FOURTH SERIES, VOL. VII.
PART I.

PRICE FOUR SHILLINGS.

1928.

ANNUAL REPORT

AND

PROCEEDINGS

OF THE

Bristol Naturalists' Society

"Rerum cognoscere causas."—Virgil.

ARBROATH: PRINTED FOR THE SOCIETY.

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TABLE OF CONTENTS.

FOURTH SERIES, VOL. VII., PART I., 1928.

For information concerning the Bristol Naturalists' Society generally, or concerning its meetings, please apply to the present Hon. Secretary and Editor:

MISS IDA M. ROPER,
4 WOODFIELD ROAD,
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Prof. Sydney Young, D.Sc., F.R.S., Trinity College, Dublin.

REPORT OF COUNCIL

TO DECEMBER 31st, 1928.

THE various activities of the Society have been well maintained, but the attendance at the General Meetings during the winter months has not been so large as usual, and they do not receive proper support, notwithstanding that the papers given are by leading authorities and on interesting subjects.

Some of the members of the Sections have availed themselves of the advantage granted to attend meetings, but most of them have limited their choice to lectures by distinguished visitors and to the Exhibition night.

Encouragement to our efforts is, however, given by the excellent work being carried out by the five Sections, and from their Reports it will be seen how varied are the studies of the members, and the satisfaction they obtain from the monthly meetings.

Entomology stands out with marked prominence on account of the splendid successes achieved by three of its workers. Mr H. Womersley, our ex-President, has continued his research on the various groups of the Apterygota, and he has been able to describe and name in technical Journals of this country and abroad new species of Protura, Thysanura, and Collembola. He is now recognised in all parts of the world as a reliable authority on these minute and difficult insects. The Diptera have not been neglected by him, and discoveries new to Britain with many records for the West of England have been established.

Mr H. Audcent has worked independently on the same group with its complicated classification, and has added much to the knowledge of the Flies, with equally successful results. Mr J. V. Pearman is the other worker who has taken an authoritative position in the investigation of the life histories and morphology of Psocids, a group of little known insects. He has produced positive evidence of the controversial mechanism that causes the well known sound of the " Death Watch," or psocid book-louse (*Clothilla pulsatoria* L.). Much of his researches has been gladly accepted for publication by the " Entomological Monthly Magazine," and members of our Society will recall his less technical descriptions in our " Proceedings." The Bristol Naturalists' Society may well feel proud of the distinguished position held in Entomology by three of its members.

Geology has not been behindhand in distinction, as Prof. S. H. Reynolds, the President of the Section, has received the high honour of the Lyell Medal from the Geological Society of London, for which all members will join in offering him cordial congratulations.

There have been two Open Meetings this year through changed arrangements, to which the public were invited, and appreciation was shown by the good attendances to hear leading Professors of Oxford and London tell of their research in Astronomy and one branch of Entomology.

The Exhibition night was acknowledged on all hands to be full of interest to Naturalists, and the Summer Excursion carried out by the Field Section to Iford Manor Gardens, Wilts, helped to maintain friendly intercourse amongst the numerous members who supported the visit.

The inaugural Dinner, promoted for a similar purpose, was a decided success, and it is hoped equal support will be forthcoming for what is intended to be an annual gathering of members.

The Society played the part of host to the South Western Naturalists' Union when it held its annual Congress in Bristol at Whitsuntide. A Reception was given to the visitors, and a programme of excursions to spots suitable for Naturalists was carried out and the excellent arrangements led to an enjoyable and stimulating meeting.

As in previous years the Society has been honoured by receiving invitations to send a delegate to take part in the special celebrations of other kindred Societies. In April the Hon. Secretary was present in Oxford at the Spring Conference of the Geographical Association, and in June Mr J. V. Pearman took part in the Centenary celebrations by the Ashmolean Natural History Society, also held in Oxford. They report on the cordiality shown to them and of the pleasant intercourse with the other distinguished visitors.

We have to record with regret the loss by death of two of our members. Sir George Wills, Bart., had long given us support by his membership and Mrs T. Charbonnier was a regular attendant at all the meetings and willing to help forward any undertaking.

The membership of the Society has only increased by the addition of five ordinary members and three young Associates, but the Sections have gathered in numerous recruits to carry on the study of Natural History.

Mr R. P. Gait has resigned the treasurership through pressure of work in other directions, and the office has been filled by the appointment of Mr M. Miller, whose experience and interest in the welfare of the Society should prove advantageous.

IDA M. ROPER, *Hon. Secretary.*

The Hon. Treasurer in Account with The Bristol Naturalists' Society.

Dr. GENERAL ACCOUNT FOR THE YEAR 1928. *Cr.*

	£	s.	d.		£	s.	d.
To Members' Subscriptions :—				By Subscriptions to Societies :—			
Ordinary	38	0	0	Ray	1	1	0
Associate,	1	10	0	S.W. Naturalists' Union	2	11	0
Under Laws	8	16	0	Zoological Record	2	10	0
,, Entrance Fees	0	10	0	Entomological Magazine	0	15	0
,, Field Section Capitation Fee	4	10	0	,, Cost of *Proceedings*, 1927	51	10	0
,, Donations to Publishing Fund	5	0	0	,, Printing, Postage, etc.	9	6	4
,, Sale of Publications	5	15	9	,, Lecture Expenses	4	3	0
,, Sale of Dinner Tickets	17	11	0	,, Rent and Fire Insurance	1	11	0
,, Interest on Deposit	1	11	10	,, Dinner Expenses	18	18	0
,, Balance forward :—				,, Bookbinding	2	18	6
General Account	71	19	0	,, Cash in hand :—			
Bookbinding Fund	12	4	6	General Account	62	18	3
				Bookbinding	9	6	0
	£167	8	1		£167	8	1

December 31st, 1928.

Audited and found correct.

ERNEST H. COOK.
CHARLES BARTLETT, A.C.A. } *Auditors.*

LIBRARIANS' REPORT

FOR THE YEAR 1928.

THE Library has had an uneventful year and it is much desired that more encouragement could be given to this portion of the Society's advantages by members consulting or taking home for further study more of the valuable books at their disposal; even although the conditions for reading within the room are not yet so suitable as anticipated.

Through the generosity of our late President, Prof. O. V. Darbishire, as an encouragement to others, a handsome cabinet with an inscription for a card catalogue of 18,000 entries has been presented and is set up in the Library. The cards, already prepared by members in anticipation of such a gift, are now in the drawers and have nearly filled them. The arrangement is under authors' names as is customary, and the different branches of Natural History are kept separate to make reference easy for the Sectional members.

This card catalogue is additional to the bound Catalogue placed on the table of the contents of the Library, and the main purpose of its preparation is to furnish information of papers by many authors, that hitherto have only been available by searching the long series of publications issued annually by the numerous Societies with which we exchange. Such papers and monographs are of great scientific value, and most helpful to enquirers, and it is hoped good use will be made of the new facilities provided by the labours of a few enthusiastic members.

A limited number of books have been presented during the year, an important one being "British Mammals," by Barrett-Hamilton. Miss Rudge gave a number of parts from her late father's library, and Mr H. J. Charbonnier has supplemented them with the remaining ones, bound together in three volumes.

The Wisconsin Academy of Sciences and the University of Latvia at Riga have applied to us during the year to ask for our "Proceedings," for which they will exchange their Natural History publications. The suggestion was cordially agreed to for future issues, and we have already received their current publications.

The Sections of Entomology, Geology and Ornithology still maintain the acceptable practice of presenting the monthly publications, to carry on our series, including the last issue of the Palaeontographical Society.

IDA M. ROPER, *Hon. Librarian.*
T. CHARBONNIER, *Hon. Sub-Librarian.*

RECENT ADDITIONS.

Balfour-Browne, "Insects," 1927, presented by Mr H. Womersley.
Carpenter, "Insect Transformation," 1921, presented by Mr Ivor W. Evans.
"Darwin's Life and Letters," 3 vols., 1888, presented by Mr H. S. Thompson.
Gunther, "Further Correspondence of John Ray," 1928.
Hogarth, "British Mosquitoes," presented by Mr C. Bartlett.
Soar and Williamson, "British Hydracarina," vol. II., 1927.
Stephenson, "British Sea Anemones," 1928.

EXCHANGE LIST.

Ashmolean Natural History Society of Oxfordshire.
Belfast Naturalists' Field Club.
Birmingham Natural History and Philosophical Society.
Bristol Museum and Art Gallery.
——— University Speleological Society.
British Association.
———Museum (Natural History), S.W.7.
Cardiff Naturalists' Society.
Chester Natural Science Society.
Clifton College Scientific Society.
Cornwall, Royal Geological Society of
——— Royal Polytechnic Society of
Cotteswold Naturalists' Field Club.
Croydon Natural History and Scientific Society.
Ealing Scientific and Microscopical Society.
Edinburgh Royal Botanic Society.
Essex Field Club.
Geological Society of London.
Geologists' Association.
Glasgow, Geological Society of
——— Natural History Society of
——— Royal Philosophical Society of
Hertfordshire Natural History Society and Field Club.
Isle of Wight Natural History Society.
Linnean Society of London.
Liverpool Geological Society.
——— Literary and Philosophical Society.
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——— Institution, and Devon and Cornwall Naturalist History Society.
Quekett Microscopical Club.
Royal Irish Academy.
Royal Microscopical Society.
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INDIA.

Agriculture, Imperial Department of, Pusa.
Geological Survey of India, Calcutta.

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Lyons, Société Linnéenne de
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LATVIA.

Riga, Zoological Institute of Latvian University.

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UNITED STATES.

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California, University of, Berkeley.
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San Diego Society of Natural History.
Smithsonian Institution, Washington.
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BOTANICAL SECTION.

1928.

THE Section has completed its third and most successful year since its re-formation. The number of members shows an increase from 18 to 25, with an average attendance of 10 at each monthly meeting. The Section has adhered to its original plan of holding twelve meetings in the year, not omitting the holiday months.

We record with regret that the President, Prof. O. V. Darbishire, has been unable through ill-health to give his usual support. Early in the year Miss I. M. Roper was elected acting chairman.

The meetings have been almost entirely concerned with members' exhibits, *i.e.*, systematic botany and plant collecting. While in no way decrying the value of much of this work, which inevitably holds a prominent place in all botanical study, we would wish to see a development of other aspects of the science, ecological, physiological, etc.

Three field meetings were held during the summer. This was an innovation for the Section, and the districts covered were Leigh Woods, left bank of Avon, and Pensford. In themselves the meetings were a success, but the support was poor, and justified the Section in its original intention of holding only indoor meetings.

At the Annual Meeting in December, the President and acting chairman were re-elected, and Mr F. F. Glasspool elected Hon. Secretary and Treasurer for the coming session.

MABEL BOWEN, *Hon. Secretary and Treasurer.*

ORNITHOLOGICAL SECTION.

1928.

THE Membership of this Section now stands at 23, and during the past year 7 meetings have been held, at which the average attendance has been about 12.

At these meetings, which have taken place as usual at the private houses of members, to whom the Section is indebted for their hospitality, the subjects taken have included a discussion on Mr E. M. Nicholson's book, "Birds in England;" an account of the observations of members during the year; an evening when various books on British Birds were shown; and at the December meeting an instructive and well illustrated paper, on "South Atlantic Birds," by Mr L. H. Matthews, one of the naturalists working with the present "Discovery" expedition, which is investigating the habits of whales and other animals in the South Atlantic Ocean.

Exhibits at these meetings have included many good photographs of birds and of bird skins, etc.

It was decided members should do what they could to support the Heronry enquiry instituted by the editors of "British Birds," and a separate account of the efforts will be found elsewhere.

During the year a total of 23 birds, including Herons have been ringed by members.

H. TETLEY, *Hon. Secretary and Treasurer.*

ENTOMOLOGICAL SECTION.

1928.

THE Section has had a most successful year. There has been a slight increase in membership which, after deducting withdrawals, now stands at 20 ordinary and 3 honorary members. Financially, a grant from Council towards the cost of subscription to entomological journals has helped to convert a debit into a satisfactory credit balance.

There have been no sectionally organised field excursions. However, small parties of members with common interests arranged expeditions for definite collecting purposes, with very satisfactory results.

In September, by invitation, members visited the University Research Station at Long Ashton where the work of the Station Entomologists was demonstrated and a large number of specially set-out exhibits in economic entomology explained.

For the purpose of sustaining interest in general entomology the insect Orders are being considered seriatim, with special reference to the British species. Members specialising in particular groups exhibit representative specimens and describe the special characteristics and biology of their insects. So far, the Hemiptera, Diptera, and certain portions of the Lepidoptera have been thus treated. When dealing with the Hemiptera, the economic bearing of the Homopterous families was surveyed and illustrated by Mr H. Tetley, B.Sc. For the Diptera a special meeting was held, by kind invitation, at the house of Mr H. Audcent, where that gentleman's extensive collection was inspected. The Lepidoptera were introduced by Mr A. Kromler who showed a representative series of British Butterflies; Mr J. W. Norgrove followed with a comprehensive synopsis of Geometrid Moths.

At the October meeting an entertaining and instructive account of experiences in collecting Lepidoptera at night in August at Paignton was given by Mr A. H. Peach, who exhibited several of his more notable captures.

Apart from those connected with the main subjects of discussion, exhibits have been brought forward by nearly all members. Among them, the following may be mentioned as of special interest :—

LEPIDOPTERA.—*Sesia andreniformis*, Portishead, Som. (a county record: bred), Mr C. Bartlett. *Lobophora halterata*, a series showing a wide range of variation collected in a very restricted area at Fishponds, Dr E. Barton White. An extensive collection of Brazilian Lepidoptera, Mr L. H. Matthews, M.A. Immigrant species have been plentiful during the year; of these *Colias edusa*, var. *helice*, has been shown by Messrs C. Bartlett and W. Taunton, *Caradrina exigua* and *Leucania vitellina* by Messrs Kromler and Peach. Many specimens of uncommon British species have been shown by Messrs Kromler, Norgrove and Peach.

DIPTERA.—*Phalocrocera replicata* and *Stenocera pectinicornis*, imagines and larvae (reared), Mr H. Womersley.

COLEOPTERA.—*Anobium* sp. attacking woodwork in a local church, Mr C. Bartlett. *Platyrhinus latirostris*, Cadbury Camp, Mr R. Beck.

APTERYGOTA.—*Entomobrya nigrina* n. sp., Lundy Island; *Bakerella andersoni* n.g. n.sp., New Hebrides; *Eosentomon germanicum* (Protura), Germany, Mr H. Womersley.

PSOCOPTERA.—Eggs and Egg-breakers of several British species; *Nanopsocus oceanicus* n.g. n.sp., New Hebrides, Mr J. V. Pearman.

MISCELLANEOUS.—Wasps' nest made from grass; unpublished drawings by the late Mr R. Beck (1865) of sensory hairs of spiders, Mr R. Beck. "Quarryman's Butterfly," a fossil brachiopod, *Spirifer* sp., Mr J. W. Tutcher, M.Sc.

A start has been made with the local Insect Fauna Records. Mr Kromler has contributed several long lists of Lepidoptera, and Miss Roper complete lists of the known Dipterous gall-makers of Somerset and Gloucestershire.

J. V. PEARMAN, *Hon. Secretary and Treasurer.*

FIELD SECTION.

1928.

STEADY progress has been made and the affiliation, completed at the beginning of 1927, has been consolidated by organisation and all the details are now working smoothly. The interest of members in natural history has been well maintained and the blending of specialists with those having more general interests has been for the good of all.

An average attendance of 24 at the general excursions may be regarded as satisfactory in view of the numerous additional arrangements.

In May Mr G. H. Beacham led a party from Pensford station through Hunstrete Woods. The spring life of both birds and plants was abundant, and the types of scenery associated with coal measures, Triassic and Liassic rocks was well exemplified.

In June the Field Section organised an excursion for the whole Society to Freshford and Iford Manor. Mr H. Vicars Webb made the arrangements, and the outward route via the magnificent Limpley Stoke valley was appreciated; and the Iford Gardens with their trees and flowers mingled with statuary figures and ornaments from continental countries were much admired.

The Mendip Hills between Winscombe and Axbridge were visited in July under the leadership of Dr. F. S. Wallis. He visualised the appearance of Mendip throughout the aeons since the birth of our planet. Bird life was quiet and the botanists did not make numerous finds.

The final excursion was held in September to Blaise Castle woods with Mr H. Womersley as leader. Mycetozoa interested the workers, and the peculiar course of the Trym streams was observed from several points.

Once again Mr H. C. Sutton made himself responsible for the botanical rambles and four were arranged for the summer. The first took place in April to Pensford and Stanton Drew, followed by others in June to Westbury and Brentry; in August to Long Ashton and Dundry; and in September to Frenchay and Moorend. Although the plants met with were mainly of the commoner species the outings proved quite enjoyable. It is to be regretted, however, that the attendance at these excursions was not so large as might have been reasonably expected.

Mr H. Vicars Webb conducted his usual excursions to observe the bird life round Bristol. The districts chosen were Stapleton, Brockley Combe, Abbots Leigh, where the party by kind permission went round the charming garden of Campfield, the residence of Mr and Mrs E. J. Taylor, and Blaise Castle Woods. The excursion to Flax Bourton was abandoned owing to heavy rain. Bird life was active and interesting, and good observations were made of migrants and resident birds.

In addition members attended the excursions organised by the Botanical and Geological Sections. During the winter months members have taken full advantage of their privileges in being able to attend the meetings of the parent Society—this was particularly noticeable at the open meetings and the exhibition evening. The membership of the Section now stands at 90, and the finance is satisfactory.

M. DORIS HILEY, *Hon. Secretary.*

GEOLOGICAL SECTION.

1928.

THE chief item of interest in the activities during the past year has been the undoubted success of the informal discussion class which now regularly precedes the usual monthly meetings. This venture, started in 1927, now definitely ranks as an important feature of this Section. Our Vice-President, Mr J. W. Tutcher, has been the enthusiastic leader of this class and its success is mainly due to his quiet methods. Others have recently helped in this, but it is well to emphasise that the success, or otherwise, of such a gathering depends in a great measure on the members themselves.

The exhibition meeting was held in January, and as in previous years it formed an opportunity for social intercourse amongst the members.

Mr O. D. Kendall, B.A., gave a lecture on "Maps and Map Making." He divided surveys into two branches—Geodetic and Topographical. The former gave control and provided a kind of framework into which it was possible to fit the detailed work of the latter.

On another occasion, Mr W. Hugh Davies, B.Sc., introduced the question of the Iron industry of the Lake Superior Region. Mr Davies was a member of the Canadian Geological Survey when the mapping of these iron ores was in progress and he was able to add many personal experiences to the geological side of the story.

The April meeting was devoted to short papers by members and this proved an unqualified success. Mrs E. Vaughan spoke on Domestic Geology and showed how the science invades our everyday life and especially that of the housewife. Mr J. W. Tutcher followed with a talk on Water Divining, and maintained that most geologists were sceptical as regards the power of the hazel rod. The whole question needs extensive research. Both papers were followed by animated discussions.

Mr A. W. Coysh, M.Sc., gave an account of his researches amongst the Rhaetic and Lower Lias rocks of West Somerset. This is a little known area to Bristol geologists and his clear visualisation of the conditions of deposition was much appreciated.

Finally, Prof. S. H. Reynolds gave an interesting account of his recent visit to the Isle of Eigg. The geological narrative was interspersed with numerous personal recollections and the rival theories regarding the formation of the igneous rocks were fully explained.

The average attendance at the monthly meetings is 25, whilst there are generally at least 10 members at the informal class.

Three excursions were held during the summer months. Mr B. A. Baker led a party to Yate to visit the Celestite deposits; Messrs H. F. Barke and J. W. Tutcher to Filton to examine the Lower Lias, whilst Mr and Mrs H. F. Barke were responsible for the organisation of an excursion to Brean.

The membership at the close of the year stands at 48 and there is a good balance in hand.

Finally, it must be urged that there is need for increased vigilance on the part of individual members concerning the numerous temporary exposures still being made in Bristol, and all should feel that they have a responsibility in this recording work.

F. S. WALLIS, *Hon. Secretary and Treasurer.*

Account of the Annual and General Meetings.

THE 65th ANNUAL MEETING.

January 19th, 1928.

Mr James Rafter, M.A., was elected President for the second time. He delivered his first presidential address, entitled "Totemism." (See Vol. VI., p. 357.)

Dr. F. S. Wallis, F.G.S., was elected a Vice-President, and Dr. W. A. Smith and Mr G. E. J. McMurtrie members of Council.

THE 534th GENERAL MEETING.

February 2nd, 1928.

"Colour in Nature," by Mr G. A. Phillips, M.A.

The lecturer began by giving a brief account of the general science of colour, beginning with the work of Newton in decomposing white light into its constituent colours. He then showed that the colour of bodies depends both on the quality of the illumination, and the selective absorption of the surface. These principles were then applied to outdoor phenomena.

The varying quality of sunlight, and the resulting variety in the appearance of a landscape, were discussed, and the lecturer then proceeded to give an account of the work that has been done, chiefly by Lord Rayleigh and his father, to establish the modern theory that the blueness of the sky is attributable to diffraction of the light of shorter wavelength by the molecules of air. Some explanation was also given of sunset effects and the colours produced by thin films, and reference was made to certain experiments to test the psychological effects of colour.

THE 1st ANNUAL DINNER.

February 10th, 1928.

The President, Mr James Rafter, M.A., presided over a company of upwards of 70, almost wholly confined to members of the Society, the result being a very successful and not too formal function.

After the loyal toast, Dr. A. L. Flemming proposed "The Society," and as this was the first occasion a dinner had been held, he congratulated the organisers on the efforts to bring about intimate association amongst the members of the different Sections. He compared the working within the Society to a beehive, whose inmates went into the field and brought back valuable gatherings, the honey from which was sampled by members at their monthly meetings. He was much struck by the long list of illustrious workers who had assisted the Society in the past and not less in the present.

The President, in acknowledgment, briefly sketched some of the activities of the Society since its foundation in 1862, and emphasised why people should be proud to belong to it. The Library alone, housed at the Bristol Museum, was an attraction for all seeking knowledge and recreation in Natural History.

An excellent musical programme was contributed by Mrs James Rafter, Mrs H. W. Turner, Dr. Stanley Smith, and Mr Charles Bartlett.

THE 535TH GENERAL MEETING.

March 8th, 1928.

"Our British Total Eclipse of 1927," by Prof. H. H. Turner, F.R.S.

(*University Observatory, Oxford.*)

In considering the circumstances of an eclipse it is important to visualise the exact dimensions of the sun and moon, and their distances. The shadow cone is a fine point, which makes a track on the earth's surface, often very narrow: such tracks repeat after 54 years nearly in the same place, so that by a long series of observations the return of eclipses can be predicted, and this was known to the Chaldeans, and through them to the Greeks: but the return is not even yet known with precision owing to our imperfect knowledge of the moon's motions: the accuracy is of course always being improved, and considerable advances have been made recently. But a total eclipse of the sun affords an opportunity of a quite different kind for seeing faint objects in the neighbourhood of the sun, especially the outlying parts of the sun himself: the nature of the corona is still mysterious, for although more than a dozen lines have been identified in its spectrum, they do not correspond to any lines we can observe in our laboratories. Besides the corona we can observe stars near the sun for the displacement suggested by Einstein, or look for small planets, none of which, however, have been found.

THE 536TH GENERAL MEETING.

April 12th, 1928.

I.—"Lives of the Psocids," by Mr J. V. Pearman, F.E.S.

These small insects feed on algae (especially Pleurococcus) and microfungi growing on the trunks, branches and leaves of trees. One or two species live in houses feeding on fungal and farinaceous matter.

Nearly all species are capable of spinning threads like those of the silkworm.

From eggs laid more or less aggregated hatch tiny creatures resembling the common "dust louse" often seen running over dusty furniture in summer.

In their ways of life two distinct groups may be remarked, (a) foliage frequenting or (b) bark inhabiting. The foliage frequenters, running over the comparatively smooth surface presented by leaves, have simple curved claws with a sucker-like tube between them by which they are assisted to maintain their foothold; the bark dwellers have toothed claws with a bristle appendage.

Prior to mating the males perform a comical and energetic whirling dance. Although many psocids live more or less gregariously they find it necessary, especially at mating time, to call one another. The female of the common " dust louse " is responsible for the ticking sound, known for centuries as the " death watch," which is made by striking rapidly a hardened knob near the end of the abdomen against the surface on which the creature is standing.

Examples of the insects and their eggs were exhibited.

II.—" Problems in Plant Distribution," by H. S. Thompson.

Tribute was first paid to the life work of H. C. Watson who, about 1830, turned his attention to the geographical distribution of flowering plants in Britain. Most of the earlier published " Floras " were little more than catalogues of plant names and localities, but modern ones, such as White's " Flora of Bristol," 1912, abound in useful notes.

After touching on some of the possible factors which have caused the present vegetation in Great Britain and Ireland, the extreme paucity of endemic plants, or those peculiar to these islands, was referred to, also the curious fact that we have in the Bristol district ten or eleven species found nowhere else in Britain. Mr Thompson urged that investigation should be carried on and observations kept on certain areas, such as the old mining ground of Mendip and also the north coast of Somerset, and the habitats of plants systematically recorded and mapped; in that way new plants might be discovered.

THE SUMMER EXCURSION.

June 23rd, 1928.

This was made in co-operation with the Field Section to Iford Manor Gardens, Wilts., when about 50 members journeyed by motor coach through beautiful scenery in splendid weather. The route chosen outwards was by way of Bath to Freshford, notice being taken of the different slopes of the open valley before Bath compared with the steeper inclines beyond, with their well wooded heights.

The confluence of the Frome and Avon rivers was visited, and the journey resumed to Iford Manor. There a prolonged stay enabled the members to enjoy the charm of the noble specimens of trees, flowers of varied hue grouped about ponds and rockeries, with statuary figures and ornaments brought from Continental countries. A truly delightful garden in which to be allowed to wander!

For the homeward drive advantage was taken of the high ridges above Limpley Stoke and Corsham, which afforded such magnificent views over the whole district. Tea was taken here and the descent made to the old-world village of Castle Combe, and thence by way of Acton Turvill and Sodbury to Bristol.

THE 537TH GENERAL MEETING.

October 4th, 1928.

"On the Habits of some Social Caterpillars," by Prof. F. Balfour-Browne, M.A., F.E.S.
(*Imperial College, South Kensington.*)

Social insects can be defined as those in which the members of the family did something for the common good, and those gregarious caterpillars which spin silk. The habits of two British "home web" builders —the Lackey Moth caterpillar, and the Little Eggar Moth caterpillar were described. The Lackey caterpillers spun a primary web which was deserted after about a week or ten days, and the family then usually broke up into a number of companies, each of which constructed a "home web." These batches later broke up into solitary individuals which got on quite well by themselves, and wandered far from the original home. The Eggar caterpillars, on the other hand, built a primary web over the egg mass, and under normal conditions occupied it until they were nearly full grown, when they, like the Lackeys, dispersed. The lecturer described the general characteristics of the Eggar web, and mentioned that the caterpillars succeeded in spreading sheets of perhaps seven inches across, although their threads were not more individually than about one and a half inches long. They carefully made tracks of silk from the "home" to the feeding place adjacent, so as to enable them to get back with certainty, and they spun mats to give a foothold when biting the leaves.

He also remarked that the full grown caterpillars, when leaving the nest in order to spin up and change to the pupae, took a definite direction and insisted upon maintaining it. It was suggested their knowledge of direction was associated with the position of the sunlight at the time the impulse seized upon them to change to pupae. At the spinning of the silken covering of the cocoon, the caterpillars were influenced to make the colour light or dark to match the shade of the substance on which they spun.

Prof. Balfour-Browne remarked that he had come to the conclusion there must be some gleaming of intelligence at the base, but that most of what was said to be intelligence was really mere instinct.

THE 538TH GENERAL MEETING.

November 1st, 1928.

Exhibits of Natural History by the Members.

In number and in excellence the drawings, photographs and material displayed were well up to the standard of past years and reflected credit on the various Sections.

In the Botanical Section, Miss I. M. Roper exhibited plants carved in stonework in Bristol churches; Mrs Sandwith, plant abnormalities; Mr J. W. White, curious fasciation of an Ash; Mr F. W. Evens, Mycetozoa and dried plants; Mr H. J. Gibbons and Miss Bowen, collection of living Fungi; Mr H. S. Thompson, photographs and specimens showing changes in the Berrow Flats, 1921-1928; Dr. Macgregor Skene, examples of graft hybrids or "chimaera;" University gardener, a good collection of rare living economic plants.

For Ornithology, Dr. A. L. Flemming showed photographic negatives of bird life retouched and improved by colour, and Mr C. Tuckett photographic studies of bird life. For the Geological Section, Prof. S. H. Reynolds displayed collections of American Crinoids, Bryozoa and limestone-forming organisms, and a Map of the Cattybrook Railway cutting (local) showing special contortions; Mr J. W. Tutcher, fossil Gastropoda from the Silurian to the Eocene, and Mrs Vaughan, local Lias fossils.

Entomology was represented by Mr H. Womersley with British horse-flies, new species of Springtails and flies bred from tree-sap; Mr J. V. Pearman, sketches of Psocids hatching, and Coleoptera from the New Forest; Master P. Pearman, living "stick" insects; Mr C. Bartlett, British longicorn beetles, and Miss Bartlett, water colour drawings of insects and flowers.

Coffee was served during the meeting.

THE 539TH GENERAL MEETING.

December 6th, 1928.

"The Strawberry Aphis," by Mr L. N. Staniland, D.I.C.
(*Advisory Entomologist, Long Ashton Research Station.*)

Until a few years ago the diseases affecting strawberry plants were very much of a mystery. Most of the defects in plants were attributed to an eelworm, including the various types of "small leaf," which were the cause of serious loss to growers. The Strawberry Aphis (*capitophorus fragariae*) was first found in this country in 1912, but even when it had become quite common it was not considered as a serious pest, and was not connected with "small leaf." Recent research, however, has shown this aphis to be the most dangerous of all strawberry pests in the country, and responsible for the major portion of "small leaf." Fortunately it is not uncontrollable; dipping of runners and spraying and dusting of older plants give every promise of developing as efficient preventatives. The knowledge attained of this subject is a remarkable result of the increasing co-operation of all branches of science affecting horticulture, in this case especially between plant physiology and entomology.

The lecturer emphasised his points with many excellent lantern slides.

