulata*, *P. jamaicensis*, *Dilophonota ænotrus*, *D. ello*; together with *Pseudosphinx tetrio*.

Mr. H. Moore exhibited specimens of the tropical American bumble-bee *Eulema dimidiata*, and read the following note on its share in the fertilisation of *Catasetum tridentatum*,

an orchid, which on account of the trimorphic flowers had been placed in three separate genera:

"If one passes under one of these plants when in flower, a swarm of yellow and black bumble-bees are seen hovering in its neighbourhood and flying from flower to flower. Except in this locality not a single bee is to be seen. The *Catasetum* flowers are not generally brilliant or showy, neither have they any strong perfumes, and the plants are frequently hidden in some out of the way corner, but nevertheless the bees do not fail to discover them, for no sooner does the spike of flowers open than they swarm around it. Having succeeded in attracting the bee from a distance in some unaccountable way, a feast is provided in the shape of a little reservoir of nectar, to procure a sip of which the bee has to bring its head in contact with a pair of incurved processes, one of which is very sensitive. Immediately on touching this the cover of the little case containing the pollen masses flies off, and like a skip-jack these spring out, when, by means of a sticky dish with which they are provided, they adhere to the back of the insect and are carried to another flower. Here the pollen masses come in contact with the stigma, and the flower is fertilised."

Mr. Chittenden exhibited a large number of striking varieties and local species of Lepidoptera taken in the neighbourhood of Ashford, Kent, during the last quarter of a century, of which the following were the most noticeable:—*Aglais* (*Vanessa*) *urticæ*, much suffused with black; *Aporia cratægi* taken in 1872; *Enodia* (*Epinephele*) *hyperanthus*, var. *arete*; *Polyommatus* (*Lycæna*) *bellargus* (*adonis*), an unusally blue female; *Callophrys* (*Thecla*) *rubi*, with a naturally brown underside; *Deilephila livornica* (*lineata*) taken in 1872; *Anthrocera* (*Zygæna*) *trifolii*, confluent; *Nola strigula*; *Boarmia roboraria*, a remarkably large specimen; *Ephyra pendularia*, reddish shade; *E. porata*, strongly suffused with red; *Acidalia inornata*, very dark suffusion; *Bupalus piniaria*, both white and yellow forms of the female; *Scoria lineata* (*dealbata*), an under side with the veins lined broadly and darkly with black; *Hybernia marginaria* (*progemmaria*), a dark suffused form; *Eupithecia consignata*; *Leucania albipuncta*; *Caradrina morpheus*, dark suffusion; *Agrotis segetum*, black; *A. exclamationis*, very light; *A. corticea*, blackish form, a red form, and a curious irregularly marked form; *A. cinerea*; *Panolis piniperda*, a green variety; *Xanthia aurago*, yellow, orange, red, and banded forms; *Dianthæcia carpophaga*, white forms; *Cleocera viminalis*, a form having the basal

half dark, in strong contrast to the outer half of the wing; *Phlogophora meticulosa*, the prevailing tint of which was a red suffusion; a series of *Plusia moneta*, bred from larvæ taken at Southborough; and a short series of *Pachetra leucophæa*.

Mr. W. J. Lucas exhibited two scarce species of dragonflies: (1) A male, *Æschna mixta*, taken this September on Esher Common. The colour had kept well. (2) *Somatochlora metallica*, one of a number taken by Mr. C. A. Briggs at Strathglass, Inverness-shire, this summer in July. He also shewed three large species of Carabidæ from Tripoli, received from Rev. A. E. Richards, *Anthia venator*, *A. bimaculatus*, and *Scarites striatus*; these species live in the sandy wastes in the neighbourhood of the coast.

Mr. Colthrup exhibited a very blue female of *Polyommatus* (*Lycæna*) *icarus*, and a bred series of very dark *Melanippe fluctuata*. He also shewed a number of specimens of asbestos in the natural state and as prepared for commerce.