Grant of the Lyell Medal to Bristol.

By the Hon. Editor.

IN the Report of Council for 1927 much gratification was expressed at the honour conferred on our Vice-President, Prof. S. H. Reynolds, D.Sc., F.G.S., by the award to him of the Lyell Medal by the Geological Society of London.

In the "Quarterly Journal" of that Society it is stated the Lyell Medal is given as a mark of honorary distinction and as an expression on the part of the Governing body of the Society that the medallist has deserved well of the Science.

It is believed members will like to know more than the bare statement of the award being made, so we extract from the same source the address of the President of the Geological Society on the occasion of the presentation, on February 17th, 1928.

Professor Reynolds,—Sir Charles Lyell directed that the Medal which bears his name should be given to one who "has deserved well of the Science." There are several ways in which a man may fulfil this condition, but few men fulfil it in so many as you have done. During the twenty-four years that have elapsed since you received a moiety of the Lyell Geological Fund, while actively continuing your duties as Professor of Geology at Bristol University, you have lost no opportunity of escaping from the lecture-room into the greater school of Nature and acquiring fresh knowledge for transmission to your colleagues. Not only have you continued with C. I. Gardiner your important work on the Lower Palaeozoic rocks of Ireland, but the obscure Silurian inlier of the Mendips, the stratigraphy, composition, fossil content, and structure of the Lower Carboniferous Series in Somerset, and the igneous rocks of Tortworth, all are subjects on which we have received from you valuable communications. No less valuable are those thorough and lucid summaries intended for a yet wider circle: your Handbook to the Bristol District, your account of the Palaeozoic rocks of that region in the Jubilee volume of the Geologists' Association, and above all, your exhaustive Presidential Address to the Geological Section of the British Association on the Lower Carboniferous rocks of England and Wales.

For recreation you have proceeded with your Monographs of the Pleistocene Mammalia, dealing successively with Bears, Canidae, *Hippopotamus*, and now the Cervidae—a work that should be most useful to the active cave-hunters of Bristol.

Finally, for many years you have found time to serve as secretary to the British Association Committee on Photographs of Geological Interest, and when I observe that the number of subjects now reaches 7623, and that no fewer than 443 prints were received in the last year, I feel that almost for this alone you deserve the Medal which it is my privilege to hand to you.

Prof. Reynolds made a suitable acknowledgment of the honour, and amongst his remarks said:—"I have worked much in collaboration, and for anything that I may have accomplished I owe much to association with others. You have alluded to work on the Bristol Silurian rocks, to which I was first introduced by my former chief, Prof. C. Lloyd Morgan. . . . You allude to progress in the study of the Carboniferous Limestone. It is scarcely necessary to say that the inspiration for all such investigation in the Bristol district is due to the late Arthur Vaughan, whose work is being carried on by what may perhaps be termed a small school of Bristol geologists."

This statement about a local school is of particular interest to our members, as showing that a definite object is being followed by the Bristol Naturalists' Society, who published in its "Proceedings," one of the original papers of Dr. Vaughan, and has followed it with a succession of similar papers on the subject. They place our "Proceedings" as the authoritative reference for the stratigraphy, composition, fossil content, and structure of the Carboniferous Series of this locality, and this should serve as an encouragement to students to produce works of high importance in other Sections of Natural History.

PRESIDENTIAL ADDRESS, 1928.

"Caste,"

By James Rafter, M.A.

THE word is derived from the Spanish and Portuguese word "Casta," which means lineage, giving the idea of family. We trace it also in the Latin " Castus," signifyng pure, chaste, its present form coming from the French. The corresponding Hindu word is Varna, or colour. It had been identified with the Brahmanic division of Hindu society into classes long before the word was included in modern European languages. It is employed for any distinction of class wherever the exclusive effect is similar to that in India.

The system has prevailed more or less throughout the world except that there are few traces of it among the Germanic races, and the suggestion that Egypt had a Caste system does not carry much weight. It was very prevalent in Peru, and the Zend Avesta shows that Persia had its threefold division of priests, warriors and husbandmen. To-day even we find similar distinctions in Africa, Polynesia and Europe. Comte, the philosopher, regarded the seclusion of women by Mahommedans as a feature of Caste.

In his " History of the Rise and Progress of the English Constitution," Palgrave gives his opinion that the Colleges of Operatives, which existed in Britain during the Roman period, was practically Caste, because, by the Code of Theodosius, the son was compelled to follow the father's employment, and marriage into a family involved adoption of the family employment. These Colleges were the forerunners of the voluntary associations, *e.g.*, frithgilds and craftgilds, for the regulation of industry and trade. Sons, who became apprentices, had great advantages; strangers were admitted and intermarriage was a matter of social feeling and some privileges were doubtless secured. The authoritative regulation of all that pertained to the life of the people both from without and from above was irksome and Gild records show what efforts were made to throw off the yoke. The Gilds of the Middle Ages were but a form of Caste, although we do not so designate it. The various trades were confined to certain families and to specified quarters of the Town.

Caste in the strict sense was non-existent in England in the Saxon period, but in the early days of German history it was found in the military associations, in the rural non-military population and in the merchant class. At some time or other professions in most countries were doubtless hereditary. In Prescott's " History of Peru," we read that notwithstanding the general rule that every man should make himself acquainted with the various arts, certain individuals were carefully trained to those occupations which minister to the wants of the more opulent classes. Like every other calling and office in Peru these occupations always descended from father to son, and in this connection the division of Caste was as rigid as that of India.

In Mexico no one could carry on trade except by right of inheritance, or by public permission. In Fiji carpenters form a separate Caste, and in the Tonga Islands all trades except tatoo-markers, barbers and club-carvers are hereditary.

It is but natural that a father should teach his son his handicraft; he thus secures labour cheaply and the son is equipped for a living when he is old enough to marry. The custom or reputation of the father as a craftsman is frequently the most important legacy he has to leave. This often happens in our own times.

The word " Caste " has been applied to sacred corporations, a family or a tribe is consecrated to the service of a particular altar, or all the altars of a particular God. In Peru the priests of the Sun at Cuzco, and the public registrars, learned men and singers transmitted their office to their sons. In that country every man was expected to be familiar with the various handicrafts essential to domestic comfort.

The great objection to this legacy of trades is that it does not favour originality, or the development of any peculiar talent of an individual. On the other hand, however, it conduces to an easy and finished execution, the artist being familiarised with the practice of his art from childhood. This is modern opinion, but the Egyptians held the same view, ascribing to the system the source of their skill in the Arts.

As regards " intermarriage " between classes, political considerations, or distinction of race have interfered with this. In Rome, for example, marriage between patricians and plebeians was taboo. Among European Royalty, at any rate, the idea of equality of birth survives. Consequently there are what are termed " morganatic marriages," and a member of a Royal family who makes such a contract really breaks Caste rules. Society in Madagascar is divided into four classes, the lowest being apparently mere slaves, and marriage between these classes is strictly forbidden.

In India Caste has brought about high barriers against indiscriminate intermarriage. This has preserved purity of blood and intellectual ability. It has encouraged hereditary trade and pursuits, which lead to the creation of experts. But there is very little knowledge regarding permission of intermarriage; the effects of a marriage permitted but looked upon as irregular; the penalties of one forbidden; the loss of Caste and how it may be regained. The Hindu marriage is indissoluble, except in the fourth Caste, the Sudras. Polygamy is permitted, but is comparatively rare, as the number of men and women is about equal. The basis is duty, rather than romantic love.

As regards India, of which I shall have more to speak than of any other country, there are four great divisions of Caste with innumerable sub-divisions. Some writers maintain that the division is founded on an original diversity of race, and that the higher Castes have superior beauty. The high forehead, stout build and light copper colour of the Brahmans, and other allied Castes, strongly contrast with the lower and wider heads, slighter make and darker bronze of the low Castes.

In India Caste or class distinction is much more pronounced than in England, and is found in its most fully developed form. In India a man continues in the Caste in which he is born. There, Caste is said to be the off-spring of Brahmanism and the Brahman, who is descended from Brahma, the creator of the Universe, is the central feature of the system.

Established more than 3000 years ago, this institution still maintains its hold over the Hindu race. At the date of the Rig-Veda, *i.e.*, B.C. 1400, the Aryans were a pastoral people without the trammels of Caste, but 500 years later the fourfold division was in full sway.

The four great divisions are:—(1) The Brahmans, or priests, (2) the Kshatriyas, or warriors, (3) the Vaisyas, or husbandmen, and (4) the Sudras, or slaves. The first three are twice-born and were the Sanscrit speaking conquerors, and the last were no doubt the aborigines. It is difficult to understand why the warrior class should allow themselves to occupy an inferior position to the priestly Caste. One can only account for it by the superstitious terror in which the Brahmans were held. As a rule, the physically strongest would sway the rest, and the intellectual would endeavour to keep down the tendency to tyranny in the strong by the engine of religion and superstition. We have only to look back to the history of our own land for an example of the great power wielded by the Church.

In their early days the Brahmans were mendicants, who lived on the festivals of birth, marriage and death and on the fines exacted for infractions of Caste rule. They claim to be produced from the mouth of Brahma and to be a class set apart for the service of God in religion, law and the perusal of the holy scriptures, etc. They are to act as guides to the kingly and warrior and other Castes. Moral authority is theirs only on condition of their leading most self-denying lives, and their failure to continue in purity of life will occasion the loss of their superiority to other men. The Brahman's person was so sacred that whoever struck him with a blade of grass would become an inferior quadruped during 21 transmigrations. In the doctrine of transmigration of souls those born in lower Castes may aspire to become Brahmans in a future life, and then to rise to life in the Eternal. This subject of Transmigration, by the way, is exceedingly interesting, but it would be out of place to enlarge upon it on this occasion.

As assigned by Brahma the duties of a Brahman are: to read the Vedas, to teach, sacrifice, give alms if rich, receive gifts if poor. In State matters he was above all the ministers; he was the Rajah's priest, exempt from taxation, and at one time was the physician of bodies as well as of souls.

Next in rank is the Kshatriya or Caste of fighting men. They are said to have sprung from the arms of Brahma and were given second place, as the ravages of war ranked next to the calamities sent by heaven. From this Caste Princes and rulers were selected to govern under the Brahman's counsel; the present day Rajputs claim direct descent. The chief duties assigned to them were: to defend the people, give alms, sacrifice, read the Veda, and shun the allurements of sensual gratification.

The third in the social scale is the Vaisya or husbandman. It is an agricultural Caste which issued from the Creator's loins. They share with the two higher Castes the privilege of hearing the Vedas, but, though many are merchants, practically they soon became much closer related to the lowest class. Their duties are to keep herds of cattle, bestow largesse, sacrifice, read the scripture, carry on trade, lend at interest and keep land. The three Castes I have just referred to wear the sacred thread.

Fourth and last in the scale are the Sudras, the degraded and servile class which sprang from the feet of Brahma, and whose duty it was to serve the three superior classes without depreciating their worth. A Sudra may not learn the Vedas and in sacrifice he must omit the sacred texts.

You will not fail to observe the great difference between Hindu religion and Christianity. We as Christians endeavour to place the Gospel within the reach of the very lowest, reserving nothing in the worship of God. The Sudras, however, are forbidden to read their Sacred books or even to mention them in worship. Their restrictions are very numerous.

Talboys Wheeler in his "History of India" suggests that the Sudra may be the original conquerors of the race now represented by the Pariahs or Outcasts. Their own position certainly indicates conquest. Military conquest, though it often introduces servitude, does not naturally lead to the elevation of the priesthood. Slavery might fairly be regarded as a form of Caste, although it is at the bottom of the scale, in that certain small customary rights are recognised. The so-called Aborigines are still found in a rude condition amongst the hills. Our Gipsies are said to have come from Indian outcast tribes, but I have never heard them called Indians though I have heard them dubbed Egyptians. It appears to me that where the Arts are deficient in a community Caste is non-existent. Without the Arts any division which has the appearance of Caste simply means that those in the lowest scale are merely slaves.

Now a word or two as to social practices. If a Kshatriya or a Vaisya slandered a Brahman they were fined, but a Sudra so acting would be whipped. On the other hand if a Brahman slandered any of the lower Caste he would have to pay a small fine. By gross or sensual habits he may sink so low as to become the meanest animal or even vegetable existences, which, in their belief, all have the spirit of life within them. In ordinary salutations a Brahman is asked whether his devotion has prospered; a Kshatriya, whether he has suffered from his wounds; a Vaisya, whether his health is secure; and a Sudra, whether he is in good health; the last-named curiously enough being on a par with our English salutation.

Loss of Caste to a Hindu means not only social ostracism but excommunication from religious rights and exclusion from sanctuaries. Elphinstone says that in the whole course of his long experience in India he never heard of a single case of degradation from Caste. One of the most important "Caste prejudices" has reference to food. Members of different Castes may not eat or drink together and no one may partake of a dish prepared by one of lower Caste than himself. Most Hindus are vegetarians—to all the cow is a sacred animal. This is exemplified in their carvings wherein the cow is depicted more frequently than any other animal. The consumption of animal flesh is regarded by Hindus, especially high Caste Brahmans, with the utmost abhorrence and disgust. This was demonstrated in a terrible manner in events which led to the Indian mutiny. The issuing of cartridges, said to be greased, to the Sepoys, was the cause. In those days it was customary to bite off the heads of cartridges before placing them in the gun. With their strong objection to animal flesh it is not to be wondered at that the Hindus regarded this act as an outrage on their religious sentiments. They are deeply religious, in fact I may say they are fanatically so. I read that now-a-days there is some relaxation in regulations in that a member of one Caste may do the work of any other.

Protestant missions in India have really made little headway considering the population of the country and the long period missionaries have laboured there. In 1901 the native converts numbered little more than 2½ millions, out of a total population of 320 millions, or a percentage of barely ·8. Christianity does not seem to appeal to high born Indians, only to the outcasts. This appears to be the case in all countries, the wealthy converts being few.

Not all the exertions of western civilisation and religion have broken down the system of Caste to any extent. It is still a powerful factor in our dealings with the Hindu subjects of the Indian Empire in accordance with modern ideas.

I must quote from Sidney Low's "Vision of India," as he puts the advantages of a Caste system in a nutshell. He says: "There is no doubt that it is the main cause of the fundamental stability and contentment by which Indian Society has been braced up for centuries against the shocks of politics and the cataclysms of Nature. It provides every man with his place, his career, his occupation, his circle of friends. It makes him at the outset a member of a corporate body; it protects him through life from the canker of social jealousy and unfulfilled aspirations; it ensures him companionship and a sense of community with others in like case with himself. The Caste organisation is to the Hindu his club, his trade union, his benefit society, his philanthropic society. An Indian without Caste, as things stand at present, is not quite easy to imagine."

Elphinstone, in his "History of India," remarks that generally speaking Hindus are quite contented with their lot. One must not overlook the fact, however, that ambition, as understood by us, plays but little part in their lives. At the present day it is the aim of many reformers not to abolish the Caste system but gradually unite the sub-Castes until but none but four main divisions remain socially effective.

To conclude—it gives one to think that the Normans and Saxons are of the Aryan race, and that they had settled down in this land of ours, a little island in the north-west extremity of Europe, and that we in turn have subjugated our ancient ancestral land of India, the older and original but now feebler branch of the family.

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A Somerset Heronry.

By H. Tetley, B.Sc.

During the past summer enquiries have been carried out regarding particulars of the Heronries situated in the British Isles. These have been undertaken at the request of the Editors of "British Birds," and it was decided that the Ornithological Section of the Bristol Naturalists' Society should do what it could to contribute.

The following paper, by the Hon. Secretary of this Section, is to give some account of what members have accomplished in this respect.

For the purpose of this enquiry a Heronry is taken to be one nest or more, so that no isolated nest, the possible forerunner of a future larger Heronry, should escape notice.

The nearest Heronry to Bristol is one situated in Brockley Combe, and the account that follows will deal solely with this one.

Here a Heronry has existed continuously for at least 50 years, and possibly longer, so that it can be regarded as well established. The large nests are built in Oak and Ash trees, comparatively close together, five oak trees having six nests between them, and four ash trees 19 nests.

The question of inter-relationship between the Herons and their neighbours was studied—the latter consisting of Rooks. These two birds both nest in the same trees, the larger ones appearing to disregard the smaller, and occupying the best building sites. No signs of enmity were noted; this is not always the case, for Herons have been known to fly off before the attacks of Rooks, and it has been thought that the increase in the number of the latter in recent years may have had some bearing on an estimated decrease in the number of nesting Herons.

The number of eggs laid averaged three, but clutches of four were noted, and 17 nests were occupied during the season, and as the Heron, speaking generally, is a very early nester in the British Isles, commonly commencing in February and March, this is not to be wondered at.

In some cases the evidence pointed to the rearing of two broods during the season.

The question of what the Heron feeds upon occupied, of course, an important part of the enquiry, and this is an easier task than may be imagined at first for, like birds of prey, such as Hawks and Owls, the Heron casts up, in the form of pellets, the indigestible portion of its meals, and examination of these pellets will give a good indication of what the bird has been enjoying. But it will not of course tell the whole story, as some of the foods will be digested and will not be cast up again.

Herons are so well fitted for catching fish that it is not to be wondered at if they form a large part of their prey. Fish, and especially Eels, were noted in a number of cases; the latter particularly by one observer as the food of the young birds, which have an unpleasant habit of bringing up their last meal when anyone comes near. But a detailed examination of a series of 26 pellets brought in by a second member reveals the interesting fact that in only one were there any remains of fish. In 22, or 85 per cent. of the total, there was the fur, and in some cases the bones, of the Water Vole or Water-Rat. In practically every case there were the remains (chiefly the hard elytra) of Water-beetles, and of other aquatic insects, such as Dragonfly larvae, etc.

The absence of fish in the latter case was very striking, as was the large proportion of Water Voles in the " catch." The latter, though doing very little damage to man if properly controlled, might become a nuisance in excessive numbers, and evidently the Brockley Herons are doing a useful work in keeping down the number.

As far as could be noted the principal feeding grounds seemed to be (1) the flats towards Clevedon, (2) Blagdon Lake, and (3) Barrow Reservoir, the order given being that of apparent preference by the birds, judged by the number present at these three places.

About twelve years ago this Heronry consisted of very few nests, but since that time it has increased. During the last year or two there has been a slight decrease in the number of occupied nests, a result which may be attributed to the very heavy volume of traffic which, as is well known, is a feature of the road from Bristol to Weston-Super-Mare, particularly in summer. Within 100 yards of this road some of the nests are situated.

Ten young Herons were ringed with the light metal rings sent out by the Editors of " British Birds." These rings are graded in sizes to suit the varying sizes of birds and are placed sufficiently securely round the leg of the bird to ensure that they remain in position without hurting the birds or interfering with their movements in any way. This task in the case of these Herons was not accomplished lightly. The nests are about 40 to 50 feet above the ground, and are not easy of access, so it may be imagined that to catch a young and active bird and put a ring round its leg, whilst maintaining a foothold at the same time, was not an easy task.

Up to the time of writing only one of these birds has been recovered, at Wrington, about two miles away from the Brockley Heronry, and 38 days after the ring had been placed on it. As a contrast to this stay-at-home bird interesting particulars are given in the current (January) number of " British Birds " of five nestling Herons, which after being ringed on the same day in April 1928, had been recovered as follows:— Two from Belgium in June, two from France (one in July and one in August), and one from Spain in December, facts which point to a speedy emigration of the young birds, which I have not seen noted before.

The Heron, indeed, in two books recently published on British Birds is described as a resident with its numbers increased in winter by emigrants from the Continent. It will thus be of interest to see how far these ideas may have to be modified as a result of the enquiry now proceeding, and it is hoped that some good results may come from the limited number of birds which have been ringed at Brockley. Needless to say we shall be very grateful, if anyone finding Herons or any other birds with rings on them, would let the Ornithological Section know, and at the same time forward the rings to the address stamped on them.

One other problem of the Heron still awaits solution. In common with other members of its tribe, this bird has on the breast and thighs what are known as "powder-down" patches. No theory has been put forward which satisfactorily explains the use of the powder in these patches. It has been supposed that the bird shakes it on to the water and in this way allures fishes within its reach, but no sound evidence for this or any other theory has been produced.

It is hoped during the coming season to continue this work on the Herons, so that as complete a record as possible will be available for the Bristol district.

In conclusion, I should like to say how very much indebted the Section has been to those younger members who, by their agility and fearlessness, have made this report possible.

Photo by *H. S. Thompson.*

BERROW FLATS. August 1921.

Plate I. Recent colonization of the mud by *Salicornia* and *Glyceria*.

Photo by *H. S. Thompson.*

BERROW FLATS, August 1928

Plate II. Snipe shooting among *Spartina* grass

The Vegetation of Berrow Flats, Somerset.

By H. Stuart Thompson.

DURING the hot summer and autumn of 1921 I made (with the aid of prismatic compass and photographic camera) a fairly exhaustive survey of the coast and its vegetation between Burnham-on-Sea and Berrow. Particular attention was paid to the new salt-marsh which had developed during the decade, and formed so conspicuous a feature from about 400 yards N.W. of Burnham lower Lighthouse to about 600 yards S.W. of Berrow Church, which is situated on the sand-hills.

A synopsis of the work, with three photographs and a map, was published in the *Journal of Ecology*, May 1922, under the title, " Changes in the Coast Vegetation near Berrow, Somerset." Its main object was to indicate the nature of the new vegetation over an approximate area of 100 acres (extreme width about 500 yards, length 1500 yards, tapering at both ends); to fix the date of the inception of the muddy salt-marsh formation at about 1910; to mention certain topographical changes at the mouth of the River Parrett; and to incorporate several observations made by Prof. C. E. Moss in his pamphlet issued by the Royal Geographical Society in 1906 on " The Geographical Distribution of Vegetation in Somerset" (which soon became out of print).

In August 1921 I observed and mapped a new tributary channel, some 10 feet deep and 40 feet wide, near where it entered the Parrett about 600 yards west of the lighthouse. This was not shown on the 6 in. Ordnance map nor any other map or chart. The channel drained a portion of the muddy Berrow Flats, and may have been the chief cause of the new vegetation by diminishing the force of scour over the flat between it and the sand hills. Its length was nearly a mile, and for some distance it formed the western boundary of the *Glyceria-Salicornia* association. (Plate I.) On October 4, the clean sand on the west of the channel was about two feet higher than the mud on the landward side. The mud was much furrowed with small irregular channels about two feet deep and half-full of water, some of which drained into the new broad channel. The very wet and glutinous nature of the mud made access to the marsh even more difficult than in 1928.

From an Admiralty Chart of 1886 it is evident that the level of the whole of this part of the coast is considerably lower than that of the major portion of the Gore Sand, which at low tides stretches four miles seawards on the south-west. It is well to bear in mind that the coast from Weston-super-Mare to Burnham runs north and south, and that the tides of the Bristol Channel rise higher than those of any other European waters. At Chepstow they sometimes rise to 50 feet, and at Bridgwater Bar, at the mouth of the River Parrett, the height of spring-tides above Ordnance datum is approximately 35 feet, while at Portishead and Avonmouth it is about 42 feet.

Moss (*loc. cit.*, p. 8) remarked in 1906 that, " Owing to the constant movements of the surface, caused by the ebb and flow of the tides, the flats possess no vegetation . . . . and in times of high winds sand blizzards are frequent." Observations by the present writer in 1921 and since fully confirm the statement of Dr. Moss about the constant movement of the surface. Partly owing to the shape of the Bay there is, as recently remarked by W. D. Miller of Burnham, a continual wash of sand from south to north, which may eventually raise the Gore Sands above high-water mark, unless the wind keeps it down. The former bare sand and mud near the shifting dunes now supports a vigorous plant life.

In July 1921 I noticed, and subsequently photographed, three clumps of Cord-grass (*Spartina Townsendi*), two of which were 9 feet across, well established on the mud. The nearest was about 30 yards from the edge of sand-dunes, and the furthest was some 300 yards from high-water mark. It is probable that pieces of rhizome of this robust grass got washed by the tide from the muddy coast south of Clevedon (14 miles round the promontories) where it had been planted some years previously, for it serves a useful purpose* in lessening coast erosion on muddy shores.

This grass was first recorded in this country in 1870 from salt-marshes near Southampton; but in 1880 it was determined by H. and J. Groves as a new species. It rapidly spread at Southampton Water and the Isle of Wight; in 1899 it extended westward to Poole harbour, eastward to Portsmouth and Chichester harbours, and from 1906 on the north coast of France. In 1922 it had reached Rye. At Poole harbour to-day the plant occupies many square miles. It has been the subject of much investigation by not a few botanists, and in particular by Prof. F. W. Oliver. A valuable paper by him on " The Economic Possibilities of Rice-grass " appeared in the *Journal of Ministry of Agriculture*, November 1928, in which it was shown how horses and cattle eat it, and how successful its planting has been in Holland.

At Berrow by June 1923 the original clumps of *Spartina* were much larger, and many young subsidiary plants extended 10 or 12 yards from the parent clumps, but the height of the young shoots was then only 6-8 inches. By September 1924 *Spartina* was rapidly increasing in other parts of the marsh, and numerous seedlings appeared. In August 1926 patches extended to the extreme southern limit of marsh vegetation, and the most southerly clump was 65 yards from the dunes.

By August 1928 the cord-grass had extended everywhere, and was dominant on the western area, with dwarf patches of *Glyceria maritima* here and there. So dense had the vegetation become, and so large the colonies of *Spartina*, that Snipe frequented the salt marsh, and one was shot with an air-gun by a boy, who appears in one of the photographs. (Plate II.)

* See papers by Ida M. Roper, these *Proc.*, 1919, 1921 and 1924.

Photo by *H. S. Thompson.*

BERROW FLATS, August 30, 1928.

Plate III. Dense bed of *Scirpus maritimus*, etc. close to the dunes.

Photo by *H. S. Thompson.*

BERROW FLATS, October 1, 1928.

Plate IV. South end. *Spartina* in mid-distance, none there in 1921.

To return to the autumn of 1921, the chief feature of the then recent vegetation was the rapid spread of *Glyceria maritima* which creeping grass was the dominant plant. South-west of Berrow Church a few detached units, in low patches two feet across, extended 1000 yards seawards on the sand north of the new channel. Others nearer the coast extended northwards 2½ miles from the lighthouse. But this first coloniser of the open mud did not then grow in the actual marsh quite so near the channel as did *Salicornia dolichostachya* (new to the Bristol Channel) and *S. ramosissima*. In July a little of the *Glyceria* was in flower, though covered at every high tide. White (*Flora of Bristol*, 1912) had seen this grass "sparingly in blown sand near Burnham; a rare position in this country, although on Mediterranean sands it is often abundant." In November 1911 Drs. Moss and E. J. Salisbury were on Berrow Flats, and walked along the mud to Highbridge. It was only near the mouth of the River Brue, south of Burnham, that they saw a little *Glyceria maritima*, " very patchy." (Salisbury *in litt.*)

In 1921 *Salicornia*, or Glasswort, of several species was at least subdominant on the mud of Berrow Flats. *S. ramosissima* and *S. stricta* were here and there interspersed with *S. dolichostachya*, some of which consisted of a single long spike of 4 to 6 inches on an unbranched stem of similar length. At Berrow it chiefly frequented the wettest mud and the sides of shallow furrows, and was often associated with *Glyceria maritima*. In places that grass was so thick that nothing else would grow. The late Cedric Bucknall and I were puzzled in October 1921 by a large Saltwort attaining a foot in height, specimens of which Dr. E. J. Salisbury considered were probably *S. Smithiana* × *ramosissima*.

That year I saw only two small plants of *Suaeda maritima* on the Flats, and no *Spergularia*,* *Statice* or *Armeria*. The absence of Sea Lavender and Thrift tended to show how recent was the vegetation and how wet the marsh. *Aster Tripolium* was present here and there. Some of it had the beautiful mauve ray florets well developed, though usually the plant of muddy salt-marshes and tidal river banks is the rayless var. *discoideus*. *Triglochin maritimum* was more widely spread than the Aster, and some of the large tufts formed conspicuous objects from afar. The only other species noticed on the marsh in 1921 was *Zostera marina*, of which very little was seen in two small pools. It is rare on the Somerset coast. Owing chiefly to the want of exposed rock no marine Algae appear to grow within the small area treated.

Space does not permit any reference to the Association of " strand " plants at high-water mark, or to those of the blown sands and mobile dunes, or the Association of Dune sward-forming plants, all of which were dealt with in *Journ. of Ecology*, 1922.

* Two species of *Spergularia* are frequent further south at the mouth of the Parrett, and abundant on other parts of the Somerset coast. Occasionally during the past 40 years they have been noted at Burnham and Berrow; and I have a specimen of *S. salina*, var. *neglecta*, gathered by Thomas Clark in 1817 on Steart Island, a bare mile from Burnham pier.

Having made observations and notes on the Berrow Flat vegetation each year since 1921, except during 1927, we may now briefly narrate the chief changes which have occurred, for they have been remarkable, particularly during the past two or three years. But the change is not so much in the extent of the marsh, though it has diminished and altered in form, as in the character of the flora.

By June 1923 the deep, mile-long channel had got much silted up, and its northern end had dwindled to nothing; but in 1928 its southern deeper portion was still draining the marsh at low tide and it had a more rapid fall than formerly. In June 1923, the *Salicornia* was mostly embedded in fresh sand, and the only visible plants were quite small; but in August that year some *Salicornia* and *Glyceria* were observed about as far seaward as in 1921. Much of the *Glyceria* on the south was also embedded in sand, and throughout the whole marsh it was of low stature and little was seen in flower.

In 1923 the extensive Gore Sand on the west of the silting up channel was higher still than the marsh, *i.e.*, the two feet rise had slightly increased. The sand beyond the marsh was of a more or less uniform texture, and on June 7th so hard that one never sank more than two inches into it. In the marsh *Aster Tripolium* was in far greater quantity, and on September 22nd hundreds of Aster plants were seen. The *Spartina* growth has already been mentioned. By September 1924 former patches of *Salicornia herbacea* and *S. dolichostachya* had retreated considerably on the south, having been ousted by an extension of the *Glyceria*.

The year 1926 saw important changes. By the end of August the vegetation had extended to within 26 yards of the dunes where a long low sand-bank covered with Marram forms a sort of bastion to the sandhills S.W. of Berrow Church. *Aster Tripolium* and *Glyceria* were then dominant. A belt of taller Aster, 2-3 feet high, extended 250 yards or more, and was edged with a 2-4 yards belt of *Glyceria* next to the strip of hard sand adjoining the *Triticum junceum*—*Salsola* zone. There also on that hard sand was a curious association of *Arenaria peploides*, small *Salicornia herbacea*, *Plantago Coronopus* and minute plants of *Aster Tripolium*.

Short clumps of Reed-mace, not flowering, but probably *Typha angustifolia*, were here and there for 100 yards in wet mud at the eastern border of the marsh among *Aster* and *Glyceria*. A dozen or two of the *Typha*, then only one to two feet high, had their leaf-tops deflexed by the waves at high tide. When photographed in August 1928, the *Typha* was three feet or more in height, though still not flowering. This narrow-leaved Reed-mace is very rare in Somerset. It was recorded from "Ditches at Burnham," by J. C. Collins in *New Bot. Guide, Suppl.*, 1837, and from a roadside ditch between Brent Knoll Station and Burnham in 1894 by S. T. Dunn; but no herbarium specimen exists from that district. In fact voucher specimens of the native plant are wanting from any part of Somerset other than from a swamp near Chard Reservoir (Marshall, 1907) and from a ditch near Wembdon (Herb. Thos. Clark, 1853). Most of the rhines below Wembdon Church and Cannington near Bridgwater drain eventually into the River Parrett, but it is over 40 years since I saw a few spikes of *T. angustifolia* near Wembdon, possibly in Clark's old station. His specimen, in my possession, is labelled " Reene by roadside, half-mile N. of Perry Green, Wembdon."

A remarkable bend in the vegetation area towards the south end, noted in 1924, was still more marked in 1926; and *Salicornia*, especially *S. dolichostachya* was still diminishing everywhere.

Among " strand " plants in 1926 were two small *Polygonum Raii*, which is extremely rare on the Somerset coast. Near them *Salsola* was remarkably abundant, but very little *Cakile*, which pretty Crucifer is most capricious and uncertain on this sandy coast.

Probably in 1926 the present remarkable colonies of Sea Club-rush (*Scirpus maritimus*) got established on the wet muddy border of the marsh close to the sand-hills. (Plate III.) During the summer and autumn of 1928 they formed conspicuous features, and the colour gradually changed from bright green to a dark sombre green at the end of August. It is a plentiful plant in brackish ditches and salt marshes near the Bristol Channel and tidal rivers, and often it occurs far from the sea on many of the Somerset lowlands, including the great central peat-moor.

It was more surprising to see on August 10th, 1928, a clump of the distinct *Scirpus Tabernaemontani* five feet across and with about 80 flowering spikes two feet high. This was growing seven yards from the edge of the marsh amidst the commoner and greener species. Both it and its close ally, the true Bulrush, are rather scarce in Somerset.

A striking feature of the present-day vegetation is the occurrence of several freshwater plants mingling with those which are more at home in brackish water. The former include *Alisma Plantago* in several places, *Juncus glaucus* and *J. articulatus* in small quantity, and *Typha*. *Juncus Gerardi* also grows there, but that species is more typical of such salt-marshes and wet spots within maritime influence. Neither *Statice* nor *Armeria* has yet appeared; and *Spergularia marginata*, *Glaux maritima* and *Suaeda maritima* are in very small quantity.

In 1928 I saw extremely little *Salicornia* of any kind, and none of the rare *S. dolichostachya*; but in October W. D. Miller sent me a little of the latter species and *S. stricta*, which often assumes a reddish colour in autumn. The great diminution of " Glassworts," except in small quantity at the extreme south, is one of the salient features to-day.

At the present time the marsh has appreciably diminished in size. Roughly the vegetation extends for 1100 yards along the shore, and is separated from the Sea Couch-grass (*Triticum junceum*) which adjoins the Marram (*Psamma arenaria*) of the sandhills by a strip of hard and usually bare sand which has become narrower each year. At its greatest width the vegetation does not now extend seawards more than 250 to 300 yards, and it narrows gradually on the north end especially. The seaward border is irregular and patchy with great colonies of *Spartina*.

There are now visible from the sandhills three main belts of vegetation: dense masses of *Scirpus maritimus* occupy most of the landward side; Cord-grass (*Spartina*) dominates the western portion nearest the sea (as well as part of the northern end), and the middle of the marsh is chiefly a mass of *Aster Tripolium*,* which seems to have crowded out much of the *Glyceria*. It is possible that eventually the *Spartina* may colonize the whole area, as it has done at Poole Harbour and elsewhere. (Plate IV.)

In conclusion, the rising of the Gore Sand, together with the effect of the new channel draining into the Parrett mouth, tended to break the force of the scour and beating action of the incoming tides, especially in stormy weather; and it would seem that the marsh thus became capable of giving a foothold to many plants that reached it. Now it appears as if the silting up of the northern portion of that channel has enabled the old forces of the waves to carry off some of the vegetation; hence its smaller area than in 1921.

* In August 1928 young seedlings of Aster, 1-2 inches high, appeared on the mud in dense patches up to a foot square. Fifty or more could be pulled up at once.

Bristol Insect Fauna.

DIPTERA (Part I.).

By H. Audcent.

IN 1912 Mr H. J. Charbonnier published in the "Proceedings" of this Society (Series 4, Vol. III., Part II.), a list of the Diptera of the Bristol District. Since then a few enthusiastic collectors have captured many other species, some of which are recorded in various publications and others of which are still in manuscript. During the last three or four years I have collected and tabulated all the records I could find and the Council of the Bristol Naturalists' Society has kindly offered to publish the list in its entirety. So many changes in classification and nomenclature have taken place since 1912 that it was deemed advisable to make a fresh list, including all records. This list is so long that it will be necessary to publish it in parts. Such a list should be of the utmost use to local collectors who can note where and when a fly is likely to be found, but it is also of interest to students of the distribution of insects and in that connection I have often seen quotations from British local lists in Danish, French and German books.

The district covered by this list is practically identical with that given by Mr J. W. White in his "Flora of Bristol," and by Mr W. Sanders in his "Geological Map of the Bristol Coalfields." The area is enclosed by a line which, starting at Minehead, follows the coast of the Bristol Channel and the bank of the Severn to Sharpness, there it turns inland to Painswick, goes on to Cirencester, down to Bath, through Frome and sweeps round through Taunton to its starting point at Minehead.

In the compilation of this list much use has been made of the lists published by the Somersetshire Archæological and Natural History Society (1915 to 1927). I have also to thank the Rev. A. T. Thornley, Mr H. J. Charbonnier, Mr H. Womersley, and Mr C. J. Wainwright for manuscript lists and notes.

The following abbreviations are used throughout the list. Before the records:—G.=Gloucestershire, S.=Somerset. The letter in brackets after each record indicates the name of the recorder, as follows:—

A. = Mr H. Audcent.
B. = Dr B. N. Blood.
Bl. = Col. L. Blathwayt.
Br. = Mr R. C. Bradley.
By. = Mr H. Bury.
C. = Mr H. J. Charbonnier.
Chm. = Mr R. E. Chamberlain.
Col. = Mr J. E. Collin.
Cr. = Mr W. C. Crawley.
E. = Mr F. Enoch.
G. = Mr G. C. Griffiths.
H. = Mr A. E. Hudd.
Ha. = Mr L. B. Hall.
J. = Col. T. Jermyn.
K. = Mr J. P. Kryger.
L. = Mr G. C. Lamb.
M. = Mr J. Merrin.
Ml. = Mr F. Milton.
Mp. = Mr H. W. Mapleton.
P. = Mr V. R. Perkins.
Pa. = Major W. S. Patton.
R. = Miss I. M. Roper.
Rd. = Rev. S. O. Ridley.
S. = Rev. G. M. Smith.
Sl. = Mr H. H. Slater.
Slm. = Miss M. Selman.
St. = Mr J. W. Saunt.
T. = Rev. A. T. Thornley.
Tr. = Capt. R. D. R. Troup.
W. = Mr C. J. Watkins.
Wm. = Mr H. Womersley.
Wt. = Mr C. J. Wainwright.
Y. = Col. J. W. Yerbury.

NEMATOCERA.

The first of the two sub-orders of Diptera. These flies have more than six joints to the antenna and the joints often bear hairs; the palpi have 4-6 joints.

I. CECIDOMYIDAE.

These are small gnats whose hairy wings have not more than six veins. The larvae usually live as internal parasites on plants causing swellings or galls. No one in this district seems to have studied the adult flies. I know of no modern work on these flies. The following books deal with galls in general:—"British Vegetable Galls," by E. Connold, 1901; "British Oak Galls," by E. Connold, 1908; "British Galls," by S. L. Mosley (B.F.C. Nature Study Handbooks Series), 1903; "British Plant Galls," by Swanton, 1912; "Les Zoocécidies des Plantes d'Europe," by Houard, 3 vols., 1908-9-13. The following is a list of the Galls made by Cecidomyidae which have been found in this district. They are the records of Miss I. M. Roper, except where otherwise stated.

INSECT.	HOST.	LOCALITY.	DATE.
Cecidomyia tornatella Bremi.	*Fagus sylvatica* L.	G., Wotton under Edge.	29/8/03.
Clinodiplosis thalictricola Rübs.	*Thalictrum minus* L.	S., Cheddar Gorge.	28/7/25.
Contarinia pyrivora Ridley.	*Pyrus communis* L.	S., (C.).	
,, *steini* Karsch.	*Lychnis dioica* L.	G., Oldbury Court Woods.	17/8/27.
,, *tiliarum* Kieff.	*Tilia cordata* Mill.	G., Compton Greenfield.	19/7/17.
,, ,,	,, ,,	S., Axbridge.	18/6/13.
,, ,,	,, *vulgaris* Hayne.	G., Durdham Downs.	1/8/07.
,, ,,	,, ,,	S., Leigh Woods.	27/6/23.
,, ,,	,, *platyphyllos* Scop.	G., Stoke Bishop.	6/7/23.
Cystiphora sonchi F. Löw.	*Sonchus arvensis* L.	G., Filton Meads.	2/8/09.
,, ,,	,, ,,	G., Almondsbury.	27/5/18.
,, *taraxaci* Kieff.	*Taraxacum officinale* Web.	G., Ashley Down.	5/6/22.
Dasyneura sisymbrii Schrank.	*Barbarea intermedia* Bor.	G., Mangotsfield Common.	11/3/22.
,, ,,	,, *vulgaris* Br.	G., Tron Acton.	4/6/08.
,, ,,	,, ,,	S., Stockwood.	19/6/18.
,, ,,	*Radicula pinnata* Moench.	S., Nailsea Moor.	23/6/00.
Hormandia tremulae Winn.	*Populus tremula* L.	G., Bishop's Hill Wood, Wickwar.	30/6/25.
Hormomyia millefolii F. Löw.	*Achillea millefolium* L.	S., Keynsham.	6/8/16.
,, *piligera* F. Löw.	*Fagus sylvatica* L.	S., Failand.	3/10/11.
,, ,,	,, ,,	S., Minehead, (Ha.).	1922.
Lasioptera rubi Hartig.	*Rubus caesius* L.	S., Sandford.	22/8/16.
Macrodiplosis dryobia Kieff.	*Quercus Robur* L.	S., Minehead, (Ha.).	1922.
,, *volvens* Kieff.	,, *sessiliflora* Salisb.	S., Minehead, (Ha.).	1922.
Macrolabis corrugans F. Löw.	*Heracleum Sphondylium* L.	S., Failand.	2/7/17.
,, *pilosellae* Binnie.	*Hieracium Pilosella* L.	S., Keynsham.	19/5/14.
Mayetiola dactylidis Kieff.	*Dactylis glomerata* L.	S., Yatton.	30/9/20.
,, *destructor* Say.	*Triticum* sp.	G., Wotton-under-Edge, (P.).	
Monarthropalpus buxi Laboulb.	*Buxus sempervirens* L.	G., Tortworth Park.	4/1/11.
,, ,,	,, ,,	S., Bourton Combe.	27/3/20.
Oligotrophus annulipes Hart.	*Fagus sylvatica* L.	S., Failand.	3/10/11.
,, ,,	,, ,,	S., Minehead, (Ha.).	1922.
,, *bursarius* Bremi.	*Nepeta Glechoma* Benth.	G., Golden Hill, Horfield.	16/10/18.
,, ,,	,, ,,	S., Tickenham.	16/10/98.
,, *capreae* Winn.	*Salix cinerea* L.	S., Long Ashton.	15/6/27.
,, *corni* Giraud.	*Cornus sanguinea* L.	G., Ashley Down.	27/7/08.
,, ,,	,, ,,	S., Asham Woods, Frome.	4/8/19.

INSECT.	HOST.	LOCALITY.	DATE.
Oligotrophus reaumurianus F. Löw.	*Tilia vulgaris* Hayne.	S., Leigh Woods.	27/6/23.
,, *solmsii* Kieff.	*Viburnum Lantana* L.	S., Leigh Woods.	23/9/11.
,, ,,	,, ,,	S., Portishead.	3/5/05.
,, *taxi* Inchb.	*Taxus fastigiata* Lindl.	G., Yate Churchyard.	19/3/24.
,, ,,	,, *baccata* L.	G., Winterbourne.	24/2/99.
,, ,,	,, ,,	S., Chelvey Batch.	16/2/16.
Perrisia affinis Kieff.	*Viola silvestris* Lam.	G., Littleton-on-Severn.	18/10/17.
,, ,,	,, ,,	S., Long Ashton.	12/5/08.
,, *brunella* Kieff.	*Prunella vulgaris* L.	S., Barrow Gurney.	24/8/07.
,, *cardamines* Winn.	*Cardamine pratensis* L.	S., Compton Dando.	27/5/11.
,, *crataegi* Winn.	*Crataegus monogyna* Jacq.	S., Long Ashton.	18/7/04.
,, ,,	,, ,,	S., Minehead, (Ha.).	1922.
,, *fraxini* Kieff.	*Fraxinus excelsior* L.	S., Leigh Woods.	10/10/05.
,, ,,	,, ,,	S., Banwell.	30/5/18.
,, ,,	,, ,,	S., Minehead, (Ha.).	1922.
,, ,,	,, ,,	G., Frenchay.	15/6/06.
,, *galii* H. Löw.	*Galium saxatile* L.	G., Bury Camp, Moorend.	27/9/10.
,, ,,	,, *verum* L.	S., Winscombe.	17/6/04.
,, ,,	,, *palustre* L.	S., Nailsea.	18/7/08.
,, ,,	,, *Mollugo* L.	S., Cheddar.	24/10/06.
,, ,,	,, ,,	S., Minehead, (Ha.).	1922.
,, *galiicola* F. Löw.	,, ,,	S., Cheddar.	24/10/06.
,, *genesticola* F. Löw.	*Genista tinctoria* L.	G., Goose Green, Yate.	22/10/20.
,, *papaveris* Winn.	*Papaver* sp.	G., Wotton-under-Edge, (P.).	
,, *persicariae* L.	*Polygonum amphibium* L.	S., Shapwick.	14/6/04.
,, ,,	,, *persicaria* L.	S., Kenn Moor.	22/6/11.
,, *rosarum* Hardy.	*Rosa* sp.	S., Minehead, (Ha.).	1922.
,, *serotina* Winn.	*Hypericum* sp.	G., Wotton-under-Edge, (P.).	
,, *stachydis* Bremi.	*Stachys sylvatica* L.	S., Charterhouse-on-Mendip.	24/8/15.
,, *terminalis* H. Löw.	*Salix fragilis* L.	S., Clapton in Gordano.	30/8/15.
,, *Thomasiana* Kieff.	*Tilia vulgaris* Hayne.	S., Leigh Woods.	27/6/23.
,, *tiliam-volvens* Rüb.	,, ,,	S., Leigh Woods.	27/6/23.
,, *ulmariae* Bremi.	*Spiraea Filipendula* L.	G., Durdham Downs.	15/6/11.
,, ,,	,, *Ulmaria* L.	S., Pensford.	26/6/03.
,, ,,	,, ,,	S., Compton Martin.	21/6/07.
,, ,,	,, ,,	S., Minehead, (Ha.).	1922.

INSECT.	HOST.	LOCALITY.	DATE.
Perrisia urticae Perris.	*Urtica dioica* L.	G., Upton Cheney.	14/7/06.
,, ,,	,, ,,	G., Bank of Avon.	8/6/18.
,, ,,	,, ,,	S., Leigh Woods.	29/9/20.
,, ,,	,, ,,	S., Brislington.	6/10/16.
,, ,,	,, ,,	S., Keynsham.	15/7/22.
,, ,,	,, ,,	S., Minehead, (Ha.).	1922.
,, ,,	,, *urens* L.	G., Frenchay.	24/10/16.
,, ,,	,, ,,	G., Moorend.	21/9/09.
,, ,,	,, ,,	S., Woodspring Priory.	20/7/27.
,, *veronicae* Vallot.	*Veronica Chamaedrys* L.	G., Yate.	22/10/20.
,, ,,	,, ,,	S., Clapton-in-Gordano.	21/6/07.
,, ,,	,, ,,	S., Barrow Gurney.	27/10/21.
,, ,,	,, ,,	S., Minehead, (Ha.).	1922.
,, *viciae* Kieff.	*Vicia angustifolia* L.	G., Shirehampton.	28/6/24.
,, ,,	,, ,,	S., Brislington.	7/6/17.
,, ,,	,, *tetrasperma* Moench.	G., Shirehampton.	16/6/21.
,, ,,	,, *Cracca* L.	S., Pensford.	28/8/24.
,, ,,	,, *sepium* L.	S., Tickenham.	25/10/19.
Rhabdophaga rosaria H. Löw.	*Salix alba* L.	S., Keynsham.	12/5/17.
,, ,,	,, ,,	S., Gurney Slode.	8/9/25.
,, ,,	,, *aurita* L.	G., Lansdown, Bath.	11/4/22.
,, ,,	,, *caprea* L.	G., Hanham.	22/3/19.
,, ,,	,, *cinerea* L.	S., Barrow Gurney.	11/6/18.
,, *salicis* Sch.	,, ,,	S., Kenn Moor.	28/9/17.
,, ,,	,, *purpurea* L.	S., Minehead, (Ha.).	1922.
Rhopalomyia ptarmicae Vallot.	*Achillea ptarmica* L.	G., Milbury Heath.	3/8/14.
,, *tanaceticola* Karsch.	*Tanacetum vulgare* L.	G., Hanham.	24/9/20.
,, ,,	,, ,,	G., Under Sea Walls.	16/8/27.
,, ,,	,, ,,	S., Under Leigh Woods.	27/9/20.
Schizomyia galiorum Kieff.	*Galium verum* L.	S., Weston-Super-Mare.	5/8/15.
,, ,,	,, ,,	S., Burnham.	22/8/23.
,, *pimpinellae* F. Löw.	*Daucus Carota* L.	S., Yatton.	14/8/16.
Stictodiplosis corylina F. Löw.	*Corylus Avellana* L.	G., Forest of Dean.	17/8/25.
,, ,,	,, ,,	S., Failand.	19/2/20.
,, ,,	,, ,,	S., Cleeve.	7/12/20.

II. MYCETOPHILIDAE.

These little flies, called Fungus Gnats because their larvae live in toadstools, are recognised by their hunchback appearance, by their long legs which have long spurs on the tibiae and by the absence of a transverse suture on the thorax. They are usually caught by sweeping with a net in grass and bushes under trees. They are comparatively easy to breed at home if the toadstool containing the larvae be placed in a pot with some dry soil at the bottom and a muslin cover over the mouth. Mr F. W. Edwards has written a most useful summary of the British Mycetophilidae in *Trans. Ent. Soc.*, February 1925.

Allodia crassicornis Stan. G., Blaise Castle (A.), 11/4/27. S., Shepton Mallet (C.).
,, *grata* Mg. G., Blaise Castle (A.)., 11/4/27.
,, *griseicollis* Staeg. (*caudata* Winn.). G., Olveston (A.), 5/11/22.
,, *lugens* Wied. G., Blaise Castle (A.)., 18/3/22. S., Leigh Woods (H.) and (A.), 31/9/27.
,, *ornaticollis* Mg. (*longicornis* Wlk.). G., Olveston (C.). S., Portishead (A.), 12/11/22.
Anlemon (*Helladepichoria*) *serrulum* Wlk. S., Leigh Woods (H.).
Apemon (*Platyura*) *marginata* Mg. G., Wotton-under-Edge (P.). S., Wells (L.); Brockley Combe (Chm.), 16/5/26.
Asindulum flavum Winn. (*rostratum* Ztt.). S., Leigh Woods (H.), 6/7/17 and 11/6/18.
Boletina basalis Mg. S., Brockley Combe (H.), 26/5/16.
,, *dubia* Mg. (*inermis* Lundst.). G., Blaise Castle (A.), 9/4/21. S., Wells (L.).
,, *gripha* Dz. S., Leigh Woods (H.).
,, *trivittata* Mg. G., Blaise Castle (A.), 28/5/27. S., Leigh Woods (H.).
Bolitophila cinerea Mg. S., Leigh Woods (A.), 18/10/24.
,, *glabrata* Lw. S., Wells (L.).
,, *hybrida* Mg. (*fusca* Mg.). G., Hallen (A.), 10/10/25.
,, *saundersi* Curt. G., Hallen (A.), 10/10/25. S., Leigh Woods (Wm.), 27/10/22.
,, *spinigera* Edw. G., Blaise Castle (A.), 18/11/22.
Brachypeza helvetica Wlk. (*spuria* Verr.). S., Wells (L.).
Cordyla fusca Mg. G., Hallen (A.), 14/9/25. S., Leigh Woods (A.), 27/9/25.
Cerotelion (*Ceroplatus*) *humeralis* Ztt. S., Leigh Woods (H.).
,, ,, *lineatus* F. S., Leigh Woods (H.); Holford Glen (Sl.), 25/7/25.
Ceroplatus testaceus Dalm. (*tipuloides* F.). S., Shepton Mallet (C.).
Dynatosoma fuscicorne Mg. S., Leigh Woods (H.), 1/7/18; Shapwick (A.), 20/5/23.
Exechia festiva Winn. S., Backwell (A.), 25/4/26.
,, *fusca* Mg. (incl. *fungorum* Auct., *guttiventris* Mg., *lateralis* Mg.). G., Blaise Castle (A.), 18/2/22; Olveston (A.), 5/11/22; Painswick (W.). S., Shepton Mallet (C.).
,, *nana* Staeg. G., Hallen (A.), 14/9/25.
,, *parva* Lundst. G., Blaise Castle (A.), 24/10/22.
,, *trisignata* Edw. G., Blaise Castle (A.), 18/2/22.
,, *trivittata* Staeg. G., Olveston (A.), 5/11/22.
,, *unguiculata* Lundst. G., Blaise Castle (A.), 18/2/22.
Isoneuromyia (*Platyura*) *ochracea* Mg. (*dorsalis* Staeg.). G., Olveston (A.); Kingsweston (A.), 31/5/25.
,, ,, *semirufa* Mg. G., Blaise Castle (A.), 8/21. S., Wells (L.).
Leia (*Leiomyia*, *Glaphyroptera*) *bilineata* Winn. var. G., Tormorton (A.), 20/5/26. First British Record.
,, ,, ,, *bimaculata* Mg., var. *fasciola* Mg. S., Leigh Woods (H.).
,, ,, ,, *fascipennis* Mg. S., Portishead (A.), 24/9/21. G., Cirencester (T.), 7/6/23; Olveston (A.), 8/10/22.

Leia (*Leiomyia, Glaphyroptera*) *winthemi* Lehm. S., Leigh Woods (H.).
Leptomorphus walkeri Curt. G., Kingsweston (A.), 29/8/24.
Macrocera angulata Mg. G., Painswick (W.), 7/9/22; Hallen (A.), 13/6/26.
,, *centralis* Mg. G., Kingsweston (A.), 9/6/23. S., Shepton Mallet (C.); Clevedon (A.), 14/5/27.
,, *fasciata* Mg. G., Hallen (A.), 10/10/25. S., Weston-s.-Mare (J.); Leigh Woods (A.), 22/5/26.
,, *lutea* Mg. G., Painswick (W.), 10/6/96. S., Cranmore Woods (C.).
,, *stigma* Curt. G., Painswick (W.), 11/5/90; Winterbourne (A.), 13/5/23; Blaise Castle (A.), 11/5/24. S., Leigh Woods (H.), 30/5/18; Pensford (A.), 24/5/23.
,, *vittata* Mg. G., Painswick (W.), 7/97. S., Leigh Woods (H.).
Mycetophila cingulum Mg. S., Leigh Woods (H.).
,, *curviseta* Lundst. G., Blaise Castle (A.), 16/3/24.
,, *formosa* Lundst. S., Flax Bourton (Wm.), 8/4/22.
,, *fungorum* Deg. (*punctata* Mg.). G., Blaise Castle (A.), 29/10/22; Olveston (A.), 8/10/22. S., Shepton Mallet (C.); Leigh Woods (H.).
,, *lineola* Mg. G., Blaise Castle (A.), 29/10/22; Olveston (A.), 5/11/22. S., Shepton Mallett (C.).
,, *marginata* Winn. S., Leigh Woods (H.).
,, *occultans* Lundst. G., Blaise Castle (A.), 29/10/22.
,, *ornata* Steph. (*rufescens* Ztt.). G., Blaise Castle (Wm.), 7/8/23.
,, *signatoides* Dz. S., Shapwick (Wm.), 6/8/22.
,, *trinotata* Staeg. (*russata* Dz.). G., Olveston (A.), 25/4/23.
,, *unicolor* Stan. S., Leigh Woods (H.), 6/5/18.
Mycomyia (*Sciophila*) *hyalinata* Mg. S., Leigh Woods (A.), 18/10/24.
,, ,, *trilineata* Ztt. S., Sharpham (A.), 9/8/23.
,, ,, *winnertzi* Dz. (*fasciata* Ztt.). G., Wotton-under-Edge (P.). S., Brockley Combe (J.); Leigh Woods (H.).
Neuratelia (*Anaclinia*) *nemoralis* Mg. S., Leigh Woods (H.), 30/5/18; (A.), 22/5/27.
Phorodonta (*Sciara*) *flavipes* F. G., Cirencester (T.); Kingsweston (A.), 13/3/26. S., Leigh Woods (H.); Shapwick (A.), 1/5/27.
Phronia basalis Winn. S., Weston-s.-Mare (H.).
,, *cinerascens* Winn. G., Hallen (A.), 24/9/27.
,, *conformis* Wlk. (*girschneri* Dz.). G., Olveston (A.), 2/5/22.
,, *forcipata* Winn. G., Kingsweston (A.), 20/4/25.
,, *signata* Winn. S., Leigh Woods (A.), 12/10/22.
,, *tenuis* Winn. S., Leigh Woods (A.), 21/9/27.
Platyura fasciata Mg. G., Painswick (W.), 28/7/92. S., Culm Head (H.); Leigh Woods (H.).
,, *nemoralis* Mg. G., Kingsweston (A.), 6/6/26. S., Leigh Woods (A.), 28/5/27.
Pnyxia (*Epidapus*) *scabiei* Hopkins. G., Clifton (C.). First British record.
Rhymosia domestica Mg. G., Blaise Castle (A.), 15/5/26. S., Wells (L.).
,, *fasciata* Mg. G., Painswick (W.); Olveston (A.), 24/3/23; Bristol (A.), 2/12/24.
,, *fenestralis* Mg. G., Painswick (W.); Olveston (A.), 24/3/23. S., Leigh Woods (H).
,, *spinipes* Winn. G., Blaise Castle (A.), 15/5/26. S., Leigh Woods (A.), 12/10/22.
Sceptonia nigra Mg. G., Blaise Castle (A.), 19/10/22; Fishponds (A.), 7/5/27. S., Leigh Woods (A.), 31/9/27.
Sciara bicolor Mg. (*rufiventris* Mcq.). G., Kingsweston (A.), 6/6/26.
,, *brunnipes* Mg. S., Shepton Mallet (C.).
,, *carbonaria* Mg. G., Bristol (C.). S., Leigh Woods (H.).
,, *flavicauda* Ztt. S., Leigh Woods (A.), 22/5/26.
,, *hyalipennis* Mg. S., Keynsham (A.), 15/5/22.
,, *nitidicollis* Mg. G., Painswick (W.). S., Shapwick (A.), 20/5/23.
,, *praecox* Mg. G., Wotton-under-Edge (P.); Olveston (A.), 6/4/23; Blaise Castle (A.), 18/3/22.
,, *ruficauda* Mg. S., Leigh Woods (H.).

Sciara thomae L. G., Chalford (W.); Olveston (A.), 5/9/22; Kingsweston (A.), 29/8/24. S., Shepton Mallet (C.); Sharpham (A.), 7/9/25.

The synonymy of the following has not been established.

Sciara morio F. S., Shepton Mallet (C.).
,, *nervosa* Mg. G., Painswick (W.).
,, *pallipes* F. S., Leigh Woods (H.), 8/9/17; Portishead (A.), 15/10/22.
,, *pulicaria* Mg. G., Painswick (W.); Bristol (C.).
,, *scatopsoides* Mg. S., Tickenham (A.), 6/22.

Many Sciaras in my collection are awaiting determination.

Sciophila (*Lasiosoma*) *varia* Winn. S., Leigh Woods (A.), 18/10/24.
Symmerus (*Plesiastina*) *annulatus* Mg. G., Painswick (W.); Wotton-under-Edge (P.).
Trichonta fasciata Winn. Synonymy ? S., Nailsea (H.), 6/5/18.
Trichosia absurda Winn. S., Culm Head (H.).
Zygomia notata Stan. (*Mycetophila nigritula* Wlk.). G., Ruscombe (W.), 15/10/98. S., Pill (H.), 8/9/17.
Zygoneura sciarina Mg. S., Sharpham (A.), 2/8/25.

III. BIBIONIDAE.

A family of fairly large, black, hairy flies with large round hairy eyes, contiguous in the male. Legs long, spurs on tibiae. Costa and fore veins of wing usually dark, other veins faint. Larvae live in decomposing vegetable matter. Mr F. W. Edwards has an excellent monograph of this and of the next family in "Ann. of App. Biology," vol. xii., No. 2, 1925.