Dr. Chapman exhibited the following species of the genus *Erebia*, taken this summer during some two months spent in Switzerland:—*E. epiphron*, *E. melampus*, *E. mnestra*, *E. pharte*, *E. ceto*, *E. medusa*, var., *E. flavofasciata*, *E. evias*, *E. glacialis*, *E. lappona*, *E. tyndarus*, *E. pronoë*, *E. æthiops*, *E. ligea*, *E. gorge*, and *E. christi*. The most notable species was *E. flavofasciata*, only known for the past six or seven years, and occurring in a very restricted locality in South Switzerland.

Mr. Mitchell exhibited a specimen of *Locusta viridissima* taken in Folkestone Warren, an example of the coleopteron *Prionus coriarius* taken at Richmond, and a bred specimen of *Smerinthus ocellatus* extensively and deeply clouded with smoky black.

Mr. Buckstone exhibited the following species:

Enodia (*Epinephele*) *hyperanthes*, var. *arete*, taken July, 1894, at Boxhill.

Pyrameis atalanta, three bred specimens; one with the left fore-wing smaller than the others. Two with very broad wings, the right fore-wing of one specimen having three holes near the tip, looking as though they had been punched out.

Aglais (*Vanessa*) *urticæ*, three bred specimens; two with the wings on the left side broader than those on the right side, and with the left fore-wing narrower than the right.

Brenthis (*Argynnis*) *selene*, a very dark specimen taken at Headley, Surrey.

Nemeobius lucina, one which emerged from pupa December,

1898; other pupæ did not produce imagines until the following May.

Chrysophanus phlæas, one with the spots on the under surface nearest the outer margin of the fore-wings elongated towards the base of the wings, the left hind wing being almost white; taken at Beckenham, August, 1886.

Polyommatus (*Lycæna*) *corydon*, a male specimen with the border of fore-wings darker and broader than usual; Sevenoaks, August, 1897.

Plebeius (*Lycæna*) *ægon*, a series of specimens taken at Oxshott (gravel soil), and at Sevenoaks (chalk soil), those off the chalk being very much larger than those from off the gravel.

Pamphila sylvanus, a male example with patch of pale yellow on fore-wings between costa and oblique mark; taken at Purley, July, 1896. A female smaller and darker than the type from Dorking, 1898.

Anthrocera (*Zygæna*) *filipendulæ*, a bred female specimen with a patch of yellow at the base of the left hind wing, and a male with spots and hind wings pale pink.

Arctia caia, bred specimens: (1) large female with lemon-coloured hind wings; (2) a very small female with hardly any cream-colour on the fore-wings, being one of fifteen similar ones bred from larvæ fed on black currant leaves.

Mr. Harrison exhibited varied series of the following species:—*Aporia cratægi*, *Pieris napi*, var. *bryoniæ*, *Euchloë cardamines*, and *Leucophasia sinapis*, all from Meiringen, Switzerland.

Mr. F. M. B. Carr exhibited short series of *Agrophila trabealis* (*sulphuralis*) from Tuddenham; *Erastria fasciana* (*fuscula*) and *Bankia argentula* from Chippenham; *Hydrelia uncula* and *Earias chlorana* from Wicken; *Acontia luctuosa* from Shoreham, Kent; *Nola strigula* from Ranmore; *N. cucullatella* and *Coremia quadrifasciaria* from Lee.

NOVEMBER 23rd, 1899.

Mr. A. HARRISON, F.L.S., F.E.S., *President*, in the Chair.

Mr. Sich exhibited four specimens of *Aglossa cuprealis*, taken in Chiswick, 1898 and 1899, showing variation in size; and an admirable sketch of the larva of *Deilephila galii*, taken on fuchsia in Chiswick, October 14th, 1892.

Mr. F. M. B. Carr exhibited a specimen of *Sirex gigas* taken at Boldrewood in the New Forest, in 1898, flying

around pine trees; he mentioned that others had been seen in 1897. He also exhibited a number of species of Lepidoptera captured at sugar during the present season, and said he had found it very attractive at Wicken in June, when even northerly winds and occasional moonlight made little difference in the number of revellers. A thick fog on one evening, however, was very deterrent. In August sugar again was attractive at Hailsham, sixty species being noticed during a week, including a number of Geometrids and two Lithosids.