Bibio clavipes Mg. G., Painswick (W.); Bristol (C.). S., Freshford (Bl.).
,, *ferruginatus* L. G., Wotton-under-Edge (P.); Tortworth (A.), 27/4/27.
,, *hortulanus* L. G., Wotton-under-Edge (P.). S., Cannington (Sl.); Leigh Woods (H.).
,, *johannis* L. G. and S., Common in May. (St John's Fly.)
,, *laniger* Mg. G. and S., Common in May.
,, *leucopterus* Mg. G., Painswick (W.). S., Shepton Mallet (C.); Axbridge (Rd.); Shapwick (A.), 20/5/23; Leigh Woods (A.), 23/5/25; Bath (A.), 8/5/26.
,, *marci* L. G. and S., Common in April. (St Mark's Fly.)
,, *nigriventris* Hal. G., Painswick (W.). S., Leigh Woods (H.), 19/5/19.
,, *pomonae* F. G., Wotton-under-Edge (P.). S., Shepton Mallet (C.); Shapwick (Sl.), 22/6/27.
,, *reticulatus* Lw. S., Leigh Woods (H.).
,, *varipes* Mg. G., Winterbourne (A.), 28/4/23; Kingsweston (A.), 2/5/26. S., Leigh Woods (H.); Backwell (A.), 25/4/26.
,, *varipes* Mg., var. *hybridus* Hal. G., Blaise Castle (A.), 15/5/26. S., Backwell (A.), 25/4/26.
,, *venosus* Mg. G., Painswick (W.). S., Shepton Mallet (C.).
Dilophus febrilis L. G. and S., Common in spring. (Fever Fly.)
,, *femoratus* Mg. (*albipennis* Mg.). G., Painswick (W.); Kingsweston (A.), 31/5/25. S., Shepton Mallet (C.); Tickenham (A.), 20/5/21; Leigh Woods (A.), 25/5/25.

IV. SCATOPSIDAE.

Small, black, shining, almost bare flies with reniform eyes, somewhat resembling the Bibionidae. Legs rather short, no spurs on tibiae. Wings and larvae as in Bibionidae.

Psectrosciara coxendix Verr. S., Sharpham (A.), 7/9/25.
,, *halterata* Mg. G., Olveston (A.). S., Shapwick (A.), 3/9/22.
,, *soluta* Lw. S., Tickenham (A.), 19/7/24.

Scatopse flavicollis Mg. S., Leigh Woods (H.).
,, *notata* L. G. and S., common.
,, *picea* Mg., var. *scutellata* Lw. G., Painswick (W.).
,, *pulicaria* Lw. G., Bristol (Wm.), 28/10/22.
Swammerdamella brevicornis Mg. G., Shepperdine (A.), 15/8/24.

V. SIMULIDAE.

These flies, known as Sand Flies, are small, black flies with very broad wings and short antennae. Legs short, costa and fore veins of wings dark, other veins pale. The females of many species can bite and are troublesome to cattle and horses. The larvae live attached to stones in running water, see "Nat. Hist. of Aquatic Insects," by Prof. L. C. Miall, 1903. Mr F. W. Edwards has written a monograph of the British species in "Bull. of Ent. Research," vol. xi., part 3, 1920. The Simulidae are one of the families studied by M. E. Séguy in "Faune de France," vol. xii., 1925. It may be said here that all French books on Diptera are of the greatest use to British entomologists. The fauna of France is more extensive than ours, but it generally includes all British species.

Simulium aureum Fries. (*angustipes* Edw.). S., Wells (C.).
,, *equinum* L. S., Taunton (C.).
,, *latipes* Mg. G., Olveston (C.). S., Tickenham (A.), 24/4/24.
,, *ornatum* Mg. G., Cirencester (T.), 30/6/23; Bristol (B.), 22/6/24. S., Taunton (C.); Wells (C.).

VI. CHIRONOMIDAE.

These flies, called Midges, are moderately large with long legs and plumed antennae in the male. Wings long and narrow, bare or slightly hairy, sometimes spotted, costa not reaching apex of wing. No cross-suture on thorax. Their larvae, known as bloodworms, live in the mud of ponds. I know of no modern work on the Chironomidae. "Faune de France," vol. xv., by Dr M. Goetghebuer, deals with the sub-family Tanypodinae. The following list of species requires revision.

Camptocladius aterrimus Mg. G., Blaise Castle (A.), 18/3/22; Fishponds (A.), 24/3/22. S., No locality (C.).
,, *byssinus* Schrk. G., Kingsweston (A.), 4/4/27.
Chironomus albimanus Mg. S., Shepton Mallet (C.).
,, *annularis* Deg. G., Olveston (A.), 8/4/23.
,, *aprilinus* Mg. G., Blaise Castle (A.), 10/4/21.
,, *dispar* Mg. G., Blaise Castle (A.), 18/2/22. S., Axbridge (Rd.); Shapwick (A.), 25/3/21; Tickenham (A.), 16/9/22.
,, *dorsalis* Mg. G., Painswick (W.). S., Leigh Woods (H.), 27/7/17; Dunster (A.).
,, *ferrugineovittatus* Ztt. S., Keynsham (A.), 14/7/26.
,, *fuscipennis* Mg. G., Painswick (W.).
,, *pallens* Mg. S., Taunton (C.).
,, *pedellus* Deg. G., Painswick (W.). S., Leigh Woods (H.); Sharpham (A.), 10/9/25.
,, *pedestris* Mg. G., Painswick (W.); Tortworth (A.), 27/4/27.
,, *plumosus* L. G., Painswick (W.), S., no locality (C.).
,, *riparius* Mg. G., Olveston (A.), 4/6/22. S., Cheddar (H.).
,, *rufipes* L. S., Hanham (A.), 19/6/22; Taunton (A.), 9/6/24.
,, *tendens* F. S., Sharpham (A.), 22/8/25.
,, *tentans* F. G., Westbury-on-Trym (A.). S., Sharpham (A.), 5/8/25; Nailsea (A.), 21/4/27.
,, *virescens* Mg. S., Nempnett (C.).

Coryoneura minuta Winn. S., Shepton Mallet (C.).
Cricotopus annulipes Mg. G., Painswick (W.). S., Shepton Mallet (C.).
,, *bicinctus* Mg. S., Shepton Mallet (C.).
,, *motitator* L. S., Nailsea (A.), 21/4/27.
,, *pilitarsis* Ztt. S., Sharpham (A.), 22/8/22.
,, *tremulus* L. S., Axbridge (Rd.).
Diamesa obscurimana Mg. S., Shepton Mallet (C.).
Metriocnemus coaequatus Wlk. G., Painswick (W.).
,, *fuscipes* Mg. G., Painswick (W.); Bristol (C.). S., Shapwick (A.), 25/3/21.
Orthocladius albolineatus Mg. G., Olveston (C.).
,, *barbicornis* F. G., Fishponds (A.), 24/3/22.
,, *irritus* Wlk. S., Axbridge (Rd.).
,, *lucens* Ztt. S., Leigh Woods (H.).
,, *notatus* Mg. S., Shepton Mallet (C.); Tickenham (A.), 24/4/22.
,, *stercorarius* Deg. G., Olveston (A.), 18/6/22. S., Leigh Woods (H.).
,, *variabilis* Staeg. G., Olveston (C.); Fishponds (A.), 24/3/22. S., Shepton Mallet (C.).
Tanytarsus flavipes Mg. S., Dundry (A.), 13/2/21.
,, *praecox* Mg. S., Nailsea (A.), 21/4/27.

Sub-family Tanypodinae.

Macropelopia nebulosa Mg. G., Winterbourne (A.), 28/4/23. S., Shepton Mallet (C.).
,, *notata* Mg. G., Stone (A.), 21/5/27.
,, *nugax* Wlk. G., Fishponds (A.), 7/5/27; Blaise Castle (A.), 28/5/27.
,, *punctata* F. G., Bitton (C.). S., Abbot's Leigh (A.), 16/5/26.
Protenthes punctipennis Mg. G., Painswick (W.).
Psectrotanypus trifascipennis Ztt. G., Painswick (W.).
,, *varius* F. G., Painswick (W.); Winterbourne (A.), 28/4/23; Fishponds (A.), 7/5/27. S., Shepton Mallet (C.); Prior Park, Bath (A.), 8/5/26; Nailsea (A.), 21/4/27.
Tanypus binotatus Mg. G., Painswick (W.).
,, *ferrugineicollis* Mg. S., Shepton Mallet (C.).
,, *melanops* Mg. G., Kingsweston (Wm.), 19/5/22.
Trichotanypus choreus Mg. S., Shepton Mallet (C.); Prior Park, Bath (A.), 8/5/26.

VII. CERATOPOGONIDAE.

These are tiny black Midges, much resembling the Chironomidae but, unlike them, very tiresome biters. The wings are folded when the fly is at rest (never folded in Chironomidae), the third vein of the wing is forked (not forked in Chironomidae), legs shorter than in Chironomidae and hind legs longest instead of front pair, back not so humped. The larvae live in decomposing vegetable matter. Mr F. W. Edwards has published a monograph on the British species in "Trans. Ent. Soc., vol. lxxiv., part 2, 1926, and M. l'abbé J. J. Kieffer deals with them in vol. xi. of the "Faune de France." These flies have not been studied locally; the following list should be easily trebled.

Bezzia ornata Mg. S., Sharpham (A.), 9/8/25.
Culicoides pulicaria L. G., Painswick (W.); Kingsweston (A.), 20/4/25. S., Shepton Mallet (C.); Shapwick (A.), 20/5/23.
,, *varius* Winn. G., Painswick (W.).
Dasyhelea aestiva Winn. G., Westbury-on-Trym (A.), 4/21.
,, *versicolor* Winn. S., Brockley Combe (Wm.), 21/8/28.
Forcipomyia brevipennis Mcq. G., Aust (A.), 6/4/22.
Serromyia femorata F. S., Nailsea (C.); Shapwick (A.), 20/5/23.

Bristol Botany in 1928.

By Jas. W. White, M.Sc., F.L.S.

THE dull chilly days, night frosts and contrasting heat waves of the late fickle spring-time together with a persistent drought in April and May had their effect on our early-blooming flowers with results that in some ways were difficult to understand. The botanist interested in water plants, and wishing to study the forms of Water-Crowfoot in particular, had a disappointing season. Ditches and ponds commonly well supplied with clear water were reduced to muddy swamps in which these pretty plants could only raise themselves a few inches amid a mass of duckweed and enteromorphic slime. Umbelliferae, on the other hand, appeared to be braced and stimulated by the conditions. For all too short a time Hedge Parsley gave our hedgerows a snowy lining of unusual depth and regularity. In the damper hedge-bottoms Water Dropwort followed in similar profusion and for a longer period. Alexanders flowered and fruited vigorously in all its stations; and Gout-weed's neat and shapely hemispheres were uncommonly abundant. Parsnips, Carrots and Fennel, too, were never in better form. Apart from Umbelliferae there was a singular dearth of wayside and woodland flowers for a time at Midsummer. The spring flowers had passed, and it seemed as if their successors had been so let and hindered in their development that they were not ready to follow on without a break. It is reported from the peat moors by Mr Miller that *Lathyrus palustris* and the several species of *Utricularia* hardly flowered at all this summer. Orchids maintained the reputation for uncertain flowering that pertains to this group. Under a Beech in Bourton Combe, where in past seasons two or three plants of the Bird's-nest Orchis had been observed, no less than twenty-two stems were counted this year by Mr Gibbons. Frog Orchis was reported to be rather more numerous, though it is never plentiful in this district; and a few plants of Fly Orchis showed themselves again in the locality mentioned in 1925.

To the non-botanical city dweller, however, the event of real interest and attraction among our wild flowers was a profuse blooming of the Hawthorn in spite of so much ungenial weather in preceding weeks. From any spot of vantage on the Downs—preferably from the Observatory Hill facing northward—the enviable onlooker could enjoy a view of surpassing natural beauty in the wide expanse of fragrant whiteness spread out before him with, on clear days, a gleam of sea shimmering in the Severn haze beyond, and South Wales heights as a background. So wonderful a display occurs only at long intervals. It is on record that the season of 1881 was thought to be the most luxuriant known in our time. These years of overblooming have to be succeeded by quiescent periods, necessary for recovery and restoration, during which the flowering is a comparative failure. Although in temperate regions these exhausting efforts are rarely if ever fatal, in warmer climates plants that overshoot their limit of endurance are sometimes unable to retrieve. Striking examples are those of the so-called Hundred-year Aloe and of a handsome Indian species that flowers once only at a considerable age. In a given area moreover all plants of the latter flower in the same year, and all die simultaneously. Then, as with the Aloe, offshoots from the root start to replace defunct parents and save the race from extinction. It might be expected that as the want of regularity referred to is by no means confined to our Hawthorns, Apples and Pears, we should find it mentioned in the works of naturalists who wrote with the intention of opening our eyes more widely to matters of interest with which they themselves had been impressed. But observations on the point, if they exist, are difficult to trace. As is known to everybody Gilbert White was an outstanding pioneer in seeking for truth among Nature's mysteries. But in the *Natural History of Selborne*, he gave little space to wild flowers. He set down the aims and attributes which he thought should qualify a botanist, but inclination led him no further in that direction. The only mention of Hawthorn in his classic work is the date of flowering given in a Calendar. During the early years of last century Dr Knapp of Thornbury wrote his *Journal of a Naturalist*, a delightful book that has been described as " a botanical companion to White's *Selborne*." With this writer the love of flowers was an implanted passion free from affectation or alloy. The eloquence, tenderness and humility with which he expresses his admiration and records his conjectures and reflections are unmatched in my reading. The White-thorn is stated to afford a good example of steadiness to *time*. Observations extending over twenty years had proved how little it deviated in its date of blossoming from one season to another. In all that period the author never but twice saw more than a partial flowering before the first of May. There is no mention of variation in the *amount* of bloom. A generation or so later Edwin Lees, the poet-botanist of Worcestershire, published the *Botanical Looker-out among the Wild Flowers of England and Wales.* Mr Lees considered that " the exact time of flowering of each species becomes a matter not merely of curiosity but of utility." And so amid pages of adulation in prose and verse we find a note that the Hawthorn, " which is in many Springs at least, partially in flower on May-day, and in 1840 was observed in flower in Worcestershire on April 25th, only commenced to bloom in 1837 on May 26th. In a ride of thirty miles the bush was the only one thus circumstanced." Here again the author has nothing to say on the matter in question. A sense of disappointment may follow such an ineffectual search; yet, as every naturalist knows, Nature never reveals her secrets without reluctance, and our ability to discern the meaning of what we see is poor indeed.

Returning now to our Downs' glory and looking back upon it all to mid-Victorian days one is aware of a decided improvement in the behaviour of the people, due either to a higher stage of mental culture attained through better schooling or to a more efficient patrol—probably to both. Half a century ago one grieved to see boys and girls carrying off armfuls of sprays and leaving broken branches to disfigure the normal shapely outline of the May-trees. Their forbears doubtless did the same but with more warrant, when there stood a Maypole to be garlanded. Even within the last twenty years I wrote that for size and elegance the Downs' trees did not compare with those protected by enclosure, as in Ashton Park. That is not true to-day, because mischief is no longer rampant and old damage has been repaired. The replaced branches, unbroken and unstripped, now bend down gracefully to touch the turf. It can be upheld that nowadays many of the Downs' trees especially those in the less frequented area beyond the Westbury road, are not to be surpassed in grace and shapeliness. What a comfort it surely is to realise that, while so much of rural England has suffered defacement during the last generation, the attractions of one beauty-spot on the confines of our crowded city are being enhanced!

One species new to our area has been reported. As will be learnt from the subjoined list, new varieties tend to become commoner than new species; and unfamiliar aliens continue to arise on ship refuse and tips of city rubbish.

Arabis stricta Huds. Introduced and well established upon walls near Bridgwater. See *Journ. Bot.*, May 1928. *H. S. Thompson*.

Cochlearia danica L. Still persists at Anchor Head, Weston-s.-Mare, in spite of increased trampling crowds; *Miss Roper*.

Sagina Reuteri Lange. Frenchay Common, G., on scanty soil; *Mrs Wedgwood*. New to the vice-county. Through some unfortunate mistake it was announced in the last Secretarial Report of the *Bot. Soc. and Exch. Club* that this rare pearl-wort had been discovered at Burnham by Mr W. D. Miller. I am informed that the specimen forwarded to Dr. Druce was not gathered in North Somerset.

Erodium moschatum L'Her., var. *minor* Rouy. The small, early-flowering plant known for many years at Purn Hill and other localities may not be the same as the Continental one although the descriptions agree, or this form may have been given varietal rank on insufficient grounds. In any case recent experiments made by Mr Miller and Lady Davy have shown that on cultivation in garden soil the Purn Hill plant speedily develops into the type.

Caucalis nodosa Scop., var. *pedunculata* Rouy. Avonmouth, G., September 1927; *Ida M. Roper* in *Report Bot. Exch. Club*. Another instance of adapting a British variation to a variety named by the French author. In its extreme state, and Miss Roper's specimens appear to have been well marked, this pedunculate form may deserve distinction. It is stated, however, not to be really constant.

Crithmum maritimum L. At least fifty plants near the old Pier, Weston-super-Mare; *F. Samson*.

Trifolium subterraneum L. On Cadbury Hill, Yatton, S.; *Dr. W. Watson*.

Agrimonia odorata Mill. Sparingly at Hill, G.; *E. Nelmes*.

Valeriana officinalis L. Feather-bed Lane, Clutton, S.; *Miss Roper.*

Galium ochroleucum Syme. (*Mollugo×verum.*) Compton Bishop, S.; *Miss Miller.*

Artemisia gnaphalodes Nutt. Alien. Edington Junction, S.; *W. D. Miller.*

Lactuca saligna L. Several fine plants of this rarity within the Docks area at Avonmouth, G.; *Mrs Sandwith.*

Sonchus asper Hill, var. *integrifolia* Lej. Chase Hill, Wickwar, G., July 1927; *Ida M. Roper* in *Report Bot. Exch. Club.* Markham Farm near Abbotsleigh, S.; *J. W. W.*

Hieracium umbellatum L. Plants on Shapwick Drove, S., had all been galled by *Aulacidea hieracii*, one of the Hymenoptera, named by Mr N. G. Hadden; *W. D. Miller.*

Obione portulacoides Moq. Ten large patches on the river bank at Shirehampton, G.; *C. Alden.* Not reported thence since St Brody's day, c. 1866. A most interesting survival.

Chenopodium album L., var. *subficifolium* Murr. and var. *pedunculare* Bert. Bristol city-tip, G.; *Miss Todd.* ×*striatum*=*C. substriatum* Murr. Near the G.W.R. Goods Depot, G.; *Dr. Druce.*

C. leptophyllum Nutt. Avonmouth Docks, G.; *Mrs Sandwith.*

C. rubrum L., var. nov. *Kochiiforme* Murr. "Ramis plurimis, teneris, fo'iis omnibus praesertim ramosum valde angustis." Bedminster, S.; *C.* and *N. Sandwith.*

Rumex Patientia L. For some years luxuriantly (5-6 feet) on rubbish tipped by the Cranbrook Road, G. Nyman says that this Dock was most probably derived originally from Central Asia, and had spread from cultivation as a culinary herb through many European countries.

R. salicifolius Weinn. A North American species. Several plants by Avonmouth Docks, G.; *Mrs Sandwith.*

Spiranthes autumnalis Rich. Still occurs sparingly on rough sandy ground near Burnham where it was recorded by Mr Waterfall many years ago; *H. S. Thompson.*

Sisyrinchium angustifolium Mill. This also still exists on "golfing ground" at Burnham, whence we heard of it in 1906 and 1912. Mr W. D. Miller now writes that at least two dozen plants were flowering in June on a patch of several square yards.

Zostera marina L. Leaves cast up on Brean sands were found by Miss Miller, thus confirming St Brody's record; and in Sand Bay, Kewstoke, by Mr Gibbons.

Scirpus Holoschoenus L. A small clump of this rare sedge, first noticed by her in September 1927, has been shown me by Mrs Sandwith on waste land adjoining the Docks at Avonmouth where it seems likely to remain undisturbed. This is a slender, weak form remarkable for its floral bracts: those subtending the small clusters being prolonged to thrice the customary length. The plant is far more frequent in

Southern Europe than with us and is described as a very polymorphic species.

Holcus mollis L. Mrs Gregory has written that " Though rare in Weston Woods before the War, it sprang up plentifully after the trees had been cut down."

Adiantum Capillus-Veneris L. In the *Flora of Bristol* the reported occurrences of Maiden-hair Fern in North Somerset were deemed unreliable—due either to mistakes or introduction—but lately I have learned from Mrs Gregory that she remembers seeing it growing, many years ago, on a sheltered rock, between Sand Bay and the old Pier at Weston-super-Mare.

Chara vulgaris L., var. *crassicaulis* Kuetz. In the deeper part of Monks Wood Reservoir near Bath. Named by Mr James Groves; *H. F. Barke.* The county boundary runs through the middle of the reservoir.

The recently formed salt-marsh on the Gore Sands at Berrow is attracting much attention. Several submaritime species have added themselves to those already established. Colonies of *Scirpus maritimus* are rapidly increasing, while *S. Tabernaemontani*, *Glaux*, *Typha* and *Juncus glaucus* have lately been noted. Salicornias are being crowded out.

Note on a Deep Boring at Somerdale, Keynsham, Somerset.

By J. W. Tutcher, M.Sc.

IN 1922 a well was sunk on the site of Messrs J. S. Fry & Sons' new factories at Somerdale. A record of this well appeared in our "Proceedings" for that year,* but it may be repeated that water was obtained in considerable quantity at 36 feet. This supply is still maintained.

In 1927 the firm decided to commence an experimental bore hole with the hope of obtaining a deeper and more suitable supply. Although this hope was not realised it is desirable that a record should be available of the 277 feet of strata passed through in making the experiment. This record is made possible by the help of the works engineer, Mr A. E. Siddons-Wilson, who kindly supplied the writer with samples of the material extracted from various depths as the work proceeded.

The bore-hole was started about 60 yards west of the excavated well referred to above on practically the same level, viz., a little below the 50 feet contour. In the earlier stages of the work a plunger tool was used, consequently the material brought up did not convey such accurate information of the uppermost deposits as the view obtained from the earlier dug-out well. It was therefore necessary to check this material by comparison with the previous record. In both cases work is commenced in the Rhætic—parts of the upper and lower Rhætic appear to be represented in the first 10 feet of mixed material. This agrees with the known conditions in the immediate vicinity. For instance, 150 yards south of these positions a trench for the drainage of Chandos Road yielded examples of Cotham Marble overlying Upper Rhætic, and, a little below this, gritty limestone containing *Chalmys valoniensis* with teeth and scales of fish (basal bed of Upper Rhætic ?).

Below the Rhætic the bore-hole penetrated 12 feet of Tea-green Marl, followed by 184 feet of Red Keuper Marl. No evidence was obtained of sandstone beds or conglomerate at the base of the Trias, but some loose red sand was entered near this position. It may also be noted that the red colouration of the Keuper Marls increases in intensity progressively with the depth from the surface.

The Pennant Grit was reached at 208 feet, when it became necessary to substitute a drill for the boring tool used in the softer rock. By means of the drill a 5-inch core of Pennant was extracted to a depth of 69 feet, making the total depth for the boring 277 feet. At this stage, the objective of the enterprise not having been attained, the work was abandoned.

* Fourth Series. Vol. v., part v., 1923 (Issued for 1922), p. 276.

DETAILS OF BORE-HOLE.

		Feet.
Rhætic	Soil and Rhætic	10
	Rhætic Black Shale	2
Trias	Tea-green Marl	12
	Pale-Red Keuper Marl, with Limestone band at the base	11
	Red Keuper Marl, with bands of Gypsum at the base	51
	Deep Red Keuper Marl, with bands of Gypsum ...	94
	Very Dark Red Keuper Marl, with bed of loose sand	28
Coal Measures	Pennant Grit, with much carbonaceous matter at some levels	69

SUMMARY.

Soil and Rhætic	12 feet.
Tea-green Marl	12 feet.
Red Keuper Marl	184 feet.
Pennant Grit	69 feet.
Total depth of Bore	277 feet.

The thickness of Trias rock varies considerably in the Keynsham-Bath area. The following records from borings made in that district are given for comparison. The distances and compass directions are taken from Keynsham Church.

Willsbridge, 1¼ miles North,	25 feet.
Bitton, 2 miles North-east,	169 feet.
Twerton, 5 miles South-east,	150 feet.
Widcombe, 6½ miles South-east,	210 feet.
Batheaston, 7 miles East,	54 feet.

List of Publications bearing on the Geology of the Bristol District for the years 1914-28.

THE following list is a continuation of those published in 1913 and 1914 in the Proceedings of the Bristol Naturalists' Society, and has been prepared in the Geological Department of the University of Bristol by Mr J. E. Livingstone.

1914.

BOLTON, H. "On the Occurrence of a Giant Dragon-Fly in the Radstock Coal Measures." *Q.J.G.S.*, vol. lxx. (1914), pp. 119-126. Abstract *Geol. Mag.*, n. s., Dec. vi., vol. i., pp. 180-1.

CANTRILL, T. C. and J. PRINGLE "On a Boring for Coal at Hemington (Somerset)." *Summary of Progress of Geol. Survey for 1913*, p. 98.

GARWOOD, E. J. "Some new Rock-building Organisms from the Lower Carboniferous Beds of Westmorland." *Geol. Mag.*, n. s., Dec. vi., vol. i., pp. 265-271, pls. xx. and xxi. (see p. 266).

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FOURTH SERIES, VOLUME VII.
PART II.

PRICE FOUR SHILLINGS.

1929.

ANNUAL REPORT

AND

PROCEEDINGS

OF THE

Bristol Naturalists' Society

" Rerum cognoscere causas."—Virgil

ARBROATH: PRINTED FOR THE SOCIETY.

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TABLE OF CONTENTS.

FOURTH SERIES, VOL. VII., PART II., 1929.

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Honorary Members.

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REPORT OF COUNCIL.

TO DECEMBER 31st,

1929.

THE year has been marked by steady progress in the work of the Society, although the membership has remained nearly stationary. The Sections, however, have added to their numbers, and the continued good work carried out by them coupled with the high quality of the "Proceedings" bear ample witness to the interest taken in Natural History. But the citizens of Bristol are still somewhat apathetic to the wealth of beauty and the opportunities for study which surround their native city, and it is hoped that in the near future Council will be able to consider some scheme to awaken greater interest.

Entomology continues to hold a prominent place in the activities of the Society. Mr H. Womersley and Mr J. V. Pearman have again published in British journals descriptions of minute insects new to Science or not hitherto recorded for Britain.

Congratulations are offered to Mr H. Womersley on his election as an Associate of the Linnean Society of London. This honour is conferred upon those who are doing original work in Zoology and Botany, and, the number being limited to 25, our Society can be proud that one of its members has been chosen to fill a vacancy.

The response to the Annual Dinner shows that this opportunity of friendly intercourse amongst the members is appreciated. Mr F. W. Rixon, lecturer in Chemistry at the Bristol University, was the guest of the evening. In his address he showed that the efforts of amateurs in the study of Natural History gave an impetus to the advancement of Science as a whole by the building up of many separate facts, and the work of the Bristol Naturalists' Society in its 66 years of existence has done much in this direction. His remarks were enlivened by many humorous episodes, and the idea of inviting a visitor to propose the toast of "The Society" was a decided success.

That the Sections are taking a real interest in Natural History was proved on the Exhibition night, when the number and quality of the exhibits were well above the average. For the first time an invitation was extended to a few members of the Field Club of the Cotham Secondary School to show examples of their work in the district, and it is hoped other schools may take part on future occasions, and in that way young recruits to our ranks would be secured.

The Summer Excursion to Charterhouse-on-Mendip was also well supported by the members, who appreciated the excellent arrangements carried out for their enjoyment by the officers of the Field Section.

The customary Open Meeting took place in October during the Autumn Foray of the British Mycological Society in Bristol, and we were fortunate to have the lecture given by one of its most prominent members, Mr John Ramsbottom, O.B.E., F.L.S., Deputy Keeper of the

Botanical Department of the British Museum. The title of his address, " The Influence of Fungi on Life in General," seemed to appeal to the general public, for the attendance was most gratifying, and should do much to extend the knowledge of the Society's existence in the City.

The Hon. Secretary represented the Society at the National Conference for the Preservation of the Countryside, held at Manchester for three days in October, with a Lake district week-end extension at Ambleside. The Earl of Crawford and Balcarres, K.T., F.R.S., presided over a representative gathering of nearly 120 delegates of kindred Societies, whose one desire was to concentrate their efforts to safeguard the beauties of rural England, and especially the scenery of the Lake District, from the dangers of disfigurement by uncontrolled development and indiscriminate tree felling.

The Society was unable to send a delegate to the British Association Conference of Corresponding Societies held at Havre, but two or three of our members attended the meeting of the Association in South Africa, and have since given the Society or the Sections interesting accounts of the proceedings.

We have to record with regret the death of Mr Frank Samson, who joined the Society in 1918. Although he did not take much part in the meetings, he was deeply interested in the Society's welfare, and helped unofficially in its organisation. His unrivalled knowledge of the walks and field paths around Bristol was always at the disposal of those responsible for the summer excursion and rambles.

The " Proceedings " for 1928 were published early in the year and distributed to the British and Foreign Societies with whom exchanges are effected. The contents maintained the high standard, and some excellent illustrations of the vegetation of the Somerset coast were included.

IDA M. ROPER, *Hon. Secretary.*

The Hon. Treasurer in Account with The Bristol Naturalists' Society.

Dr. GENERAL ACCOUNT FOR THE YEAR 1929. *Cr.*

	£	s.	d.
To Members' Subscriptions :—			
Ordinary,	47	10	0
Associate,	2	10	0
Life,	5	0	0
Arrears,	13	10	0
In advance,	3	0	0
,, Entrance Fees,	1	10	0
,, Field Section Capitation Fee,	4	10	0
,, Donations to Publishing Fund,	4	0	0
,, Sale of Publications,	6	16	6
,, Sale of Dinner Tickets,	15	11	6
,, Interest on Deposit,	2	2	8
,, Balance forward :—			
General Account,	62	18	3
Bookbinding Fund,	9	6	0
	£178	4	11

	£	s.	d.
By Subscriptions to Societies :—			
Ray,	1	1	0
S.W. Naturalists' Union,	0	11	0
,, Cost of *Proceedings*, 1928,	32	15	6
,, Printing, Postage, etc.,	11	7	11
,, Lecture Expenses,	1	0	0
,, Rent and Fire Insurance,	1	11	0
,, Dinner Expenses,	15	8	0
,, Bookbinding,	3	13	9
,, Cash in hand :—			
General Account,	105	4	6
Bookbinding,	5	12	3
	£178	4	11

December 31st, 1929.

Audited and found correct.

ERNEST H. COOK.
CHARLES BARTLETT, A.C.A. } *Auditors.*

LIBRARIANS' REPORT

FOR THE YEAR 1929.

STRUCTURAL alterations to the Museum buildings in the course of linking up the new extension with the present galleries resulted in the temporary closing of the Library from July onwards.

As far as possible assistance was given to those of our members engaged in research work to gain access to volumes urgently required, but they—and others—have unfortunately been deprived of the facilities for consulting the current publications of the numerous kindred societies with whom we exchange.

Another unfortunate result of the building operations was the disfigurement to some bound volumes in the American section by moulds, the growth of which was encouraged during the period the heating apparatus was disconnected. Luckily only a few books were affected, but it will be advisable to have them rebound when funds are available. It is anticipated that early in the New Year the Library will be again open to members under even better conditions than have prevailed in the past.

Copies of the " Proceedings " for 1906, containing the classic paper by the late Arthur Vaughan on " The Avonian of the Avon Gorge," are always in demand by students of geology, but the supply is now exhausted, and funds are not at present forthcoming to encourage the Council to consider issuing a second edition. A few reprints without illustrations are however still on hand. Prof. S. H. Reynolds holds the negatives, and through his kindly energy some 150 prints have been made and incorporated in these reprints, and the whole bound in book form. The price in future will be 6/6.

Mr H. J. Charbonnier has presented three bound volumes of " British Mammals," by Barrett-Hamilton, issued originally in paper covers as a memorial to his " dear friend, Dr C. K. Rudge." Council was gratified that the spirit which had prompted the welcome gift to the Library was coupled with the memory of our past President, Hon. Librarian, and ardent supporter of the Society for upwards of forty years.

A few members continue to take advantage of the privilege by which certain volumes may be borrowed for reference from the London Science Library.

IDA M. ROPER, *Hon. Librarian.*
T. CHARBONNIER, *Hon. Sub-Librarian.*

BOTANICAL SECTION.

1929.

THE Section has now completed its fourth and most successful year since its inauguration, the number of members having risen to 28. The average attendance has been ten; we should like to see it far higher, but we realise that this is quite good as many members are prevented from attending in the winter months.

Monthly meetings have been held as formerly, but it was found advisable to abandon the August meeting.

We regret the loss to the Section through the death of Mr C. Alden, who was a keen botanist and one of its first members. Our good wishes go with Mr D. Morris who resigned when he left Bristol for Edinburgh.

The meetings have been informal discussions about members' exhibits, photographs and topics of botanical interest. Miss Bowen gave some interesting information on South African vegetation which she had obtained during her visit to the meeting of the British Association. During April, Mr Stevens noticed and photographed vertical rows of nodules on the trunks of trees in St Anne's Wood. The origin of these nodules gave rise to much discussion. The exhibits have not been confined to the home country but have included many from abroad. In December, Miss Yates, a visitor, showed her collection of paintings of Italian flowers. At the Exhibition, held in November, the Section was well represented. Mr H. J. Gibbons showed a comprehensive collection of Fungi obtained in two hours.

During the absence of Prof. O. V. Darbishire, Miss Roper has continued to act as chairman.

F. F. GLASSPOOL, *Hon. Secretary and Treasurer.*

ORNITHOLOGICAL SECTION.

1929.

THE membership has now increased to 30, and five meetings have been held during the year. Although the attendance has not been altogether commensurate with this increase, there has always been keen discussion on the subject concerned, and papers of original observations have been contributed by members.

The Section is now undertaking a revision of the list of Bristol Birds. The last list was published in the Society's "Proceedings," Vol. IX., Part II. (1899), and it was felt it was time a fresh list was prepared as many alterations have probably taken place since that time. The area to be included will be the same as that of the last list, *i.e.*, the Bristol Coalfield, as this coincides with the country covered by other Sections.

Mr V. C. Wynne-Edwards gave an interesting account of the work he has been doing recently on the movements of Starlings in winter, particularly in Devon and East Cornwall. This included observations on their roosting-habits, the distances travelled to and from their roosts, etc., and a full account is given in "British Birds" (magazine) for November and December 1929 in the Society's Library.

Mr D. Macdonald, at the November meeting, entertained members with a description of his observations in Perthshire of the nesting of the Common Gull, Wigeon, Black-throated Diver and Golden Eagle, a fuller account of which will be found elsewhere.

H. TETLEY, *Hon. Secretary and Treasurer.*

ENTOMOLOGICAL SECTION.

1929.

THERE has been no change in the number of members, gains being offset by losses. Financially, the year ends with a small balance in hand although one or two subscriptions are in arrear.

Nine indoor meetings and one field excursion have been held during the year. The average attendance has been just over eight.

Continuing the policy of surveying the whole field of entomology piecemeal, there have been reviews of three groups of Lepidoptera (Sphingidae by Mr A. Kromler, Arctiidae and Notodontidae by Mr C. Bartlett) and two groups of Coleoptera (Longicornia by Mr Bartlett and Phytophaga by Mr R. Beck). To illustrate these demonstrations many members have contributed liberally with exhibits.

The Section has been fortunate in having had, on three separate occasions, expositions by Mr H. G. H. Kearns, B.Sc., of his work in economic entomology. The subjects of his communications have been Timber Beetles, *Phaedon tumidulum* Germ. (a Chrysomelid pest of celery, etc.) and *Phyllodecta vitellinae* L. (a Chrysomelid pest of willows).

At the November and December meetings there were special exhibits of the year's captures. Most of the insects shown were Lepidoptera, the collectors of which found the long hot summer generally favourable, and many interesting species and forms were brought forward.

The one excursion was in August to Bourton Combe. This particular locality was new ground to most members. Although no specimens of special interest were obtained during the visit, the terrain seemed to hold promise of good results from more thorough working. After an enjoyable afternoon the party was entertained to tea by Mr and Mrs Womersley.

A further addition to our records has been made by Miss I. M. Roper with a list of the local Curculionid (weevil) gall-makers.

Exhibits have been made during the year by Mr Bartlett (Coleoptera and Lepidoptera), Mr Beck (Coleoptera), Messrs Kromler, Norgrove, Peach, Taylor and Dr Barton White (Lepidoptera), Mr Tetley (Coleoptera), Mr Womersley (Apterygota), and Mr Pearman (Psocoptera), and included amongst others the following :—

LEPIDOPTERA.—*O.* (*Lophopteryx*) *carmelita* Esper, ♂, Clifton (a local record), Mr W. R. Taylor; *Eriogaster lanestris* L., emerged after five years in the pupa, Mr A. Kromler; a number of striking varieties of *Abraxas grossulariata* L. caught wild at Fishponds, including var. *lacticolor* ab. *iochalca*, Dr E. Barton White; a melanistic variety of *A. grossulariata* with very pale hind-wings, Mr C. Bartlett; *Lycaena corydon* Poda, var. *fowleri*, and a beautiful variety of *Callimorpha hera* L., the only imago reared from seven larvae, Mr A. H. Peach.

COLEOPTERA.—*Acanthocinus aedilis* L., from a newly-built house at Horfield, and *Duliticola* sp. ♀, the so-called " Trilobite larva," Mr H. Tetley.

APTERYGOTA.—Types of various British species of Machilidae, *Tomocerus minor* Lubb. and *Lepidocyrtoides coeruleus* Schott (two additions to the fauna of New Zealand), and *Rhyniella praecursor* Hirst (fossil), Mr H. Womersley.

J. V. PEARMAN, *Hon. Secretary and Treasurer.*

FIELD SECTION.

1929.

IN all Field Excursions of any Society there exists a strong tendency towards degeneration into mere rambles, often of an aimless and uneducative character. This tendency can be counteracted by rigid and good leadership, and during the past Session an additional safeguard of supplying members in advance with outline notes was put into operation. These were incorporated in the programme, and although of an experimental character, the basic idea proved a success. It is hoped that during the coming year these details will again be written in order more fully to meet the needs of members.

At the Annual Meeting held in January the retiring President, Mr J. W. Tutcher, M.Sc., took the opportunity of emphasising the value of the interchange of views between specialists and amateurs, and pointed out that facts submitted to specialists often led to unsuspected results. He instanced his point by a specimen of Millstone Grit recently forwarded to him by a member; a specimen which ultimately suggested that the original site of Bristol depended upon the outcrop of this particular band.

Four general excursions have been held during the year, with an average attendance of 31.

In May, by kind permission of the owner, Mr Edward Bromet, Mr H. Vicars Webb led a party to Denewood Grange, Batheaston, to view the beautiful grounds charmingly situated in the Avon Valley. Mr Bromet is a keen enthusiast for bird life and has carried out a scheme for making the grounds a bird sanctuary. Numbers of migrant and resident birds haunt the garden, it being computed that about 50 species either lived in or passed through the grounds last year. The Botanists present expressed their admiration of the examples of floral wealth and beauty so lavishly cultivated.

In June, Mr H. F. Barke and Miss M. Doris Hiley led the Annual Excursion of the Society to Charterhouse-on-Mendip. Barrows, lead-mining, geological features, botanical and insect life were observed and studied under the guidance of leaders expert in their particular study.

Mrs E. Vaughan was responsible for the July excursion to another part of the Mendip country, and this included an ascent from Winscombe to the top of Crook Peak. Many characteristic fossils were collected from the limestone.

An experiment of amalgamating the September fixture with the usual Saturday afternoon excursion of the Workers' Educational Association proved successful. Dr F. S. Wallis acted as general leader, whilst Miss I. M. Roper and Mr H. Tetley ably supported him. The remains of an extinct volcano and raised beach were seen at Spring Cove, and much of interest in the plant world was observed in a traverse of Kewstoke Woods. The structure of Milton Hill was shown in characteristic exposures, and from the top members were able to enjoy a remarkably fine panoramic view.

Mr H. Vicars Webb conducted his usual excursions for the observation of bird life, and sends the following report :—

April 20. Wickham and Stapleton Glens. Of migrants, Swallow, Blackcap, Willow Warbler and Chiff-chaff had arrived, and were in good voice. Of resident songsters, Blackbird and Common Wren in full song. A pair of Long-tailed Tits excited much interest. Swans nesting on the Frome and at the Duchess Pond.

May 8th. St Anne's Wood and Birchwood, the property of Mr James Sinnott. Birdlife abundant and tree foliage at a charming stage.

May 18th. Brean Down. A most successful day, both as regards weather and observations. Mr Harry Cox, "The Watcher," accompanied the party round. Many species of birds observed, including Peregrine Falcon, Shelduck, Mallard, Gulls, Green Plover, Rock and Meadow Pipits, Swallows, Martins, Swifts, Whitethroats, Linnets, Wheatears, Skylarks and Hedge Warblers. The one disappointment of the day, no Ravens seen.

May 29th. Flax Bourton District. Interesting observations of Red-backed Shrike on nest, Water Hen and young Cuckoos, Swallows, Martins and Swifts, Spotted Flycatchers (two nests), Green Woodpecker, and both spring migrants and resident species all in full song.

Mr H. C. Sutton, who was again responsible for the Botanical rambles, sends the following report :—

Following the practice of former years, four excursions were arranged for the season. Happily, perfect weather enabled all the fixtures to be carried out in their entirety. Some new ground was visited and several interesting plants were met with on the rough marshy land around the New Passage.

In September a visit was paid to the Botanic Gardens at Bath. This ramble was somewhat in the nature of a new departure, but judging by the excellent attendance, the venture was fully justified. It is gratifying to report a substantial increase in the attendances this season as compared with those of previous years, but a still further improvement should not be difficult to obtain.

Members also attended the excursions organised by the Geological Section of the parent Society, and have again taken advantage of their privilege of attending the meetings of the parent Society during the winter months, but it would be gratifying to see still larger attendances at the latter.

The membership of the Section now stands at 100, and the finances show a credit balance.

M. DORIS HILEY, *Hon. Secretary.*

GEOLOGICAL SECTION.

1929.

FOR many years past this Section has strongly advocated the policy of asking some prominent geologist to speak on the recent advances in his particular branch of the science. The plan has met with continued success as it achieved the double purpose of giving stimulus to local workers and—as many of our visitors have confessed—an opportunity for the lecturer to meet enthusiasts. Financially, it is a big drain on our slender resources, though the Section has been exceptionally well served by lecturers who have only been repaid by bare travelling expenses.

During the year under review two such geologists have visited Bristol. Prof. A. Morley Davies, D.Sc., of the Imperial College of Science, London, repeated the Presidential Address he had recently given to the Geologists' Association of London on " Geographical Distribution and Migration in Tertiary times." Prof. Davies clearly showed that as in the present day we have zoological provinces, so in past times and especially during the Tertiary period, there was a well established geographical distribution of genera as well as definite lines of migration from one province to another.

Dr A. E. Trueman, F.G.S., of University College, Swansea, was for the second time a welcome visitor under this scheme and gave a lucid and stimulating lecture on " Fossil Shells and problems of Evolution " printed in another portion of these " Proceedings."

At another meeting Mr E. K. Tratman, B.D.S., gave an account of some discoveries recently made at Brean Down and elsewhere. He mentioned that a peculiar deposit, containing remains of terrestrial molluscs, reindeer, horse, arctic hare, etc., is now known to extend not only along much of the Brean coast but also at Uphill and Steep Holm. It seems conclusive that the deposit was of terrestrial and not of marine origin, but sufficient data had not yet accumulated to give it an exact date.

At the October meeting Major A. Gorham read a paper describing the junction beds of the Lias and Inferior Oolite at Limpley Stoke. The paper was the result of much detailed work carried out under unusual circumstances and with meticulous care.

Three excursions have been held during the year. Mr T. Fry was the leader to Bromley Pit, Pensford, when about 30 members made the descent; Prof. S. H. Reynolds and Dr Stanley Smith acted as leaders to the Section at Cattybrook which they had recently described; whilst Mr and Mrs H. F. Barke were responsible for an excursion to Wotton-under-Edge in Cotteswold country.

Owing to the re-issue of monthly reminders, the attendance at both the winter meetings and summer excursions has shown a considerable increase. Another gratifying feature is the increased attendance and interest shown by members in the informal discussion class which now precedes the regular meetings.

The Section still subscribes to the Geological Magazine and Palæontographical Society and places these publications in the library of the Society.

The membership now stands at 50 (nett increase of two during the year) and the finances are satisfactory.

F. S. WALLIS, *Hon. Secretary and Treasurer.*

Account of the Annual and General Meetings.

THE 66TH ANNUAL MEETING.

January 17th, 1929.

Mr James Rafter, M.A., was elected President for the third time. He delivered his second presidential address, entitled "Caste." (See p. 26.)

Mr J. V. Pearman, F.E.S., was elected a Vice-President; Mr M. Miller, Hon. Treasurer; and Mr R. P. Gait and Mr G. H. Beacham, members of Council.

THE 540TH GENERAL MEETING.

February 7th, 1929.

THE 2ND ANNUAL DINNER.

The President, Mr James Rafter, M.A., presided over a company of upwards of 50 members and friends, and an enjoyable evening was spent.

Dr F. W. Rixon, of Bristol University, the guest of the evening, referred to the fine record of the Bristol Naturalists' Society, and to the way the history of the times was reflected in the history of the Society. Anyone who studied the processes of Nature was subjecting himself, unwittingly perhaps, to subtle influences which would leave a deep mark on his character and mentality. A man might have little effect upon the world of science and research, but the research was bound to have an indelible effect on him; the forces of Nature were more powerful and subtle than any other branch of knowledge. There would come, first and inevitably, if the study was pursued, a recognition of the necessity for intelligent organisation, primarily devoted to systemisation of the nature of the facts collected, but secondarily reflected in the mental processes—the development of logical and sequential thought, a mental clarity which was eminently desirable. There followed also a growth of what they might call self-control and patience. In the true student of nature there grew, moreover, a sense of humility which came from the true proportioning of things. Finally, it was rare indeed to find one such who did not arrive at some measure of understanding of that spirit of nature, which for those whose eyes are open, was to be seen shining through and from the universal spirit of all things.

Dr Rixon deplored the fact that every subject seemed to develop a technical language; it seemed a shame that Latin and Greek should be exhausted before the resources of English had been explored. Every walk of life has its technical language, which, however, was always approved by other walks of life.

With the spread of our complete civilisation came the demand for trained minds to deal with the problems of natural supplies, and societies such as theirs are training grounds for biologists, for which there was such a demand that we were at present going outside this country for such men. "I will not labour this point," said Dr Rixon, "as it has been so much in the public eye lately, but it has a certain pleasant aspect from our point of view. It is always a joy to find that a hobby or even pet vice has become not merely innocuous, but actually of practical import."

An excellent musical programme was contributed to by Mrs James Rafter, Mr M. Miller, Mr I. W. Evans, and Dr F. W. Rixon.

THE 541ST GENERAL MEETING.

March 7th, 1929.

"Ecology of the Avon Banks," by Dr Rose Bracher.

The lecturer gave an account of a series of observations and experiments which she had carried out upon the ecological conditions of the Avon banks at Bristol. It was established that the vegetation could definitely be classed as the salt-marsh type, though differing from the typical salt-marsh in several important respects.

The shelter afforded by the cliffs of the Avon Gorge, the steeper gradient of the shore, and consequent difference in water and salt content of the soil, resulted in the absence of some plants, e.g., *Salicornia*, typical of the mud flats at Portishead. Also, the species flourishing in the Bristol region usually attained a much greater size than those of exposed marshes.

The lecturer went on to show that the outstanding feature of such an association is the presence of large numbers of *Euglena* and diatoms upon the surface of the mud, which is covered by every tide. They form a conspicuous carpet of bright green or brownish hue extending over wide areas of mud. These organisms burrow into the mud at the approach of darkness and the onset of high water and reappear when conditions are favourable. They are very sensitive to changes in the water content of the mud, and seek out situations where the mud consistency is best suited to their method of locomotion.

They are also very sensitive to changes in light conditions, a definite light intensity being necessary before they will make their appearance. The duration of light is also important, and at these times when high water in the daytime cuts off the light for several hours, the organisms die down appreciably in numbers.

In winter, the low temperature, lack of illumination, and scarcity of food material are responsible for the dying down of very large numbers, but they never disappear entirely. The whole study is a remarkable example of the adaptation of plants to a very specialised habitat.

THE 542ND GENERAL MEETING.

April 11th, 1929.

"Bird Hunting with a Camera," by Mr Coldstream Tuckett.

Bird photography, apart from its scientific purposes, could be regarded as a most excellent sport, for without the least cruelty to the objects of the chase it provided its devotees with as much excitement as any other sport. Yet it was by no means an easy pastime, and called for an inexhaustible amount of patience, perseverance, and determination.

There were many difficulties to be overcome—inaccessibility of the quarry, adverse lighting conditions, perverseness and nervousness of the subject—and often the photographer was fortunate if, after hours of patient waiting and manœuvring, out of ten or a dozen exposures there resulted only a single negative from which a satisfactory lantern slide could be made.

An example of the successful surmounting of the obstacle of inaccessibility was demonstrated by lantern slides which showed how a kestrel on a cliff-face was photographed by the aid of a telephoto lens at an awkward angle of view. One slide, secured after much trouble, depicted a tufted duck at its nest. That was the first occasion on which the bird had been photographed in Somerset, and the fact established that this duck bred (wild) in the county. Other slides showed kingfishers, nightingale, sandpiper, dipper, black-headed gull, redstart, reed warbler, and snipe, and with each one the lecturer retailed his experiences in the field. There being a rich variety of bird life around Bristol, bird photography could be recommended as a sport for city dwellers.

THE SUMMER EXCURSION.

June 22nd, 1929.

This was made to Charterhouse-on-Mendip under the leadership of Miss M. D. Hiley and Mr H. F. Barke. Leaving Bristol via Bedminster Down, the flat, plateau-like top of Broadfield Down was soon reached. Typical limestone scenery was here evident on all sides, and the contrast with the succeeding country in the Vale of Wrington was strongly marked. Mendip country was entered through Burrington Combe, and it was pointed out that this valley was probably formed by the agency of running water during the great Ice Age.

Mr E. K. Tratman, B.D.S., met the party at Charterhouse, and in a survey of the district during prehistoric and early historic times, pointed out that the place probably took its name from an ancient priory. Charterhouse is one of the few places on Mendip that is well supplied with water, and this has probably been the reason that has made it a centre of habitation since early times. Barrows, long and round, were to be seen in the district and the evidences of lead mining, both Roman and later, were conspicuous in all directions. Mr Tratman dealt with the question of early trackways and roads, and clearly visualised the life and environment of these early people.

A move was then made to Tynings Farm, from which place Dr F. S. Wallis pointed out the main geological features of the Mendip country, and visualised the appearance of the area in old red sandstone and carboniferous limestone times.

After tea a return was made to Charterhouse, where, under the guidance of Miss I. M. Roper, F.L.S., the botanists spent an interesting time. The flora included the greater spearwort, the sweet-scented orchis, shrubby vetch, alpine pennycress, sea campion, the two marsh horsetails, and moonwort. The sedge, *Carex montana*, covers scores of acres of rough pasture.

Mr A. Selley interested many members by pointing out all the features indicated by Mr Tratman. The entomologists had the expert assistance of Mr H. Womersley, and many captures were made. The stone flies and skipper butterflies were seen, and many members made their first acquaintance with these early forms of life. Bird life was exceptionally quiet.

THE 543RD GENERAL MEETING.

October 3rd, 1929.

"The Influence of Fungi on Life in General," by Mr J. Ramsbottom, O.B.E., M.A. (British Museum (Nat. Hist.), London).

The public generally connected Fungi with mushrooms, moulds and mildews, and the lecturer was often asked how to distinguish mushrooms from toadstools. There were about 70 different species of fungi that people could eat and enjoy; most people were satisfied with about 20, and these are as markedly distinct and distinguishable as are the flowering plants. Thus, though there is no simple way of deciding whether a given fungus is edible or not, comparative safety may be ensured if a few species well known to be poisonous are avoided. There appears to be only one fungus concerning which there is no doubt that it causes the death of healthy people, though some of its allies and other suspicious species are equally to be avoided. This toadstool is *Amanita phalloides* and all the commonly accepted rule of thumb methods break down with it; it peels and does not turn silver black. Records taken over the last half-century or so show that 90 per cent. of deaths caused by fungi are due to this one. Moreover, the death is an agonising and lingering one; a French account states that the patient, if he is lucky, dies on the third day.

Nothing but the common mushroom has been sold at Covent Garden for the last 30 years, though on the Continent it was easy to purchase a large number of fungi. Truffles, which always have been highly prized, are subterranean fungi, and consequently difficult to find. As they have a characteristic odour dogs or pigs are trained to hunt for them, the digging being done by the owner of the animal. Truffle hunting was carried out on the South Downs until comparatively recently but now appears to have died out. The lecturer paid a warm tribute to the memory of C. E. Broome, of Batheaston, who had accomplished more than anyone in this country in the study of subterranean fungi.

Though fungi have been eaten by man for thousands of years, their food value is small, their chief value is as appetisers in giving variety to more nutritious but less interesting foods.

As Fungi do not possess chlorophyll and cannot build up their carbohydrates, they are either saprophytes—those living on dead organic material, or parasites—those living on living organic material.

With the aid of coloured slides the lecturer showed common fungi in their natural environment; these included *Amanita phalloides*, in which the differences from the common mushroom were pointed out. The Scarlet Fly Agaric, which is so much used in pictorial art at the present day. *Hypholoma fasciculare*, a common yellow tufted fungus on old stumps. *Paxillus atromentosus*, which occurs on coniferous stumps. *Russula cyanoxantha*, a common terrestrial fungus with a variously coloured cap. *Pleurotus ostreatus*, the dove-blue oyster fungus of old stumps, and several others. Ergot of Rye, the only fungus used in the British Pharmacopaeia. The Morel and Champignon, used in cookery. Dry Rot fungus, which breaks down wood and produces dampness or water and makes people think it is not dry rot. Also excellent slides of Fairy rings from photos taken from aeroplanes. Meadows, downs and grasslands show darker rings of grass here and there, with a bare patch of grass between the rings, which suggested to the poetically-minded that it was worn during the midnight frolics of fairies or in some equally mythical way. Heavy rain will stand on the bare portion in the same way that it does on footpaths. The soil cannot absorb water as the interstices are filled with fungal mycelium. This fungus lives saprophytically at the expense of organic substances in the soil, and in so doing liberates materials which act as chemical manures for grasses and plants. The ring increases annually, and the rate of advance can be calculated, and so a rough estimate of the age of the ring can be obtained. This has been found to be of quite unexpected dimensions, often reaching a century and occasionally as much as four centuries. The slides showed the enormous size of some rings.

Another aspect of the relation between fungi and plants is usually called Symbiosis, where two organisms live constantly together generally for mutual benefit. This association between flowering plant and fungus is termed Mycorrhiza (fungus root), although fungal hyphae are not restricted to the roots. It is thought that the tree benefits by the passage to the roots of nutriment obtained by the fungus from the humus. It is known that certain fungi are usually found in the neighbourhood of certain trees. Thus *Boletus elegans* and *B. viscidus* occur under larch, *Amanita muscari* and *Lactarius turpis* under birch, *Russula fellea* under beech, and so on. The association once established lasts for years, and the fungus may be seen growing in a ring round the tree, and presumably keeps pace with the gradually extending root system.

It is owing to the consequences of their peculiar physiology that Fungi are of general interest. Broadly speaking, they occur wherever there is organic life, and if it were not for fungi and their very similar bacteria, life as we know it would be impossible. The yeast are fungi, which possess substances called enzymes or ferments and these bring about essential chemical changes in organisms.

The enzyme action of yeast on sugar gives man fermented alcoholic liquors such as beer, wine, cider, perry, mead, and this fermentation has been known since B.C. 2000. All nations have their primitive alcoholic beverages, and in all of them yeasts are concerned.

The rising of bread is due to yeast which acts on the sugar on the flour, breaking it down to alcohol and carbon dioxide, the gas distends the dough, making it porous with a resultant light bread.

Various diseases are caused by fungi, such as "ringworm." A very common one is "thrush," which is an affection of the mucous membrane of the throat due to a yeast-like fungus growing in the milk of dirty feeding bottles. It was due to the researches of Metchnikoff with yeast that he was led to discover the work of the white corpuscles of the blood.

THE 534TH GENERAL MEETING.

November 7th, 1929.

Exhibits of Natural History by the Members.

The exhibit laid out by the Geological Section included that of Prof. S. H. Reynolds, showing specimens illustrating the fin spines of fossil fish; fossil brittle stars and sea lilies from the Devonian slate of the Rhine region of Western Germany; photographs and specimens illustrating the penetration by granite of the slates at Sea Point, Cape Town. Mr J. W. Tutcher exhibited fossil ammonites from middle and upper Lias, and fossils from the Capricornus bed at Welton, near Radstock. Mr H. F. Barke, fossils from Fullers Earth, from gravels at Keynsham and from Capricornus zone at Radstock; Mr J. E. G. McMurtrie, Coal measure fossils from Radstock; Mr M. Miller, local sands; Mrs E. Vaughan, Iron ores.

In the Entomological Section Mr A. Kromler showed moths and beetles from the Bristol district, and Mr J. V. Pearman diagrams illustrating the development of venational forms in the Psocoptera.

Botany was represented by Miss I. M. Roper, with specimens of Water plants; Mr G. H. Beacham, seeds and specimens collected at the Society's excursions; Mr H. J. Gibbons, local fungi; The University, fungi and living foreign plants; Mr H. S. Thompson, typical genera of three allied families of Monocotyledonous water plants widely distributed in the Northern hemisphere; Mr F. W. Evens, a few local specimens of Mycetozoa recently gathered in Blaise Castle woods, Blagdon, and other localities; Miss E. M. Lee, autumn plants showing strength of stalk and stem.

Four members of the Field Club of Cotham Secondary School exhibited collections. R. Luxford and G. A. Kellaway showed minerals collected locally; G. A. Walton, collection of bones and teeth of animals and birds, beetles and butterflies; F. H. Rawlings, a miniature pond surrounded with dried plants on which insects were placed.

Coffee was served during the evening.

THE 545TH GENERAL MEETING.

December 5th, 1929.

" British Association Meeting in South Africa, 1929," by Prof. S. H. Reynolds, M.A., Sc.D.

The lecturer said there were two events in South Africa which attracted attention—the International Geologists' Congress and the meeting of the British Association, and for the latter 500 members went out from England. Five days after leaving St Helena they arrived at Cape Town, a city of fine buildings, dominated by Table Mountain. This is built up of horizontally bedded sandstone, known as Table Mount sandstone, and this sandstone forms the fine scenery of the Cape peninsula. The wild flowers of Cape Town district formed his most vivid impression of South Africa, there being 3000 flowering plants. Leaving Cape Town, they passed over the Karroo to Kimberley and visited the diamond mines, which are in the pipe or throat of an old volcano, and a description of the method of mining was given. Passing on to Johannesburg, which, like Kimberley, depended on its mines, the party visited the gold mines, witnessed a war dance and inspected the specimens of " Bushman's Painting " in the Museum. From there the party went on to the Victoria Falls, the most wonderful sight in South Africa. With diagrams and views of the falls the Professor gave the theory of the origin of the gorge and falls. The journey was continued to Bulawayo, and the Matoppo Hills and Rhodes' Tomb, the weathering of the granite and rounded boulders there being explained by diagrams. Barberton, in East Transvaal, was visited to see the country industries of orange, papaw, and cotton growing, and to view the asbestos mining; the method of transport by oxen or donkey teams being shown. Then, over the Central African plateau to Portuguese territory to Lorenzo Marquez, the finest watering place in South Africa. The Kruger National Park, the game reserve of South Africa, was visited, and then back to Port Elizabeth and Mossel Bay, where the Seal Islands with 1000 sea-lions on them, were seen, and so back to Cape Town, the party having travelled 6000 miles in the train and 500 miles in motor cars. The feature of the lecture was the splendid slides made from photographs taken by Professor Reynolds.

PRESIDENTIAL ADDRESS, 1929

Commons and Footpaths.

By James Rafter, M.A.

THE time has now arrived when I must relinquish the reins of office which I have held for the last three years. The Presidency of such a Society as this, which has been in existence close upon seventy years, is an honourable one involving certain duties not onerous but capable of affording much pleasure to the holder.

The long line of Presidents includes many who were of repute among the brilliant scientists of their day, and it is no light matter for anyone, be he scientist or not, to follow in their footsteps.