Mr. R. Adkin exhibited on behalf of Mr. Newman some interesting varieties of Lepidoptera, of which the following were the most notable:

Argynnis paphia, a specimen much suffused with black; taken at Brockenhurst on July 17th, 1898.

Smerinthus tiliæ, a series selected from a large number bred during the past summer from parents taken at Bexley, Kent, in the previous year. In some of the specimens the central band was reduced to a triangular blotch, and the ground-colour of the wings of some was very pale.

Smerinthus populi, a series similarly reared, which included pinkish and unusually dark forms.

Saturnia pavonia, a subdiaphanous specimen bred June 16th, 1899, from a larva taken on the Cotswold Hills in August, 1896, the pupal stage having thus extended to the third year.

A series of cross-bred *Pygæra*, the result of a pairing between *P. curtula* and *P. pigra* (*reclusa*). About half of the whole brood which emerged consisted of 120 individuals, 117 of them being females, and only three males; the remainder of the pupæ were laying over. The first imago emerged on August 20th, the time from the hatching of the egg being thirty-two days.

The exhibit also included sundry more or less aberrant forms of *Arctia caia*, *Odonestis potatoria*, *Lasiocampa quercûs*, and *Hepialus lupulinus*, taken in or bred from the neighbourhood of Dartford during the last four years.

Mr. Adkin read a paper entitled "More Lazy Days by the Sea" (page 44).

In the discussion which ensued, Mr. Harrison said that he had observed both *P. cardui* and *P. atalanta* in Delamere Forest, the latter being very plentiful. *A. urticæ* was very scarce. Mr. Sich had seen *H. semele* and various dragonflies on the fence mentioned by Mr. Adkin, and thought that they were there for warmth. Mr. Carpenter said that he had

examined numerous specimens of *P. cardui* in the spring, and they were invariably females in which the ova were undeveloped; and he suggested they were infertile, and that had they been paired they would not have immigrated to this country. Dr. Chapman called special attention to the immigration of *P. rapæ*, which phenomenon he said it was rarely the good fortune of an entomologist to observe. Mr. Buckstone had taken *P. cardui* at Sevenoaks in the spring, and all, some eight specimens, were females.

DECEMBER 14th, 1899.

Dr. CHAPMAN, F.L.S., *Vice-President*, in the Chair.

Mr. Robson exhibited a bred series of *Dianthæcia irregularis* from Tuddenham, all the specimens being unusually large.

Major Ficklin exhibited a specimen of *D. luteago*, var. *ficklini*, which he stated he would be pleased to place in the Society's cabinet.

Mr. Lucas exhibited a specimen of *Somatochlora metallica* and contributed the following note:

"As many of you know, Mr. C. A. Briggs, accompanied by Mr. King, of Glasgow, passed a fortnight last July in the North of Inverness, in search of some of the northern dragonflies, including *Somatochlora metallica*, which as far as is known occurs in the British Isles in one district only in that county. They were successful in their search, and Mr. Briggs has sent me a well-set specimen of *metallica*, in good condition, for the Society's cabinet. I might add that apart from its beauty, its scarcity and the difficulty attending its capture give it considerable interest and value."

Mr. Robert Adkin exhibited examples of a *Crambus* taken in his garden at Lewisham, between August 16th and 28th last. He said that he now had no hesitation in referring them to *Crambus geniculeus*, but that the appearance of the specimens was so much less robust than, and the markings so faintly indicated when compared with, South Coast examples of that species, that he at first had some hesitation in assigning a name to them.

Mr. Edwards exhibited long series of most of the following species of *Erebia*, taken by himself in July, 1899, in the neighbourhood of Fusio, the Simplon and Macunagno:

E. ceto, *E. lappona*, *E. goante*, *E. tyndarus*, *E. euryale*,

E. flavofasciata, *E. melampus*, *E. epiphron*, *E. mnestra*, *E. pronoë*, *E. medusa*, *E. ligea*, and a specimen of *E. gorge*.

Mr. F. M. Bennock-Carr exhibited a considerable number of insects taken at sugar, including *Cossus ligniperda* and about a dozen *Macrogaster castaneæ* (*arundinis*) taken at light in Wicken Fen.