I have endeavoured to maintain the dignity of the chair and to advance, as far as lay in my power, the best interests of the Society.

One cannot help regretting that in these days of the cinema, and in the growth of other light pleasures, the difficulty of maintaining the number of members to a level commensurate with the size of the City of Bristol, is very considerable.

I had hopes at one time that the teaching of science in schools throughout the country would eventually produce a crop of enthusiasts who would crowd into societies like ours. Unfortunately those hopes are far from being realised, and we can but peg away, ploughing a lone furrow but feeling happy in that we are, I trust, advancing the cause of Natural History by seeking the truth.

To turn to the subject of my Address, viz., "Commons and Footpaths," I feel sure that, as Naturalists, we are all disposed to look with favour on the proper use and preservation of Common Land in this country and I trust that my remarks may be worth the utterance.

The pursuit of Natural History often entails the necessity of traversing footpaths, narrow tracks and commons over which the general public have a perfect right to go without let or hindrance.

Attempts to restrain the public are occasionally made by some landlords whose property abuts on some such pathways, and the help of the law is sought in order to assert their rights. Many a hard fight has resulted in the ousting of the claimant, and the public have been left to enjoy their privileges in peace without the stigma of being trespassers.

Commons is the term for the lands held in Commonalty and is a relic of the system on which the lands of England were, for the most part, cultivated during the Middle Ages.

The country was divided into vills, or townships, often, though not necessarily, or always, coterminous with the parish. In each stood a cluster of houses, a village, in which dwelt the men of the township, and around the village lay the arable fields and other lands which they worked as one common farm. Except a few small inclosures nearer the village—for gardens, orchards or paddocks for young stock—the whole township was free from permanent fencing. The arable lands received the crops in rotation; the low lying lands were used as meadows, and the poorest land of the township was left waste, and this waste land is the Common of our own days.

So far back as accurate information extends the arable land is found to be parcelled out; each householder owning strips, long and narrow, in each field. Upon the waste or Common the householder turned out his oxen and horses, which he had lent for ploughing the town lands, and the cows and sheep which were useful in manuring the common fields. Commoners are those who may enjoy the following rights or privileges:—

To feed cattle upon the Common land.

To take gorse, bushes or heather for fuel or litter.

To cut turf or peat for fuel—this is called right of Common or Turbary.

To take sand, gravel or loam for repair and maintenance of land.

It will be found that Common rights are generally attached to, or enjoyed with, certain lands or houses. The right usually consists of being able to turn out to pasture as many cattle as the farm, or other private holding, can support. For instance, such a man could not mix with his own cattle those belonging to another man who possessed no such right of Common.

The animals that may be turned out to Common are horses, oxen, cows and sheep; but not donkeys, pigs and geese unless the right is established on proof of special usage. Geese are such familiar objects on our Commons that I am surprised to find that in law they are regarded as non-commonable.

The right of taking gorse or bushes, or of lopping wood for fuel is limited to the taking of such fuel as may be necessary for the hearths of a particular house, and no more may be taken than is thus required. Heather taken for litter cannot be taken in larger quantities than is needed for manuring the lands in respect of which the right is enjoyed. It is illegal to take the wood or heather from the Common and to sell it to anyone who has not himself a right to take it. The same rule applies to the digging of sand, gravel, clay or loam. To the over-lord, otherwise lord of the manor, belongs the Common which comprises the soil, trees, bushes and even the grass though the Commoners have the right to take it by the mouths of the cattle. To the over-lord was assigned a seignory, or dominion over all the other lands of the vill, which word, by the way, is derived from the French and means a hamlet or village. The vill came to be termed his manor, hence the title "Lord of the Manor."

The division of interest is very strange. On the one hand the soil belongs to one person and on the other hand other persons are entitled to take certain products of the soil. The land cannot be enclosed by the Commoners as it does not belong to them; neither can it be enclosed by the owner as it would interfere with the rights of the Commoners.

The term Common embraces widely-differing species. There is the Common in the popular sense, varying in size from a few acres to many thousands. Next, there are the wastes of Forests, of which Epping is a very good example. Then, there are mountain regions, *e.g.*, the Cumberland Hills, Welsh mountains and Dartmoor which the law still dubs the "Forest of Dartmoor." Then again, we have the Village Green, a spot which, with its rustic life, its ivy-covered church and hostelry, its geese, poultry; and school children, appeals to us, perhaps, more than all the rest. Lastly comes the Common field, ranging from the marsh, which is always grazing ground, to fields which are tilled in rotation two years out of three and are traversed by footpaths and thrown open to all at certain times.

Altogether it is estimated roughly that there are about two million acres of Common land in England. The greater part of this, however, lies in mountain districts and, apparently, is unsuitable for cultivation. It cannot be built upon, it cannot be enclosed, and it cannot be tilled, but must always remain in the same condition. Whenever land is in this state the nation at large has an interest in it different from that which it possesses in other land; for the mode of enjoyment of such land cannot be changed without the assistance of Parliament, that is, of course, without the consent of the nation. While it remains in its natural condition all His Majesty's subjects have for the most part the use of it for exercise and recreation, and always the benefit of it as a reservoir of pure air, and if a change in its condition is allowed, the nation may dictate its own terms and reserve to itself, or to any of its members, beneficial rights and privileges.

A few centuries ago nearly the whole of the lands of England lay in an open and more or less in a commonable state, each parish or township was considered as one common farm, though the tenantry were numerous.

How did enclosure come about?

Macaulay, describing the state of the country on the accession of James II., in 1685, infers from the road books and maps of the 17th century that the country was to a large extent unenclosed, and he computes that in the course of little more than a hundred years from that time a fourth part of England had been turned from a wild into a garden. Macaulay probably overrated the change, not realising the extent to which the country was formerly cultivated in common. Parliamentary returns show that at least five million acres of land, coming within the definition of Commons, have been enclosed since the reign of Queen Anne, but seven million acres may be nearer the mark.

No doubt Commons are a remnant of collective ownership of land, the prevalence of which in all communities in early stage of development recent research may be taken to have established. Property has actually been traced from the ownership of the whole tribe or community, through that of the family to that of the individual.

In Russia, before the last Great War at any rate, the land was held not by individuals, but by village communities called Mirs, amongst the members of which it was periodically partitioned.

In England the state of things points to a still earlier time when the village community owned absolutely the lands which it collectively cultivated and acknowledged no superior lord.

Before the Norman Conquest the richer nobles had acquired a certain pre-eminence in land-holding and had, in many cases, by means of royal grants established a species of lordship over their humbler neighbours. The introduction of the feudal system permanently and radically changed the position of the cultivators of the soil and in particular their legal relation to the Forests and Waste Lands which they enjoyed in common. This feudal system placed over each community a lord, who was accountable to the Sovereign for its quiet government and for a supply of soldiers from it, and who held of the King by military service the land which the village farmed. The feudal lawyers considered that the lord had a right of property over all the lands of the community: they reverted to the lord upon failure of heirs of the tenant. Those which were in the hands of men who were in the condition of serfs attached to the soil, were, after the Conquest, deemed to be held merely at the will of the lord and hence the copy-holds of modern times. The waste lands—the Commons of the present day—which were not in individual occupation at all and which had previously belonged to the village, became henceforth the freehold of the lord, subject only to use by the villagers for pasturage, wood, fuel, hedges and repairs. The enjoyment continued practically the same but the legal relationship was changed. This change has influenced the whole history of Commons. It has led to limitation and restriction of popular rights and to the indefinite enlargement of the interest of the "great men of England," as they were called in an early statute, the Lords of Manors of our own day. It has led to a certain divergence between popular conceptions and traditions on the one hand and legal theory on the other, which has lasted even to this day and makes it sometimes difficult to reconcile the actual use and enjoyment of a Common with the law.

There is little doubt that the village lands, arable, meadow or waste, were substantially the property of the villagers for their use and enjoyment, but were wrested from them by some one with a stronger hand. As I have already remarked, the idea that the Common was the lord's waste and that he could do as he pleased with it was, probably, the creation of the Norman lawyers, the Norman conquerors always favouring the aristocracy, if I may so term it.

At the Black Death, when half the population of the country was swept away, frequently whole families disappeared which gave the over-lord the opportunity to appropriate the holding in the Common fields.

In the Wars of the Roses, however, when a great many of the nobility were killed, the small cultivator had a chance to make headway.

In the reigns of Henry VIII. and Edward VI., the wool trade was the cause of much arable land being converted into pasture land for the sake of sheep breeding. The price of wool enhanced the value of pasturage, this increased value withdrew field after field from tillage; the decline of tillage, the depression of the markets, and the monopoly of the wool trade by the staple towns, of which one was Bristol, reduced those country towns which had not encouraged manufacture to such poverty that they were unable to pay their contingent to the revenue, and the regular sum of tenths and fifteenths was reduced by more than a fifth in consequence. The same causes which in the 16th century made the inclosure of the Commons a most important popular grievance had begun to set class against class as early as the 14th century although the thinning of the population by the Plague acted to some extent as a corrective.

The same thing appears to be happening in our own time except that the cause cannot be attributed to the breeding of sheep but rather to the great importation of corn from other countries and to the great trek from the villages to the big towns and cities of our land. Unfortunately we do not grow corn sufficient to meet our needs and thereby follow the excellent example set by our neighbours the French.

The confiscation of the Monasteries introduced a race of new over-lords, not bound to his territory by any family ties or traditions. It also tended to spread the view that the strong hand was its own justification.

To come to our own times, for the health and enjoyment of the community it is expedient that the bulk of the commons of England should be preserved as open spaces. As time progresses this is being realised more than ever, as witness to-day all over the country the dedication of parks and spaces to be maintained at the expense of the rates of the locality concerned. The artisan class is fully alive to the value of open spaces and is appreciative of natural beauty. The provision of bird sanctuaries is also a step in the right direction. These are diametrically opposite to Common land in that, though permanently set apart for the preservation and enjoyment of birds, they are not open to the general public to wander about at will.

By the Commons Act a Common may be drained, levelled, planted and generally improved for purposes of pasture or other beneficial occupation, and at the same time it may be put under popular management and rendered subject to bye-laws in the public interest. In this case it cannot be arbitrarily enclosed. A large number of Enclosure Acts have been passed, the most important of these is that of 1845 constituting a body called the Inclosure Commissioners of England, whose duties have now devolved upon the Board of Agriculture. By the sanction of this Board Commons may be enclosed and divided among the parties entitled to Common rights. Commons in the neighbourhood of London and other large towns, however, are subject to special legislation and cannot generally be enclosed. By the Commons Act of 1876 Commons within six miles of a town of 5000 inhabitants may, under certain circumstances, be taken away by the local authority in the public interest. In Scotland land held in commonty can be divided among the persons having rights in it under the Enclosure Act of 1695, and this has been so generally done that there is very little land of the kind left.

The enclosure of Commons tends to the extinction of the small freeholder and tenant-farmer, the yeoman class and to the deterioration of the labourer's condition. So long as a Common is open the rights descend from father to son, from vendor to purchaser.

A right of Common is annexed by law to land and so adds to the value of a small farm. But when once it has been commuted for money or for an additional plot of land, there is no such inalienability. The money may be spent or lost, or the land sold the next day, and the succeeding generation is so much the poorer. A Common once gone cannot be regained.

When there are no hedges, no commons, no grassy lanes, but where every inch of land is appropriated to farming purposes, the labourer has not a stick of wood and no place for a pig or a cow to graze on.

Long before the present desire for open spaces sprung up Sir Robert Peel told the House of Commons to be cautious how it dealt with the rights of Common which connected the peasant with the soil; the right of having a goose on the Common made a man feel interested in the tenure of land. To buy him out was very unfair to his successors.

Our land is covered by footpaths, the free use of which dates back to remote times. A public footpath is a highway, or right of way for the use of pedestrians only. Included in this term are stiles, foot bridges, fords, steps, unlocked wicket or other gates, and other conveniences for pedestrian use. Strictly speaking, any vehicle, from a bicycle upwards, may not go upon it without trespass. The soil over which the path runs belongs as a rule to the owner or owners of the land adjoining, and these paths generally lead to and from places where the public have a right to be. But a path leading to a farmhouse would not be a public one although long usage may have given rise to the impression that it was free. On the other hand it does not follow that because land is Common persons have the right to run their motor cars over it without lawful authority.

One rarely knows the history attaching to any particular path or common. A short cut is taken to a parish church, a village, shops, a pond, a public carriage road or to some other public path. It is there to be used and one walks over it under the impression that it has served the same purpose from time immemorial.

In the great majority of cases Right of Way has been given by express Dedication. Where this has not been granted all that can be proved is that for a long period of years the path has been in fact used as a thoroughfare by the public freely, openly, without interference and as of right. When sufficient evidence of this sort is forthcoming the presumption is that some owner or other must at some time have dedicated a Right of Way to the public. No fixed number of years has been laid down to established a public Right of Way; it varies in accordance with the facts of each case. A path may be lost by illegal obstruction, or by mere disuse it may become muddy, overgrown or otherwise impassable. But the rights of the public are not thereby abolished; it is only the more difficult to prove that it is a highway. By Act of Parliament any Highway, footpaths included, may be closed or diverted. This may also be done by Order of a Magistrate at Quarter Sessions, but in that case the consent of the Parish and District Council concerned is necessary.

Town, Parish and District Councils have a duty to perform in protecting all public rights of way within their sphere and preventing the stopping or obstruction of any such rights. Anyone erecting an impossible stile can be brought to book. And here I should like to give a word of advice to all who may discover that some particular path which they have been accustomed to use without let or hindrance is closed that they report the matter without delay to the proper quarter. Another method of meeting the danger of a way being lost by disuse is to use the path as much as possible and encourage others to do so. Stiles, gates and footbridges should be kept in repair by the Parish Council, or the body concerned, and the District Council or Town Council, as the case may be, should erect finger-posts informing people that the path is a public way leading to the places or roads to which it gives access. One can easily imagine a path across a field being ploughed up and so absorbed into the general acreage. Unless a case of this kind is watched and reported the disappearance of the path would be permanent.

In conclusion I would like to add a word of caution. I have endeavoured to give the views of various authorities on the subject with, perhaps, an undue preponderance to the legal aspect. It is just possible that recent Acts of Parliament may have upset the outlook in some degree. My remarks, therefore, must not be regarded as the last word on the matter.

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Research Items.

BLAGDON LAKE VEGETATION, 1929.

THE major part of 1929 was so dry that no such opportunity since 1921 had been afforded to investigate the interesting vegetation on the extensive areas of mud, sand and gravel around what remained of the reservoir. But it was not until August 20th that I started with note-book and photographic camera to study the actual state of things. The water was then about eight feet below high-water level. It was two feet lower on September 12th when my survey was continued, and by October 3rd, after some rain had fallen, it was nine inches still lower. When fishing as late as October 12th the great lake had risen a foot owing to heavy rain a week earlier.

Over seventy phanerogamic plants were listed on the actual shores, and at the shallow Ubley end a moss was conspicuous beneath the taller vegetation of a large area. It was not fruiting, and on the wetter mud nearer the water it gave place to the sporadic alga known as *Botrydium granulatum*. An increase of *Littorella*, so strangely rare in Somerset, was noticed on both north and south banks; and the establishment of a much larger colony of *Scirpus maritimus*, though of short stature, was apparent not far from the Anglers' Hut, though well below high-water level.

Perhaps the most interesting fact is that several of the most abundant plants on the mud were the same species that one had observed and collected on certain reservoirs and lakes in Warwickshire and Worcestershire after the drought of 1893. These are *Chenopodium rubrum* and its small prostrate variety, *C. album*, several species of *Polygonum* and *Atriplex*, *Nasturtium palustre*, and *Gnaphalium uliginosum*. Particularly at Blagdon *C. rubrum* was not only the dominant plant over many acres of ground, but the first coloniser of the drying mud nearest the water. There were innumerable seedlings of decreasing size as the water was approached. Many not an inch high and in dense beds were already flowering, while on longer exposed stretches older plants of this annual weed were one to two feet high. Other abundant species were the brilliant yellow flowered *Nasturtium sylvestre*, *Veronica Anagallis*, very variable in form and colour, *Matricaria inodora*, etc.

Since midsummer great quantities of mud, dug out with the spade, were carted away and deposited on slightly higher ground. On some of these new surfaces already by September a certain number of plants had become established. Conspicuous among them were *Chenopodium rubrum*, *Alisma Plantago*, well in flower, *Polygonum* spp., *Nasturtium sylvestre* and *Juncus bufonius*.

H. STUART THOMPSON.

SCOTTISH BIRDS.

The following notes, taken from a paper read by Mr D. Macdonald at the December meeting of the Ornithological Section, deal with four of the rarer Scottish birds.

These observations were made in a comparatively small area chiefly in Perthshire and as such do not necessarily apply to all Scotland. They were offered in the hope that other observers, who might be fortunate enough to go to those parts, might be saved time and trouble, and dealt with the appearance of these four birds in the field.

Common Gull. Compared with the Black-headed Gull, their flight is more buoyant, and has a touch of the Herring or Lesser Black-headed Gull, and they do not bunch when their colonies are invaded, as the Black-headed Gulls do. Their cry is shriller and wilder. They nest on larger lochs at a higher elevation, and those with a firmer shore; Black-headed Gulls will use a swampy reedy loch or moss-hag. The eggs are about one-third larger than those of the latter bird.

Two to three form a clutch, a larger number being probably due to two birds using the same nest, which can easily happen in crowded colonies. They may nest in heather, among peebles and rocks, on big islands or isolated rocks a few feet above water.

Red Grouse have been found sitting on eggs and surrounded by nesting Gulls, and yet undisturbed. This is interesting as the Common Gull is said to loot the nests of Grouse, Curlew and Duck.

Wigeon. Nests usually within ten feet of water's edge, in deep heather. The birds always gave a harsh grating quack when disturbed, which shows that their habits vary, as a good authority has said they rise silently. The eggs are laid about the beginning of June, seven to nine forming a clutch. The down is much like that of the Tufted Duck, but has conspicuous white tips to each tuft of down. The Wigeon is common on most hill-lochs and is increasing, and the drake is often seen with two Ducks in the nesting-season.

Black-throated Diver. The size and beauty of this bird can only be appreciated when it is seen in the wild state. Their dives were timed, and found to average thirty seconds, one being of fifty-five seconds. The snake-like movements of the head were very noticeable. No nest was found by 8th June, bad weather probably making them later than usual. The birds on one loch were tame and came within twenty yards. Their flight is like that of a Wild Duck, and has a decided resemblance to a fast-flying Gannet going down-wind. As breeding-birds they are rare.

Golden Eagle. The average altitude of twenty-one nests visited was from 1800 to 2000 feet above sea level. These were situated on broad ledges. They were usually easy of access, though some were awkward and required a rope. One pair may have two or three eyries and use them alternately; in a bad season the most sheltered eyrie will be chosen.

The size varies, the largest seen being six feet long by five broad and four deep. The eggs always rest on the Great Wood-rush (*Luzula sylvatica*) and are usually poorly marked. The cock broods the young up to ten days old; one was seen diving from a hide six feet away.

This is believed to be a new observation. One nest was decorated with fresh ivy leaves. Their food is chiefly Grouse and Mountain Hare. Only one lamb was found, and this was probably still-born and picked up dead. Eagles will take carrion, and sheep-wool was found in their castings in a glen where many sheep were lying smashed up. The birds were very timid, and a good hide was absolutely necessary.

Eagles can move as rapidly as a Peregrine Falcon when they are roused, but this is rarely seen.

Further notes can be found in "British Birds" (Magazine) for February 1926.

H. Tetley.

ENTOMOLOGY.

In the Entomological Section the President, Mr C. Bartlett, specialises in Coleoptera and Lepidoptera; he has a happy knack of bringing to light unexpected rarities and is doing pioneer work in studying the unpopular groups of micro-lepidoptera. Dr E. Barton White, Messrs A. Kromler, J. W. Norgrove and A. H. Peach also specialise in Lepidoptera, and it is hoped that their records of local species may be incorporated in a revised list of Bristol Lepidoptera. Miss I. M. Roper is particularly interested in galls and has compiled records of all the known insect gall-makers in Somerset and Gloucester.

For some few years past Mr H. Audcent has made a close study of Diptera. Members will recall his stimulating paper, "Diptera—An Appeal," in our "Proceedings" for 1927. So far as our immediate area is concerned, by assiduous collecting Mr Audcent has been able to add enormously to a knowledge of locally occurring flies. His carefully compiled list of the Diptera of the Bristol District (with which has been incorporated Miss Roper's records of gall-makers) is now in course of publication in the Society's "Proceedings." Elsewhere he has contributed considerable additions to the list of the Diptera of Somerset.

While the results of some of Mr H. Womersley's investigations have been communicated to the Society, much of his more important work has not come directly to the notice of members. In particular reference must be made to his research on the Protura, published at length in the Entomological Monthly Magazine, vol. lxiii., 1927. There, for the first time, are set out the positive characters by which the little-differentiated species in this group of minute creatures can be discriminated and an account is given of certain immature stages. A number of new species described in that paper was taken in the course of collecting in the Bristol district. More recently Mr Womersley has completed a comprehensive survey, with tabular diagnoses, of the Irish Collembola and Thysanura for publication in the "Proceedings" of the Royal Irish Academy, 1929. He has also made a critical revision of the British species of Machilidae (Thysanura) and this study forms the subject of a paper appearing in the *Annals and Magazine of Nat. Hist.*

Of the work of Mr H. G. H. Kearns in economic entomology members will have a first-hand account when he gives his lecture on "Timber Beetles" in March. His cellulose-spray device for combating the attacks of *Lyctus* spp., by rendering it impossible for the beetles to lay their eggs in the treated wood, has provided a means for definitely checking what was threatening to become a most serious pest. Another important investigation on which Mr Kearns has been engaged is that in connection with willow pests. Some idea of the patience and labour involved in this research may be formed when it is considered that in the case of the Chrysomelid beetle, *Phyllodecta vitellinae* L., the whole life history has been worked out in detail, including the peculiarities of mating and oviposition, the duration of the different stages in the life cycle, the number of broods in the year, the method and time of hibernation, the feeding habits of larvae and adults, and the probable inter-relation between the beetle infestations and the salicin content of the plant. By such close study the most vulnerable points of attack have been found and suitable methods of control have been devised.

Mr J. V. Pearman is endeavouring to trace out the biological histories and relationships of the Psocoptera.

J. V. PEARMAN.

The Fungi of the Bristol District.

By Elsie M. Wakefield, M.A. (Oxon.), F.L.S.

BRISTOL and its neighbourhood is of special interest to British mycologists in that it is classical ground for some of the rarer species of our fungus flora. C. E. Broome, who was a friend of M. J. Berkeley and collaborator in many of his publications, lived for some time from about 1836 to 1848 in the vicinity, and collected actively, sometimes in company with G. H. K. Thwaites, known later through his investigation of the Ceylon Flora. Broome seems to have had a "flair" for finding those unusual and interesting fungi which grow beneath the surface of the ground (hypogeal fungi), and again and again, in the pages of Berkeley's publications, one finds "Bristol, C.E.B." cited as the locality for the British record of species belonging to the groups Hymenogastraceae or Tuberaceae.

Obviously hypogeal fungi are not easily discovered unless unearthed by the scratching of animals, and except for a few species they seem to be very rare and very local in occurrence. Some of Broome's finds have never been recorded since, but it is difficult to believe that these fungi should have disappeared from the district. There is still scope for the enterprising and patient collector. On the two occasions when the British Mycological Society has visited Bristol the only species of the group found has been *Hydnangium carotaecolor*. This, as its name indicates, is of a bright orange colour, and furthermore occurs close to the surface of the soil so that it is frequently exposed and easily seen. There is little hope of finding other forms by a casual, superficial hunt; careful and patient digging is necessary.

A later mycologist of the district was Cedric Bucknall, who between 1878 and 1891 published a complete list, with an index, of all fungi recorded from Bristol up to that date. Since then the only additional lists of any length have been one compiled during the Spring Foray of the British Mycological Society in 1923, and published in the "Transactions" of the Society, and another drawn up at the Autumn Foray of the same Society in October last, and now in course of publication.

Comparison of these lists with that of Bucknall is instructive, as indicating in what ways British Mycology has advanced during the past forty years. Particularly noticeable is the fact that the recent lists include many more microfungi. This is due partly to the development of plant pathology and the more general interest in parasitic forms, and partly to the presence in large parties such as attend these Forays of specialists in many different groups, who naturally pay particular attention to the plants in which they are interested. Then again, with the more specialised study of fungi and greater use of the microscope many species have been distinguished and described in recent years which were unknown to the older authors. Thus during the recent Autumn Foray such species as *Astrosporina duriuscula* Rea, *Poria* *xantha* Lind, *Corticium confine* Bourd. & Galz., *Peniophora glebulosa* Bres., *Sebacina subhyalina* Pears., and many others were listed which have been either described or added to the British flora only in recent years.

A word of warning is necessary. On a superficial examination the number of additions to Bucknall's list which occur in the Foray lists may appear greater than it really is. With advances in our knowledge of fungi inevitable changes in nomenclature have taken place. *Peniophora cinerea* and *P. incarnata* may appear to the unwary to be new to the Bristol list, but the mycologist recognises that *Corticium cinereum* and *C. incarnatum* in Bucknall's list represent the same plants. Similarly Bucknall included under Polyporus species now distinguished as Fomes or Polystictus. *Uromyces Scillarum* appears in the list as *U. concentrica*, and *Phragmidium Rubi* as *P. bulbosum*.

Such cases are simple. More difficult are those in which the old name has been found to include several species which are now distinguished on biological or other grounds. Thus it is impossible to know which of the specialised cereal smuts was included in *Ustilago Carbo* Tul., and this name should be omitted from any future compilation.

Allowing for such nomenclatorial changes, and also for the drawback that on both occasions when the British Mycological Society has visited Bristol the weather has been for some time previously particularly unfavourable to the growth of fungi, the recent lists have nevertheless made substantial additions to the local fungus flora.

As already mentioned, very many of the additions are among the microfungi or among the lower Basidiomycetes. During the recent Foray one of the most common of the " Rust " fungi was *Kuehneola albida*, which occurred on brambles everywhere. This is an example of a species which was formerly overlooked as being one or other of the two species of Phragmidium which occur on Rubus. It differs especially in the perfect or teleutospore stage, but is also recognisable by the smaller and paler uredosori. One of the most interesting of the microforms found was *Sporocybe Azaleae*, on buds and leaves of Rhododendron. This fungus, which is a parasite of Rhododendrons, was recorded for the first time in this country only about two years ago, but is probably not uncommon. *Sphaerostilbe aurantiaca*, a little species which in its early stage forms bright orange heads on elm twigs and branches, is one of those fungi which has not been recorded for many years, and appears to be really rare. At Bristol both conidial and perithecial stages were found.

Among the larger, fleshy fungi, the recent list is perhaps more remarkable for its omissions than for its additions. In a normal season such common species as *Laccaria laccata*, *Russula emetica* and *R. ochroleuca*, *Cortinarius elatior*, etc., are brought in in quantities. After the long drought of 1929 they were noticeably absent, and are not represented in the list by a single specimen. The fungus " season " in this year began extremely late, and was prolonged into the mild winter. At the end of November in the London district one could gather species which normally appear in September and October.

On the other hand, exceptional seasons, either by reason of the unusual conditions or owing to the more intensive searching which is necessary, do give rise to some unusual records. Some rare species rewarded the "forayers" in October last. The woods at Brockley and Cleeve Combe gave the beautiful white *Amanita echinocephala*, and two small and closely allied species of Lepiota, *L. sistrata* and *L. seminuda*. On bare soil at the entrance to Brockley Combe was found also *Psathyra noli-tangere*, a small greyish Agaric whose fragility amply justifies its specific name. This was new to many of the members present. *Tricholoma inamoenum* and *Pluteus phlebophorus*, two other uncommon members of the toadstool alliance, and a particularly nice group of "Earth Stars" (*Geaster fimbriatus*) were also found in Brockley Combe. One member who made a private expedition to Chelwood brought back *Nyctalis parasitica*, an interesting Agaric which is parasitic on certain of the larger fleshy Agarics, especially *Russula nigricans*. It is remarkable in that its gills are frequently not developed at all, and the whole cap is transformed into a powdery mass of conidial, or chlamydospores.

Among the cup fungi, some very fine examples of *Chlorosplenium aeruginosum* were obtained. This fungus is not new to the Bristol list, but is mentioned because these examples were particularly beautiful. *C. aeruginosum*, as its name implies, is entirely of a vivid, verdigris green colour, and wood stained by its mycelium was formerly used in the manufacture of the so-called Tunbridge ware. A cup-fungus which is rare and new to the Bristol flora is *Encoelia tiliacea*. This was found on the last day of the Foray, growing for some distance along the bark of a fallen lime tree.

These are only a few of the more striking new records. Comparison of the lists will show that the majority of the Fungi Imperfecti listed recently, as well as many of the Pyrenomycetes and Rusts, are all additions to the flora of the district. There is no doubt that more favourable conditions as regards weather would have produced even better results.

The Mycetozea of the Bristol District.

By W. R. Ivimey Cook, B.Sc., Ph.D., F.L.S.
(Dept. of Botany, University of Bristol).

In the Autumn of last year the British Mycological Society visited Bristol. Among their number were several who were specially interested in the Mycetozoa. Although the weather had been so dry that few of the higher fungi were to be found the Mycetozoa had not suffered so badly. A number of interesting species were found, some of which are apparently new to the district.

There are some who consider that the Mycetozoa, or Myxomycetes as they were formerly called, should not be included as Fungi. The mode of nutrition, however, is in some instances the same although it is now known that the spores of other fungi may be eaten whole by these organisms. This power of digesting solid food has led to the belief that the Mycetozoa are more closely allied to animals than plants.

The Mycetozoa are found in damp places chiefly on decaying sticks and leaves. In the early stage they consist of a slimy mass of protoplasm which is capable of slow movement. It feeds partly on solid material and partly upon the decomposition products of the wood on which it lives. When mature the protoplastic mass, which is called a plasmodium, becomes converted into a mass of sporangia. These may be either sessile or stalked and are frequently very beautifully coloured. It is these sporangia which are the objects collected. During the time that the British Mycological Society were in the district some 33 species were found. Reference to the old records will show that a number of these have already been found by Broome and Bucknall. It is interesting to note, however, that among those species which are not recorded by these careful workers are some of considerable size. *Badhamia macrocarpa* for example is a very striking species yet it is not recorded in Bucknall's list. One may reasonably ask whether it is probable that a worker, who studies the fungi of the district as carefully as Bucknall, could have overlooked this species, or is it more likely that this species has only recently appeared in the neighbourhood. This particular species was found in Ashton Court.

The other species which have not apparently been previously recorded are *Diderma floriforme*, *Cribraria rufa*, *Cribraria tenella*, *Lachnobolus congestus* and *Perichaena chryosperma*.

The same difficulty which is experienced in working with Bucknall's lists when studying the higher fungi occurs in his treatment of the Mycetozoa. During the last thirty years the study of the Mycetozoa has increased with the result that more and more information is available. The inevitable result is that specific and not infrequently generic names become changed. The common "Flowers of Tan," for example, appears in Bucknall's list under the name *Fuligo varians* Somm.; it is now always referred to as *Fuligo septica* Gmel.

It is many years since Bucknall's list of the Fungi of the Bristol district appeared. Since that time several other lists of the local species of the Mycetozoa have been published. Since three of these lists at any rate are not readily accessible to members of the Society it seemed desirable that a complete list of all the species which, as far as the writer knows, have been recorded around Bristol, should be published in the records of the Society. As will be seen, some of the early records have not been found by later observers, and it would be interesting to know whether such species have really disappeared or merely been overlooked.

Where necessary the synonyms used in Bucknall's list have been added after the now generally recognised name of the species. In compiling this list the Third edition (1925) of Lister's *Monograph of the Mycetozoa* has been followed.

Ceratiomyxa fruticulosa Macbr. 2,* 3, 4. (=*Ceratium hydnoides* Alb. & Schw. in Bucknall.)
Badhamia capsulifera Berk. 1, 2, 4. (=*B. hyalina* Berk. in Bucknall.)
,, *utricularis* Berk. 1, 2, 3, 4.
,, *macrocarpa* Rost. 5.
,, *panicea* Rost. 1, 3, 4, 5.
Physarum citrinum Schum. 2. (=*P. Schumacheri* Sperng. in Bucknall.)
,, *leucopus* Link. 1.
,, *psittacinum* Ditm. 5.
,, *viride* Pers. 2, 3, 5. (=*Tilmadoche mutabilis* Rost. in Bucknall.)
,, *nutans* Pers. 2, 3, 4, 5. (=*Tilmadoche nutans* Rost. in Bucknall.)
,, ,, v. *leucophaeum* Lister. 1, 2. (=*P. leucophaeum* Fr. in Bucknall.)
,, *compressum* Alb. & Schw. 1, 3, 4, 5.
,, *didermoides* Rost. 3.
,, *venum* Somm. 4.
,, *cinereum* Pers. 2. (=*Didymium cinereum* Fr. in Bucknall.)
,, *sinuosum* Weinm. 1, 3.
Fuligo septica Gmel. 1, 2, 3, 5. (=*F. varians* Somm. in Bucknall.)
Craterium minutum Fr. 1, 2, 3, 4, 5. (=*C. vulgare* Ditm. in Bucknall.)
,, *leucocephalum* Ditm. 3.
,, *aureum* Rost. 1, 3, 5.
Leocarpus fragilis Rost. 2, 3, 4.
Diderma spumarioides Fr. 3, 4.
,, *hemisphericum* Hornem. 1, 3, 4.
,, *effusum* Morg. 3.
,, *radiatum* Lister. 2, 3, 4. (=*Chondrioderma radiatum* Linn. in Bucknall.)
,, *floriforme* Pers. 5.
Diachea leucopoda Rost. 3, 5.
Didymium difforme Duby. 1, 2, 3, 4. (=*Chondrioderma difforme* Pers. in Bucknall.)
,, ,, v. *comatum* Lister. 4.
,, *trachysporum* G. Lister. 1.
,, *Clavus* Rabenh. 1, 3.
,, *melanospermum* Macbr. 2, 4. (=*D. farinaceum* Fr. in Bucknall.)
,, *nigripes* Fr. 2, 3, 5. (=*D. microcarpon* Fr. in Bucknall.)
,, ,, v. *xanthopus* Lister. 1, 3.
,, *squamulosum* Fr. 1, 2, 3, 4.
Mucilago spongiosa Morg. 1, 2, 3. (=*Spumaria alba* DC. in Bucknall.)
Lepidoderma Chailletii Rost. 3.

*These numbers refer to the list of references at the end.

Stemonitis fusca Roth. 1, 2, 3, 4, 5.
,, *splendens*, v. *flaccida* Lister. 3.
,, *flavogenita* Jahn. 3.
,, *ferruginea* Ehrenb. 2, 3.
,, *herbatica* Peck. 1, 5.
Comatricha nigra Schroet. 2, 3, 4, 5. (=*C. Friesiana* de Bary = *Stemonitis obtusata* Fr. in Bucknall.)
,, ,, v. *alta* Lister.*
,, *pulchella* Rost. 1.
,, ,, v. *fusca* Lister.
,, *typhoides* Rost. 2, 3. (=*Stemonitis typhoides* DC. in Bucknall.)
Enerthenema papillatum Rost. 1, 2, 3. (=*E. elegans* Bowman in Bucknall.)
Lamproderma columbinum Rost. 2. (=*L. physaroides* Alb. & Schw. in Bucknall.)
,, *scintillans* Morg. 1, 2, 3, 5.
,, *violaceum* Rost. 2. (=*L. arcyrioides* Somm. in Bucknall.)
Amaurochaete fuliginosa Macbr. 3.
Brefeldia maxima Rost. 4.
Lindbladia effusa Rost. 2. (=*Reticularia maxima* Fr. in Bucknall.)
Cribraria argillacea Pers. 3.
,, *rufa* Rost. 5.
,, *intricata* Schrad. 2.
,, *tenella* Schrad. 5.
,, *vulgaris* v. *aurantiaca* Pers. 3.
,, *microcarpa* Pers. 2.
Dictydium cancellatum Macbr. 2, 3. (=*D. cernuum* Pers. in Bucknall.)
Licea flexuosa Pers. 3.
Tubifera ferruginosa Gmel. 2, 3. (=*Licea cylindrica* Fr. in Bucknall.)
Dictydiaethalium plumbeum Rost. 1, 2, 3, 4. (=*Clathroptychium rugulosum* Wallr. in Bucknall.)
Reticularia Lycoperdon Bull. 1, 2, 4. (=*R. umbrina* Fr. in Bucknall.)
Liceopsis lobata Torrend. 4.
Lycogala epidendrum Fr. 1, 2, 3, 4, 5.
Trichia flavoginea Pers. 2. (=*T. chrysosperma* DC. in Bucknall.)
,, *affinis* de Bary. 3, 4, 5.
,, *persimilis* Karst. 1, 3, 4, 5.
,, *scabra* Rost. 1, 2, 3, 5.
,, *varia* Pers. 1, 2, 3, 4, 5. (=*T. nigripes* Pers. in Bucknall.)
,, *contorta* Rost. 2, 3.
,, *lutescens* Lister. 2. (=*Oligonema furcatum* Buckn. in Bucknall.)
,, *decipiens* Macbr. 1, 2, 3, 4, 5. (=*T. cerina* Ditm. = *T. fallax* Pers. in Bucknall.)
,, *Botrytis* Pers. 1, 4, 5.
,, ,, v. *flavicoma* Lister. 3.
,, *floriformis* (Schwein.) G. Lister. 3. (=*T. Botrytis*, v. *lateritia* in Fry.)
Oligonema nitens Rost. 2.
Hemitricha Vesparium Macbr. 1, 2, 3. (=*Hemiarcyria rubiformis* Pers. in Bucknall.)
,, *clavata* Rost. 1, 2, 3, 4. (=*Hemiarcyria clavata* Pers. in Bucknall.)
Arcyria ferruginea Sauter. 1, 3.
,, *cinerea* Pers. 1, 3, 5.
,, *pomiformis* Rost. 1, 2, 3.
,, *denudata* Wettst. 1, 2, 3, 5. (=*A. punicea* Pers. in Bucknall.)
,, *incarnata* Pers. 1, 4, 5.
,, *nutans* Grev. 1, 2, 3, 5.
,, *Oersedlii* Rost. 3.
Lachnobolus congestus Lister. 5.
Perichaena chrysosperma Lister. 5.
,, *depressa* Libert. 2, 3, 5.
,, *corticalis* Rost. 1, 2, 3.
,, *vermicularis* Rost. 1, 2, 3. (=*Ophiotheca umbrina* Berk. in Bucknall.)

*Found recently on dead wood at Henleaze.

Margarita metallica Lister. 1, 2, 4. (=*Cornuvia metallica* B. & Br.=*Physarum metallicum* Berk. in Bucknall.)
Dianema depressum Lister. 1.
Prototrichia metallica Mass. 1.

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*I wish to thank Miss G. Lister for so kindly supplying me with these records and also for much valuable assistance in compiling this list.

Limestone Scenery.

By S. H. Reynolds, M.A., Sc.D.,
Professor of Geology in the University of Bristol.

It is probable that there is no other kind of rock which gives rise to such a distinctive type of scenery as massive limestone, and although for certain of its features one must visit regions like the north of England, there are others which are admirably displayed in the Bristol District.

The special characters of massive limestone upon which its scenic features depend are in the first place its solubility by water containing carbon dioxide in solution, and in the second place the strong divisional planes—joints and bedding planes—which commonly traverse it, and along which it readily breaks, producing cliffs and precipices such as those of Cheddar and the Avon Gorge. In the British Isles all the features of massive limestone country are best displayed by the Carboniferous Limestone.

Chalk is a special type of limestone with features of its own so distinctive as to require special treatment.

Regions formed of pure limestone, especially when it is lying horizontally, are commonly very bare and barren, since when the rock is affected by the weathering action of rain, almost the whole is carried off in solution, and little insoluble matter remains to form a soil. The bare rock surfaces known in parts of the north of England as clints have their cracks and joints widened by solution producing a system of fissures sometimes called grikes, which may be difficult to traverse. These features are admirably seen in the Carboniferous Limestone district of West Yorkshire. (Pl. III. and V.) The scanty insoluble residue of the limestone accumulates in the grikes, and supports groups of ferns or an occasional bush or tree which alone break the bare monotony.

In the Bristol District, owing mainly to the fact that the Carboniferous Limestone nowhere lies horizontally, vertical solution channels and bare platforms comparable to those of the North of England are nowhere typically developed. Durdham Down is a limestone platform, but is in the main reasonably well covered with soil and turf, though many football and hockey players are painfully aware of the fact that the soil in places is very thin and that solid rock often comes to the surface. Probably the nearest approach locally to the barren limestone plateaux of the north of England is seen in the Mendips in the region between the Cheddar valley railway and Crook's Peak.

In course of time the cracks and joints in the limestone get widened by solution and give rise to an intricate system of passages along which nearly all the rain escapes underground, causing the surfaces of limestone uplands to be streamless. This feature is well illustrated locally in the case of the Western and Central Mendips and of Broadfield Down. In the Western Mendips several small streams rise on the slopes of

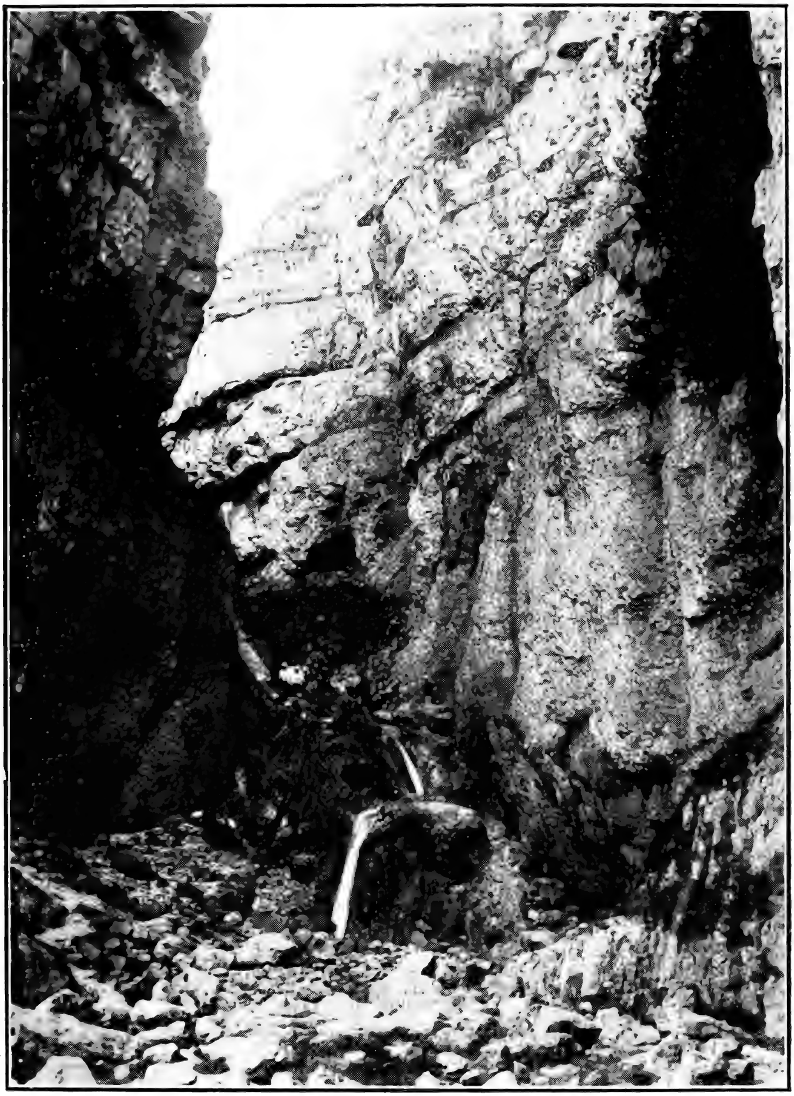
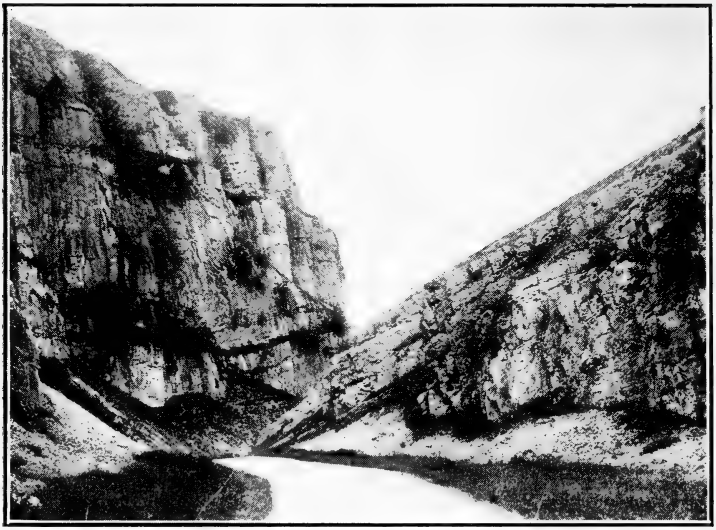


Plate I. GORDALE RAVINE, WEST YORKSHIRE.



A.—THE CHEDDAR GORGE.
On the left side the erosion is along joints, on the right side along bedding planes.

B.—BURRINGTON COMBE (Upper Part).
Plate II. The Combe here follows the strike of the rocks.

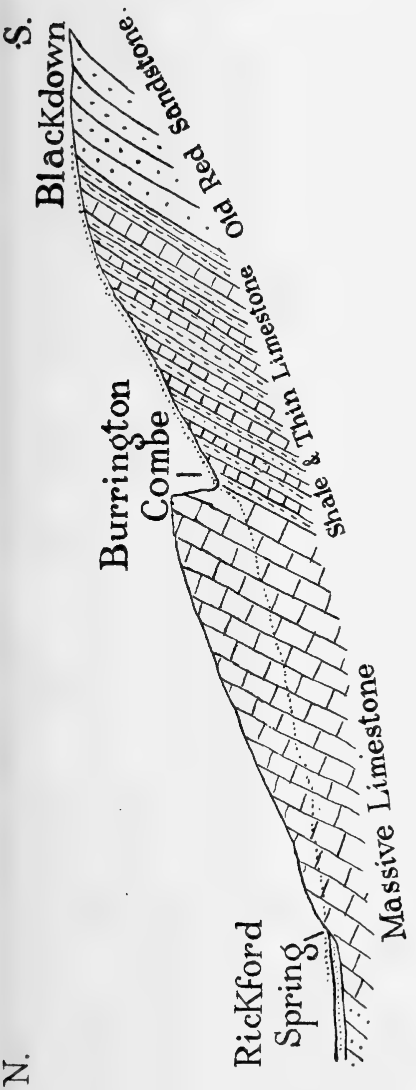


FIG. I.—SECTION THROUGH THE NORTHERN SLOPE OF THE WESTERN MENDIPS FROM BLACKDOWN TO RICKFORD. (Scale about 4 ins. to 1 mile.)

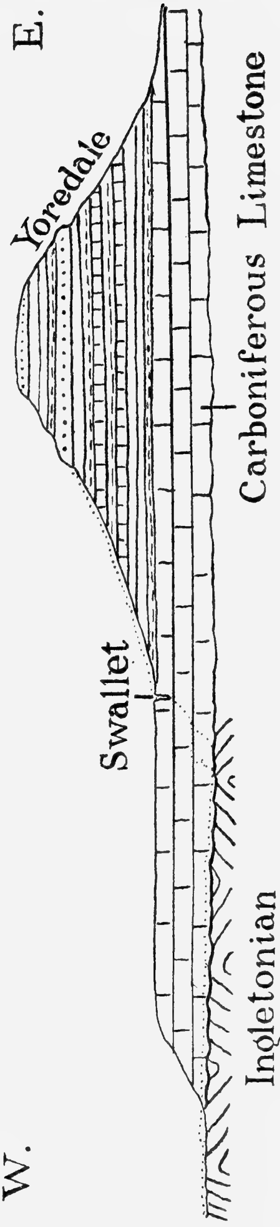


FIG. II.—SECTION THROUGH INGLEBOROUGH. (Scale about 3 ins. to 1 mile.)

Blackdown, including the Burrington twin streams, but the water disappears underground into swallets when or before the massive limestone is reached (see Fig. 1). The Central Mendip area from the Cheddar Gorge eastward forms a typical example of a streamless limestone plateau.

Similar limestone plateaux, but of a more impressive character, are seen in the case of the Causse district of Central France, and the Karst area of Istria. In the Karst country the scanty insoluble matter collects in solution hollows known as dolinas, which may provide the chief land capable of cultivation. In parts of the Causse, such as near Montpellier le Vieux, the weathering of the limestone has given rise to a fantastic series of pinnacles and arches. In many of the countries bordering the eastern part of the Mediterranean, such as Syria, Palestine, Greece, and Montenegro, many of the features of limestone country are typically displayed, but the prevalent bareness and barrenness of much of the country partly depends on the destruction of the trees either for fuel, or by goats, the destruction being followed too often by the washing away of the scanty soil.

When the surface of the limestone is covered by a considerable accumulation of superficial material, and particularly at points where large cracks or joints intersect, crater-like solution hollows* are found. Though most numerous in parts of West Yorkshire, there are many of them in the Central Mendips, especially to the north and north-east of the Castle of Comfort Inn. The largest of these are the Wurt Pit and the Devil's Punch Bowl. The sink-holes of Kentucky are similar.

When the conditions are such that a stream, temporary or perennial, discharges into a swallet, very remarkable results may follow. In West Yorkshire, where the rocks lie horizontally, huge vertical-sided pits or "pots" (see Pl. IV.B) may arise. The most impressive of these, Gaping Gill, is 365 feet deep, and opens at the bottom into a huge cavern 480 feet long and about 110 feet high.

In the Mendips, owing to the fact that the limestone is highly inclined, vertical openings like the Yorkshire pots do not arise, but the underground channels, which may rival in depth and probably exceed in intricacy those of Yorkshire, tend to follow the bedding planes more than the joints. The most remarkable of these caves, if they may be so termed, are the Eastwater Swallet and Swildon's Hole near Priddy, Wookey Cave near Wells, and the Lamb Cave (Pl. VI.A) above West Harptree. The latter is in some respects the most remarkable of the Mendip caves, the great chamber being as much as 130 feet high.

The disappearance of streams into swallets and the eventual re-emergence of the water forms one of the most impressive and interesting features of a district of massive limestone, admirably seen in the Mendips as well as in West Yorkshire, the Gower Peninsula (Pl IV.A), and numerous other areas.

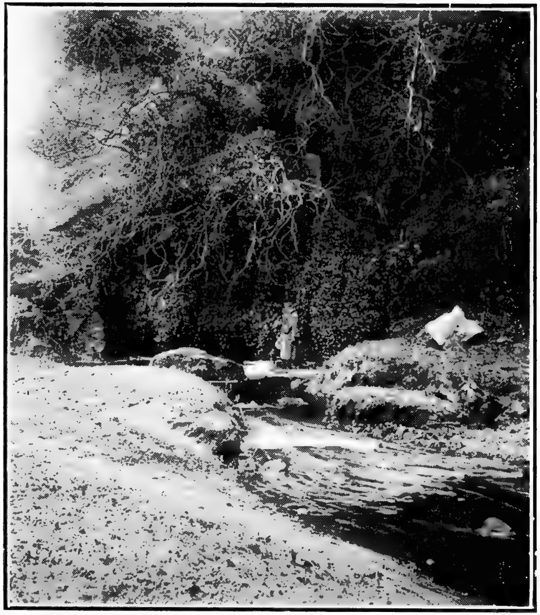
Perhaps these features are nowhere better seen than at Ingleborough. The main part of Ingleborough (Pl. V. and Fig. 2) consists of rocks

*See Kendall and Wroot Geology of Yorkshire, p. 63.

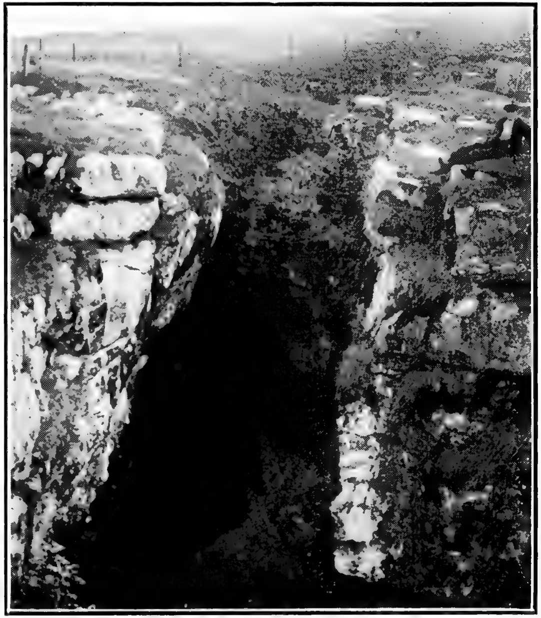
NEAR CHAPEL-LE-DALE, WEST YORKSHIRE.

The bare Carboniferous Limestone platform is deeply scored by solution channels (grikes).

Plate III.



A.—NEAR BISHOPSTON, GOWER.
The stream disappears into a swallet at the base of the ivy-covered cliff.



B.—ROUGHTON POT, near INGLETON, WEST YORKSHIRE.

Plate IV.

relatively impervious to water and thus supporting surface streams. About two-thirds of the way down the hillside these impervious rocks rest on the massive limestone already referred to, and on reaching this all the streams disappear into swallets. The water traverses the limestone and comes to the surface in a series of springs at the junction of the massive limestone and the impervious Ingletonian beds.

In the Mendips a number of similar cases occur. Thus the water of the Burrington twin streams, to which reference has already been made, comes to the surface as the Rickford springs (see Fig. 1). A second spring produces the powerful outflow of water from which Banwell gets its name. It is sad to think that the Banwell pool has been covered over and destroyed in providing a water supply for Weston-super-Mare. On the south side of the Mendips there is the magnificent spring in the grounds of the Bishop's Palace at Wells, after which the city is named, while the sources of the Axe at Wookey and of the Cheddar stream are analogous.

The best known features of districts of massive limestone are, however, the caves and gorges. All limestone caves are the product of solution, and, while some, such as that of Gaping Gill and the Lamb Cave, are deep within the earth, the better known ones are readily accessible from the surface, and are either famous for the beauty of the stalactites, or of interest from the traces of their presence left by the former inhabitants, whether hyaenas, bears, or men.

The great majority of the caves of the British Isles are in Carboniferous Limestone, including those of Somerset, Derbyshire, North and South Wales, West Yorkshire, and Ireland. Those of Devonshire are in Devonian Limestone and the famous Kirkdale Cave of East Yorkshire, described by Dean Buckland*, was in Corallian Limestone. The largest English cave is said to be the Peak Cave, near Castleton, Derbyshire, but it is claimed that the Mitchelstown Cave, Tipperary, is larger than any in England. Both are in Carboniferous Limestone.

Allusion may be made to a few of the more famous extra-British examples:—

On the European continent—Belgium (Carboniferous and Devonian); France—Cevennes and Provence (Jurassic); Germany—Swabia and Franconia (Jurassic); Moravia (Devonian); Eastern Alpine region—Karst (Carso) district, near Trieste (Cretaceous); Spain—Gibraltar (Cretaceous). The great cave near Trieste, formerly known as the Adelsberg cave, but now doubtless bearing an Italian name, is said to be the largest in Europe. The caves, gorges, and underground rivers and lakes of the Karst probably form the most remarkable examples of the underground action of water to be seen in Europe.

Extraeuropean—In S. Africa the most remarkable caves are the Cango Caves near Oudtshoorn, in the Cape Province, and the Sinoia caves in Rhodesia, in each case in dolomitized Precambrian limestone. In North America the most famous cave is the Mammoth Cave of Kentucky in Carboniferous Limestone.

*Reliquiae diluvianae.

The most impressive feature of many districts of massive limestone is afforded by the gorges, the steep sides of which depend on the well-jointed character of the rocks.

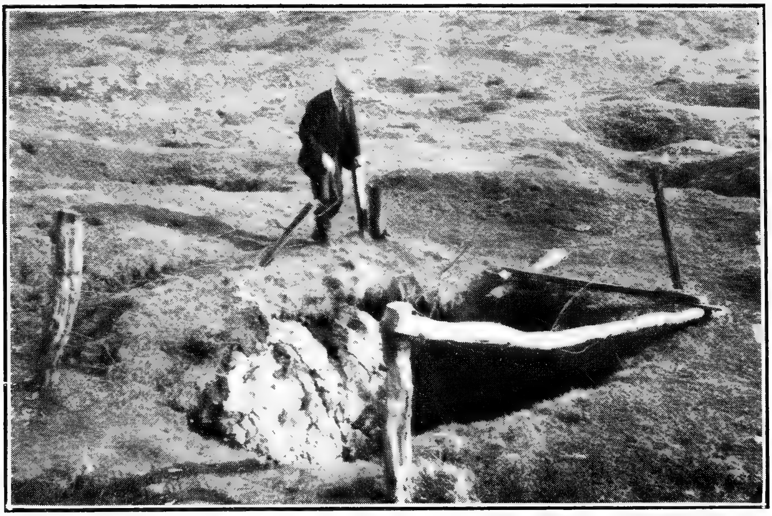
Limestone gorges may be divided into two groups, those with a river at the bottom such as the Avon Gorge, and that of the Tarn in Central France, and the dry gorges and valleys so admirably displayed in the Somerset combes. The origin of the former group is clear, they are the work of the river which now occupies them; but it is by no means so obvious how the dry valleys such as Goblin and Burrington Combes, the Cheddar and Ebbor gorges were formed. They resemble those with streams at the bottom in all essential respects, and it can scarcely be doubted that they are the work of water in spite of the fact that under present conditions all the water that enters them escapes by underground channels instead of collecting into streams. It has been claimed that the gorges are really gigantic unroofed caverns, and this may sometimes be the case, some support of this theory being found in the conditions at Wookey. The river Axe on emerging from Wookey Cave traverses a ravine into which open certain small caves, which bear much the same relation to the ravine that the lateral passages in Wookey Cave bear to the main cave. A more probable explanation for most dry valleys is that they are the work of ordinary river erosion during interglacial or early post-glacial times, when, owing to the underground water being still frozen, the limestone was impervious and surface streams could exist. A third possibility is suggested by the winterbournes and nailbournes of the Chalk districts of the south of England, and by certain rivers and streams such as the Manifold in Derbyshire and some of the Yorkshire becks. These stream courses are dry, sometimes normally, sometimes only under conditions of exceptional drought, but when the rainfall is such as to raise the saturation level of the rocks to the level of the ground, the streams begin to flow. It is possible that the dry valleys of Somerset were formed during a prolonged period of exceptional wetness, which caused the saturation level of the limestone to rise to such an extent that surface streams were formed.

The fact that the Yorkshire gorges like Gordale (Pl. I. and VI.B) are worn in horizontally lying limestone, while those of Somerset, like the Cheddar Gorge and Burrington Combe are worn in limestone inclined at a considerable angle, causes them to differ in one well-marked respect. The Yorkshire gorges (Pl. I. and VI.B) have both sides equally steep, their faces being determined by the joint planes. In the Somerset gorges (Pl. II.) one side is much steeper than the other. The steep side is determined by erosion along the joint planes, the more gently sloping side by erosion along the bedding planes.

The English Jurassic limestones, such as those forming the Cotteswold escarpment, being softer and not so pure as the Carboniferous Limestone, do not give rise to such bare plateaux or such precipitous escarpments. The Silurian limestones of the Welsh border counties give rise to very characteristic tree-capped escarpments, such as Wenlock Edge in Shropshire.

INGLEBOROUGH, WEST YORKSHIRE.

Plate V. With the bare platform of Carboniferous Limestone in the foreground.



A.—MOUTH OF THE LAMB CAVE, ABOVE WEST HARPTREE, MENDIPS.

B.—DRY VALLEY ABOVE MALHAM COVE, WEST YORKSHIRE.

Plate VI.

Chalk country shows many of the features characteristic of other regions of thick limestone, such as the precipitous sea cliffs, the scarcity of streams, and the abundance of dry valleys. Temporary streams—winterbournes and nailbournes—are specially characteristic of the Chalk. Some of them flow every season, others such as the Croydon bourne only exceptionally.