Mr. Carrington gave an address on the subject "Meteorites."

JANUARY 11th, 1900.

Mr. A. HARRISON, F.L.S., *President*, in the Chair.

Mr. Buckstone exhibited larvæ of *Triphæna fimbria*, and contributed the following note:

"I received forty-five of this larva on December 4th, and placed them in a warm cupboard admitting no light, giving them cabbage to feed on; they were about to moult for the second time, and there was no apparent difference in colour, all being of the light form. On December 6th all the larvæ had commenced feeding again. Thirty-one were of the light form, fourteen of the dark form. Twenty of the light form have burrowed for pupation, only one of the dark. Not one of the light form has died, while eleven of the dark have.

"I should state that the larvæ were kindly given to me by Mr. Lawrence, of Anerley, who captured a female at electric light at South Norwood, in September last, from which he obtained over four hundred eggs, every one fertile."

Mr. Turner exhibited (1) A specimen of *Periplaneta americana*, found while visiting the Zoological Gardens. (2) An example of *Melanippe fluctuata* having the usually light ground somewhat darkened and the usually dark markings very much contracted in area, the central band being represented by only a narrow costal fascia. The specimen was captured on lily flowers in 1899. (3) A bred specimen of *Abraxas grossulariata* having a large amount of black on the fore-wing enclosing a white ring with a fair-sized black spot in the middle.

Mr. Lucas exhibited lantern slides of well-known scenery in several entomological localities.

Mr. F. Noad Clark exhibited a large number of photo-micrographic slides by means of the Society's lantern. The subjects were as follows:

Details of *Orgyia antiqua*, (1) Male and female examples

of the moth. (2) Females and group of ova. (3) Group of ova magnified. (4) Ova under microscope greatly enlarged. (5) Young larva just emerged; the hatching continues about five weeks. (6) Female larva, adult, 1¼ inches long on leaf; yellow tufts first acquired, these are white directly after first moult. (7) Male and female larvæ, adult, on leaf. (8) Cocoons. (9) Pupæ, male and female; the imago appears about fortnight after pupation. (10) Antenna of male; (11) Antenna of female; at same magnification. (12) Hairs of larvæ. (13) Proleg of larvæ. (14) Immature wings of female, all four seen to be present.

Antennæ of various insects.

Tongues of four species of butterflies. Ova of Lepidoptera.

Among the many other interesting objects were certain Desmids, etc.

JANUARY 25th, 1900.

ANNUAL GENERAL MEETING.

Mr. A. HARRISON, F.L.S., F.E.S., *President*, in the Chair.

The Report of the Council and Officers was read, and the Balance-sheet was received and adopted. The following Officers and Council for the ensuing year were elected:

President.—Mr. W. J. Lucas, B.A., F.E.S.

Vice-Presidents.—H. S. Fremlin, M.R.C.S., L.R.C.P., F.E.S., and Mr. A. Harrison, F.C.S., F.L.S., F.E.S.

Treasurer.—Mr. T. W. Hall, F.E.S.

Librarian.—Mr. H. A. Sauzé.

Curator.—Mr. W. West.

Hon. Secretaries.—Mr. Stanley Edwards, F.L.S., etc. (*Corresponding*), and Mr. H. J. Turner, F.E.S. (*Report*).

Council.—Messrs. R. Adkin, F.E.S., F. Noad Clark, W. J. Ashdown, Dr. T. A. Chapman, M.D., F.E.S., H. Moore, A. M. Montgomery, J. W. Tutt, F.E.S.

The President read an Address, and votes of thanks were passed to the retiring Officers and Council.

Mr. Blenkarn, of East Dulwich, and Mr. T. H. Day, of Carlisle, were elected members.

Mr. Brooks, of Rotherham, exhibited several bred specimens of *Acherontia atropos*, including a somewhat small but very pale variety, together with very fine varieties of *Arctia* (*Spilosoma*) *lubricipeda*, *A.* (*S.*) *menthastri*, and *Triphæna fimbria*.

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Printed by E. KNIGHT, 22½ Bartholomew Close, E.C.