But there are other features dependant in the main on the relative softness, porosity, and little jointed character in which Chalk differs from other limestones. The caves and underground channels, swallets and gorges so characteristic of Carboniferous Limestone are not found in Chalk country. It is a noteworthy fact that in spite of its softness, Chalk commonly forms fairly lofty hills, this being due to the fact that its porosity allows the rain to escape underground without collecting into streams, so that mechanical erosion is at a minimum.

Regions formed of massive dolomite show many of the characters of limestone country in an exaggerated form, as is seen in the Eastern Alps, where the most remarkable feature is afforded by the precipices, which depend on the thick bedded and well jointed character of the rocks.

Bristol Insect Fauna.

DIPTERA (Part II.).

By H. Audcent.

VIII. THAUMALEIDAE (ORPHNEPHILIDAE).

Small flies (3-5 mm.), rather stout, wings broad longer than body with six unbranched veins, antennae short with eleven joints, legs short. Found near streams in which their larvae live. Only one genus is British, and only three species of this genus have so far been found in Great Britain. Until lately only one genus with one species was known for Great Britain, and this is described in " Insecta Britannica," F. Walker, and " Faune de France," vol. xii., E. Séguy. In 1929 Mr F. W. Edwards published a full account of the family (four genera, thirty-two species) in " Zoologischen Anzeiger," Leipzig.

Thaumalea verralli Edw. S., St Audries (A.), 26/8/29.

IX. PSYCHODIDAE.

Small flies (1-4 mm.) with broad wings covered with scales which gives them the appearance of small moths. They are plentiful in all damp places as their larvae live in damp detritus. The females of one genus only (Phlebotomus) are blood suckers and attack man; this genus does not occur here. No one seems to have collected Psychodidae in our district since the Rev. E. A. Eaton, from whose paper, published in " E.M.M.," 1893-5, the following list of records is taken. I know of no recent literature on this family.

Pericoma advena Eat. S., Bratton Seymour.
,, *blandula* Eat. S., Blackmore Vale.
,, *caliginosa* Eat. S., Minehead.
,, *canescens* Mg. S., Wincanton.
,, *cognata* Eat. S., Bruton.
,, *compta* Eat. S., Stoney Stoke.
,, *consors* Eat. S., Ashcot.
,, *exquisita* Eat. S., Blackmore Vale.
,, *extricata* Eat. S., Stoney Stoke.
,, *fallax* Eat. S., Blackmore Vale.
,, *fratercula* Eat. S., Wincanton.
,, *fusca* Mg. S., Wincanton and Shepton Mallet.
,, *gracilis* Eat. S., Stoney Stoke.
,, *incerta* Eat. S., Wincanton.
,, *morulae* Eat. S., Wincanton.
,, *mutua* Eat. S., Bruton.
,, *neglecta* Eat. S., Minehead.
,, *notabilis* Eat. S., Stoney Stoke.
,, *nubila* Mg. S., Minehead; Shepton Mallet (C.).
,, *ocellaris* Mg. S., Wincanton.
,, *palustris* Mg. S., Stoney Stoke.
,, *pulchra* Eat. S., Stoney Stoke.
,, *revisenda* Eat. S., Stoney Stoke.
,, *soleata* Hal. S., Wincanton.
,, *trifasciata* Mg. S., Stoney Stoke.
,, *trivialis* Eat. S., Stoney Stoke.
,, *ustulata* Hal. S., Ashcot.

Psychoda erminea Eat. S., Cutcombe.
„ *lucifuga* Hal. S., Bruton.
„ *phalaenoides* L. G., Bristol (C.).
„ *sexpunctata* Curt. G., Bristol (C.); Painswick (W.).
Ulomyia fuliginosa Mg. (*hirta* L.). S., Stoney Stoke.

X. CULICIDAE.

In this family we have flies that have short, soft mouth organs and cannot bite (Dixinae and Chaoborinae) and others, commonly known as Mosquitoes, with long, hard mouth organs of which the females are ferocious biters (Anophelinae, Aedinae and Culicinae). In all of them the costa extends beyond the apex of the wing and the larvae are aquatic and free-swimming. In Dixinae both sexes have long, slender antennae and the wings are bare. In all the other sub-families the antennae of the males are plumose, those of the females long and slender, the wings in both sexes bear scales on the veins and in the Aedinae and Culicinae there are scales on the body. Many books and papers have been written on this family; some of them are given below:—"Chaoborinae and Dixinae," F. W. Edwards, "E.M.M.," 3rd series, vol. vi.; "Anophelinae, Aedinae and Culicinae," F. W. Edwards, "Ent. Tidskrift," 1921; "Les Moustiques de France," E. Séguy, "Encyclopédie Pratique du Naturaliste," vol. xiv., 1923; "Culicidae (and others)," E. Séguy; "Faune de France," vol. xii., 1925; "Dixidae de Belgique," Dr M. Goetghebuer, "Bull. Soc. Ent. de Belg.," vol. ii., 1920, and vol. iii., 1921; "Handbook of British Mosquitoes," W. D. Lang, 1920.

Sub-family Dixinae.

Dixa aestivalis Mg. G., Shepperdine (A.), 10/8/24.
„ *maculata* Mg. S., Cheddar (C.).
„ *nebulosa* Mg. S., Tickenham (A.), 23/7/22.
„ *puberula* Lw. S., Holford Glen (A.), 28/8/29.
„ *submaculata* Edw. S., Rodney Stoke (A.), 6/4/29; St Audries (A.), 24/8/29.

Sub-family Chaoborinae.

Chaoborus crystallinus Deg. (*Corethra plumicornis* F.). G., Frenchay (C.); Henbury (A.), 5/9/16. S., Shepton Mallet (C.); Backwell (A.), 16/5/27.
„ *pallidus* F. S., Sharpham (A.), 5/8/25.

Sub-family Anophelinae.

Anopheles bifurcatus L. G., Tortworth (A.). S., Shepton Mallet (C.); Freshford (C.).
„ *maculipennis* Mg. G., Olveston (C.). S., Sharpham (A.), 22/8/22.
„ *plumbeus* Steph. S., St Audries (A.), 18/8/29.

Sub-family Aedinae.

Ochlerotatus communis Deg. (*Culex nemorosus* Mg.). G., Olveston (A.). S., Nailsea (C.); Leigh Woods (C.).
„ *geniculatus* Oliv. (*ornatus* Mg.). G., Bristol (A.), 14/7/29; Stroud (W.). S., Leigh Woods (H.), 10/7/17; Brockley Combe (H.).
„ *maculatus* Mg. (*cantans* Mg.). S., Sharpham (A.), 27/8/25.
„ *rusticus* Rossi. G., Olveston (A.), 4/6/22; Kingsweston (A.), 31/5/24. S., Wellington (Ml.).

Sub-family Culicinae.

Theobaldia annulata Schr. (*Culex annulatus* Schr.). G. and S., common.
,, *fumipennis* Steph. S., Shapwick (A.), 9/8/23.
Culex pipiens L. G. and S., common.

XI. LIRIOPEIDAE (PTYCHOPTERIDAE).

Black flies of medium size found among reeds and water-plants where they " flop about " from plant to plant in the same way as Craneflies. They have long, black legs and a strong cross-suture on thorax. The venation of the wing is typical and besides true veins they have two longitudinal folds which look like veins. The larvae live in mud. They are included in " Faune de France," vol. xii., and Mr Chris. A. Cheetham has published a very useful short note on the British species in " The Naturalist " for 1922, p. 153.

Ptychoptera albimana F. G. and S., common.
,, *contaminata* L. G., Painswick (W.); Olveston (C.); Shepperdine (A.), 8/8/24. S., Shepton Mallet (C.); Sharpham (A.), 11/8/23; Taunton (A.), 7/6/24.
,, *lacustris* Mg. G., Olveston (A.), 2/5/22. S., Crook's Peak (Rd.); Tickenham (A.), 16/9/25.
,, *paludosa* Mg. G., Olveston (A.), 4/6/22; Tortworth (A.), 24/7/27. S., Shepton Mallet (C.); Tickenham (A.), 2/6/25.
,, *scutellaris* Mg. G., Gloucester (W.); Olveston (A.), 2/9/23. S., Tickenham (A.), 24/5/26.

XII. LIMONIIDAE (LIMNOBIIDAE).

These flies, known as Craneflies, have a well marked thoracic suture and short palpi. They vary much in size; all have large wings and long legs which break off easily when dry. These flies and those of the next family should be mounted on long, thin, Carlsbad pins with their legs hanging vertically along the pin. The Limnobiidae are divided into three sub-families which differ markedly in their larvae. The larvae of the sub-family Cylindrotominae resemble the caterpillars of Lepidoptera; they are aquatic except in one genus (Cylindrotoma) in which they are terrestial. The larvae of the sub-family Limnobiinae are mostly aquatic, a few live in rotten wood. The larvae of the sub-family Trichocerinae live in rich humus or in toadstools. This family and the next form the subject matter of " Faune de France," vol. viii., by C. Pierre. Dr M. Goetghebuer has published a useful key to the family in " Bull. Soc. Ent. de Belg.," vol. ii., 1920, and vol. iii., 1921. Mr F. W. Edwards has given keys to some of the British genera in " Trans. Ent. Soc.," 1921, with additions in " E.M.M.," 1924 and 1926.

Sub-family Cylindrotominae.

Cylindrotoma distinctissima Mg. G., Blaise Castle Woods (Wm.), 20/8/22. S., Wells (A.), 10/8/25; Keynsham (A.), 26/5/29; Shepton Mallet (C.).
Liogma glabrata Mg. G., Blaise Castle Woods (A.), 14/7/29. S., Leigh Woods (H.); Backwell (A.), 17/7/26.
Phalacrocera replicata L. S., Backwell (Wm.), 11/5/27; Shapwick (A.), 1/5/27.

Sub-family Limnobiinae.

Adelphomyia fuscula Lw. S., St Audries (A.), 21/8/29.

Crypteria limnophiloides Berg. G., Blaise Castle Woods (A.), 17/9/21.

Dasymolophilus murinus Mg. S., Leigh Woods (A.), 22/5/27.

Dicranomyia affinis Schum. S., Leigh Woods (H.), 6/5/18; Nailsea (A.), 22/4/27; Tickenham (A.), 22/4/25; Prior Park, Bath (A.), 8/5/26.

„ *aquosa* Verr. S., Shepton Mallet (C.).

„ *autumnalis* Staeg. G., Kingsweston (A.), 25/5/24.

„ *chorea* Mg. G. and S., common.

„ *danica* Kuntz. S., Shapwick (A.), 6/7/27. First British record.

„ *didyma* Mg. S., Leigh Woods (G.); St Audries (A.), 19/8/29.

„ *dumetorum* Mg. G., Kingsweston (A.), 6/6/26. S., Leigh Woods (H.), 27/6/18; St Audries (A.), 23/8/29.

„ *goritensis* Mik. G., Aust (Wm.).

„ *lutea* Mg. G., Kingsweston (A.), 25/5/24; Dursley (A.), 9/6/25; Bristol (C.). S., Leigh Woods (G.).

„ *mitis* Mg. G., Kingsweston (A.), 6/5/25. S., Flax Bourton (H.); Shapwick (A.), 16/7/27.

„ *modesta* Mg. G., Blaise Castle Woods (A.), 11/9/21. S., Tickenham (A.), 16/9/22; Sharpham (A.), 1/8/23.

„ *morio* F. G., Tockington (A.), 29/4/27. S., Tickenham (A.), 16/9/22; Sharpham (A.), 2/9/25.

„ *ornata* Mg. S., Keynsham (A.), 16/6/24.

„ *pilipennis* Egg. S., Holford Glen (A.), 28/8/29.

„ *sera* Wlk. G., Shepperdine (A.), 10/8/24; Blaise Castle Woods (A.), 7/9/29.

„ *sericata* Mg. S., Leigh Woods (H.); Cheddar (H.).

„ *ventralis* Schum. S., Sharpham (A.), 5/8/25.

Dicranota bimaculata Schum. S., Shepton Mallet (C.); Rodney Stoke (A.), 18/4/29.

„ *pavida* Hal. S., St Audries (A.), 20/8/29.

Empeda flava Schum. G., Olveston (A.), 18/6/22; Blaise Castle Woods (A.), 28/5/27. S., Tickenham (A.), 17/6/27.

„ *nubila* Schum. G., Winterbourne (A.), 28/4/23; Kingsweston (A.), 16/4/26. S., Leigh Woods (H.); Sharpham (A.), 6/9/25; Nailsea (A.), 21/4/27.

Ephelia marmorata Mg. G., Blaise Castle Woods (A.), 14/7/29. S., Winscombe (J.), 9/7/16; Abbot's Leigh (H.), 16/5/26; Prior Park, Bath (A.), 18/7/25; Tickenham (A.), 27/5/22.

„ *submarmorata* Verr. S., Hanham (A.), 19/6/22.

Epiphragma ocellaris L. (*picta* F.). G., Olveston (C.); Tormarton (A.), 20/6/26; Hallen (A.), 18/6/25. S., Leigh Woods (A.), 22/5/27; Kewstoke Woods (Wm.), 27/5/27.

Erioptera diuturna Wlk. G., Shepperdine (A.), 15/8/24.

„ *flavescens* Mg. G., Olveston (A.), 5/9/22. S., Leigh Woods (H.), 31/5/18; Tickenham (A.), 23/8/22.

„ *fuscipennis* Mg. G., Fishponds (A.), 7/5/27. S., Cheddar (H.); Brockley Combe (J.); Shapwick (A.), 17/7/27.

„ *griseipennis* Mg. S., Hanham (A.), 19/6/22.

„ *lutea* Mg. S., Leigh Woods (H.); Flax Bourton (H.).

„ *macrophthalma* Lw. S., Shepton Mallet (C.); Tickenham (A.), 16/5/25; Sharpham (A.), 5/8/25.

„ *taenionata* Mg. G., Painswick (W.); Wotton-u-Edge (P.); Stone (A.), 21/5/27. S., Leigh Woods (G.); Tickenham (A.), 27/5/22; Sharpham (A.), 23/8/25.

„ *trivialis* Mg. G. and S., common.

Geranomyia unicolor Hal. S., Clevedon (Wm.); Weston-super-Mare (Wm.).

Gonomyia tenella Mg. S., Sharpham (A.), 22/8/25; St Audries (A.), 23/8/29.

Helius (*Rhamphidia*) *longirostris* Wied. (*dubius* Edw.). S., Sharpham (A.), 18/8/25.

„ „ *pallirostris* Edw. S., Shapwick (A.), 16/7/27.

Ilisia (*Acyphona*) *maculata* Mg. G., Painswick (W.); Hallen (A.), 26/6/26. S., Leigh Woods (H.), 17/6/18; Tickenham (A.), 23/7/22.

Limnobia bifasciata Schrk. S., Leigh Woods (A.), 3/9/24.

„ *decemmaculata* Lw. S., Leigh Woods (H.), 30/5/18 and 27/9/19.

Limnobia flavipes F. G. and S., common.
,, *macrostigma* Schum. G., Painswick (W.); Blaise Castle Woods (A.), 28/5/27. S., Keynsham (A.), 16/6/24; Tickenham (A.), 16/9/22; Shapwick (A.), 26/8/25.
,, *nubeculosa* Mg. G. and S., common.
,, *quadrinotata* Mg. G., Birdlip (W.); Wotton-under-Edge (P.). S., Shapwick (A.), 31/8/24; Leigh Woods (H.), 1/8/18.
,, *stigma* Mg. S., Leigh Woods (H.).
,, *tripunctata* F. G., Cirencester (T.), 9/6/23; Kingsweston (A.), 20/5/22. S., Pill (H.); Leigh Woods (A.), 23/5/26; Shapwick (A.), 20/5/23.
,, *trivittata* Schum. S., Keynsham (A.), 16/6/24.
Limnophila aperta Verr. S., St Audries (A.), 20/8/29.
,, *dimidiata* Meij. (*nemoralis*, var. *noscibilis* Edw.). G., Tockington (A.), 8/5/27. S., Leigh Woods (A.), 23/5/25; Tickenham (A.), 16/5/25; Sharpham (A.), 10/9/25.
,, (*Pilaria*) *discicollis* Mg. G., Olveston (A.), 4/6/22; Tormarton (A.), 20/6/26. S., Shapwick (A.), 20/5/23; Tickenham (A.), 16/9/22; Prior Park, Bath (A.), 18/7/25.
,, *dispar* Mg. G., Hallen (A.), 13/6/25; Filton (A.), 14/5/22; Blaise Castle (A.), 28/5/27. S., Leigh Woods (H.), 28/5/20; Cheddar (H.), 16/6/20; Tickenham (A.), 16/5/25.
,, *ferruginea* Mg. G., Olveston (A.), 8/9/22. S., Shapwick (Wm.), 30/4/21; Tickenham (A.), 16/5/25.
,, *filata* Wlk. G., Olveston (A.), 6/21. S., Tickenham (A.), 27/5/22.
,, (*Pilaria*) *fuscipennis* Mg. S., St Audries (A.), 19/8/29.
,, *lineola* Mg. G., Painswick (W.); Olveston (A.), 2/9/23.
,, (*Pseudolimnophila*) *lucorum* Mg. G., Olveston (A.), 4/6/22; Hallen (A.), 10/10/25. S., Nailsea (A.), 17/7/26; Clevedon (A.), 14/5/27.
,, *nemoralis* Mg. G., Olveston (A.), 4/6/22; Hallen (A.), 13/6/26. S., Leigh Woods (H.); Portbury (H.); Shapwick (A.), 10/8/23.
,, *ochracea* Mg. G., Olveston (A.), 5/5/23; Tormarton (A.), 20/6/26; Kingsweston (A.), 31/5/25. S., Leigh Woods (H.); Tickenham (A.), 21/6/23.
,, (*Pseudolimnophila*) *sepium* Verr. G., Tormarton (A.), 13/7/29. S., Tickenham (A.), 17/6/27.
Lipsothrix remota Wlk. (*errans* Wlk.). G., Painswick (W.); Wotton-under-Edge (P.).
Molophilus appendiculatus Staeg. G., Hallen (A.), 13/6/25. S., Leigh Woods (A.), 23/6/25.
,, *armatus* Meij. G., Hallen (A.), 14/9/25.
,, *bifilatus* Verr. G., Blaise Castle Woods (A.), 17/9/21; Olveston (A.), 18/6/22. S., Leigh Woods (H.); Hanham (A.), 19/6/22.
,, *cinereifrons* Meij. S., Leigh Woods (H.).
,, *griseifrons* Meij. G., Hallen (A.), 13/6/25.
,, *niger* Goet. G., Tockington (A.), 29/4/27. First British record; Fishponds (A.), 7/5/27.
,, *obscurus* Mg. G., Painswick (W.); Wotton-under-Edge (P.). S., Tickenham (A.), 16/9/22; Shapwick (A.), 24/5/25.
Ormosia (*Rhypholophus*) *bifurcata* Goet. G., Blaise Castle Woods (A.), 13/9/26. First British record; Olveston (A.), 15/9/28. S., Leigh Woods (A.), 12/9/28.
,, ,, *haemorrhoidalis* Ztt. G., Hallen (A.), 10/10/25. S., Leigh Woods (H.); Leigh Woods (A.), 27/9/25.
,, ,, *lineata* Mg. G., Blaise Castle Woods (A.), 24/4/25. S., Shepton Mallet (C.).
,, ,, *nodulosa* Mcq. G., Painswick (W.); Kingsweston (A.), 17/5/24. S., Leigh Woods (H.); Shapwick (A.), 24/5/25.
,, ,, *similis* Staeg. S., Cheddar (C.).
,, ,, *uncinata* Meij. G., Fishponds (A.), 7/5/27. S., Sharpham (A.), 10/9/25; Tickenham (A.), 16/9/22.

Pedicia rivosa L. G., Kilcot (P.). S., Wellington (Bl.); St Audries (A.), 29/8/29.
Poecilostola punctata Schrk. G., Painswick (W.); Fishponds (A.), 7/5/27. S., Leigh Woods (H.); Tickenham (A.), 12/5/25.
Rhipidia maculata Mg. G., Dursley (A.), 9/6/25; Tormarton (A.), 20/6/26; Shepperdine (A.), 7/8/24. S., Leigh Woods (H.); Sharpham (A.), 18/8/25.
Symplectomorpha stictica Mg. G., Dursley (A.), 20/6/25; Shepperdine (A.), 15/8/24. S., Leigh Woods (H.); Tickenham (A.), 16/9/ 22; Berrow (A.), 29/9/24.
Tricyphona (*Amalopis*) *claripennis* Verr. S., Burrington (Wm.), 14/5/27; St Audries (A.), 23/8/29.
,, ,, *immaculata* Mg. G., Olveston (C.); Blaise Castle Woods (A.), 24/4/25. S., Tickenham (A.), 2/6/25; Shapwick (A.), 20/5/23.
,, ,, *littoralis* Mg. G., Olveston (A.), 4/6/22. S., St Audries (A.), 20/8/29.
,, ,, *straminea* Mg. S., Wellington (Ml.).
Ula pilosa Schum. G., Blaise Castle Woods (A.), 2/2/23. S., Leigh Woods (H.); Leigh Woods (A.), bred 8/2/23.

Sub-family Trichocerinae.

Trichocera annulata Mg. G., Blaise Castle Woods (A.), 4/3/22; Olveston (A.), 8/10/22. S., Shepton Mallet (C.); Leigh Woods (H.); Tickenham (A.), 16/9/22.
,, *fuscata* Mg. (*saltator* Harr.). S., Shepton Mallet (C.); Leigh Woods (A.), 22/1/22.
,, *hiemalis* Deg. G. and S., common.
,, *regelationis* L. G. and S., common.

XIII. TIPULIDAE.

These flies, commonly known as Daddy-long-legs, are distinguished from the Limnobiidae by the greater length of the palpi and a slight difference in the venation of the wing. They are usually large flies with big wings (in two species the females are wingless) and long legs. They fly in a jerky manner in long grass and in woods. The larvae of some species live in the soil and are known as Leather-jackets, the larvae of others live in rotten wood. The Pachyrhina are black and yellow, the others grey or brown. Literature same as for Limnobiidae.

Ctenophora pectinicornis L. G., Wotton-under-Edge (P.); Cirencester (T.), 14/7/23; Kingsweston (A.), 6/6/26. S., Wellington (Ml.).
Dictenidia bimaculata L. G., Painswick (W.); Wotton-under-Edge (P.). S., Wellington (Ml.); Sharpham (A.), 11/8/23.
Dolichopeza albipes Ström. (*sylvicola* Curt.). S., Weston-super-Mare (J.) and St Audries (A.), 20/8/29.
Pachyrhina analis Schum. S., Leigh Woods (A.), 3/9/24.
,, *annulicornis* Mg. (*Tipula variicornis* Schum.). S., Cannington (Sl.), 20/5/26; Tickenham (A.), 2/6/25.
,, *cornicina* L. G., Painswick (W.); Blaise Castle Woods (A.), 28/5/27. S., Leigh Woods (H.), 6/7/18; Sharpham (A.), 3/8/25.
,, *crinicauda* Rdl. (*imperialis* Mg., *scalaris* Mg.). G., Kingsweston (A.), 29/8/24; Bristol (A.), 16/7/22. S., Leigh Woods (H.), 19/6/20; Prior Park, Bath (A.), 18/7/25.
,, *guestfalica* West. G., Cirencester (T.), 24/5/23. S., Leigh Woods (H.), 8/6/20; Tickenham (A.), 19/6/25.
,, *histrio* F. (*lineata* Scop.). G., Olveston (C.); Dursley (A.), 20/6/25. S., Shepton Mallet (C.); Tickenham (A.), 26/6/24.
,, *lunulicornis* Schum. G., Hallen (A.), 22/7/24; Olveston (A.), 28/6/25. S., Cannington (Sl.), 20/5/26; Taunton (A.), 9/6/24.
,, *maculosa* Mg. (*maculata* Mg). G. and S., common.
,, *quadrifaria* Mg. G., Cirencester (T.), 20/6/23; Hallen (A.), 12/6/24. S., Shepton Mallet (C.); Tickenham (A.), 16/5/25.

Prionocera (*Stygeropis*) *pubescens* Lw. G., Bristol (Wm.), 1927. First British record.
Tanyptera (*Xiphura*) *nigricornis* Mg. G., Painswick (W.).
Tipula anonyma Berg. (*marmorata* Mg., *signata* Staeg.). G., Painswick (W.); Wotton-under-Edge (P.); Hallen (A.), 10/10/25. S., Leigh Woods (H.).
,, *brevispina* Pierre. G., Kingsweston (A.), 31/5/25.
,, *cava* Rdl. S., Shapwick (Wm.), 11/7/25; St Audries (A.), 20/8/29.
,, *fascipennis* Mg. G., Cirencester (T.), 24/6/24; Tormarton (A.), 20/6/26; Hallen (A.), 13/6/21. S., Tickenham (A.), 26/6/24.
,, *flavolineata* Mg. G., Painswick (W.); Olveston (C.); Kingsweston (A.), 6/6/26. S., Banwell (H.); Leigh Woods (H.); Backwell (A.), 6/6/25.
,, *fulvipennis* Deg. (*lutescens* F.). S., Sharpham (A.), 8/8/25; Charterhouse-on-Mendip (A.), 30/6/23; St Audries (A.), 20/8/29.
,, *hortulana* Mg. G., Painswick (W.); Blaise Castle Woods (Wm.), 13/5/22. S., Leigh Woods (A.), 23/5/25; Prior Park, Bath (A.), 8/5/26.
,, *irrorata* Mcq. G., Blaise Castle Woods (A.), bred 10/6/28. S., Kewstoke Woods (Wm.), 22/5/27; Brockley (Wm.), bred 16/5/28.
,, *lateralis* Mg. G. and S., common.
,, *lunata* L. (*luna* West.). G., Fishponds (A.), 7/5/27. S., Weston-super-Mare (J.); Tickenham (A.), 16/5/25.
,, *luteipennis* Mg. S., Tickenham (A.), 22/9/25; Leigh Woods (A.), 27/9/25.
,, *marmorata* Mg. (*confusa* v. d. Wulp.). G., Bristol (A.), 12/9/24; Hallen (A.), 10/10/25. S., Wellington (Ml.); Avon Bank (Wm.), 17/9/22.
,, *maxima* Poda (*gigantea* Schrk.). G., Painswick (W.); Kilcot (P.); Bristol (C.); Filton (A.), 6/20. S., Freshford (C.); Tickenham (A.), 27/5/22; St Audries (A.), 19/8/29.
,, *melanoceras* Schum. S., Nailsea (A.), 6/6/22.
,, *nigra* L. S., Shapwick (A.), 10/7/27; Tickenham (A.), 19/7/24.
,, *nubeculosa* Mg. S., Leigh Woods (H.).
,, *obsoleta* Mg. G., Cirencester (T.), 10/10/23; Hallen (A.), 10/10/25. S., Leigh Woods (A.), 17/10/24.
,, *ochracea* Mg. (*lunata* L.). G. and S., common.
,, *oleracea* L. G. and S., common.
,, *pagana* Mg. G., Clifton (H.). S., Leigh Woods (H.); Banwell (A.), 20/10/28.
,, *paludosa* Mg. G. and S., common.
,, *peliostigma* Schum. G., Bristol (A.), 10/6/25.
,, *pierrei* Tonn. S., Sharpham (A.), 7/8/25.
,, *rufina* Mg. G., Painswick (W.); Bristol (B.), 17/4/27; Aust (A.), 6/4/23. S., Shepton Mallett (C.); Keynsham (A.), 1/6/29; St Audries (A.), 19/8/29.
,, *scripta* Mg. G., Painswick (W.); Tormarton (A.), 20/6/26; Kingsweston (A.), 11/6/27. S., Shepton Mallet (C.); Leigh Woods (A.), 22/5/26.
,, *selene* Mg. G., Kingsweston (A.), 6/6/26; Oldbury Court (A.), 7/7/28. S., Keynsham (A.), 1/4/29.
,, *signata* Staeg. (*staegeri* Rdl.). G., Fishponds (A.), 10/10/21. S., Nailsea (Wm.), 10/10/28.
,, *unca* Wied. (*longicornis* Schum.). G., Cirencester (T.), 1/8/23. S., Prior Park, Bath (A.), 18/7/25.
,, *variipennis* Mg. G., Blaise Castle Woods (Wm.), 13/5/22; Fishponds (A.), 7/5/22. S., Wellington (Ml.); Shapwick (A.), 20/5/23; Leigh Woods (A.), 23/5/26.
,, *vernalis* Mg. G. and S., common.
,, *vittata* Mg. G., Blaise Castle Woods (Wm.), 2/4/24; Blaise Castle Woods (A.), 11/4/27. S., Keynsham (A.), 21/5/29.

XIV. ANISOPODIDAE (RHYPHIDAE, PHRYNEIDAE).

Small Gnat-like flies often seen on windows. Thorax without cross suture and one more cross vein in wing than in that of Gnats; antennae moderately short and stout. Larvae live in rotting vegetable matter.

Mr F. W. Edwards has given a table of British species in "E.M.M.," for May 1926, and a more complete review of the group in "Ann. and Mag. Nat. Hist.," S. 9, vol. xii.

Anisopus (*Rhyphus*) *fenestralis* Scop. G. and S., common.
,, ,, *punctatus* F. G. and S., common.

Some authors place here the sub-family Trichocerinae dealt with on page 125.

ADDITIONAL NOTES TO PART I.

FUNGIVORIDAE (MYCETOPHILIDAE).

Acnemia nitidicollis Mg. G., Blaise Castle Woods (Wm.), 18/2/22.
Anatella setigera Edw. S., Rodney Stoke (A.), 6/4/29.
Boletina nigricans Dz. G., Blaise Castle Woods (Wm.), 18/2/22.
Epicypta testata Edw. G., Blaise Castle Woods (Wm.), 26/10/22.
Exechia spinigera Winn. G., Clifton Downs (Wm.), 1/2/22.
Isoneuromyia modesta Winn. S., St Audries (A.), 19/8/29.
,, *biumbrata* Edw. S., West Town (Wm.), 10/9/28.
Macrocera pusilla Mg. S., West Town (Wm.), 22/7/28.
Mycetophila finlandica Edw. S., St Audries (A.), 25/8/29.
,, *ocellus* Wlk. (*dimidiata* Staeg.). G., Olveston (A.), 5/11/22; Bristol (Wm.), 11/11/22.
,, *vittipes* Ztt. G., Blaise Castle Woods (Wm.), 28/10/22.
Phronia tarsata Staeg. (*crassipes* Winn.). G., Clifton (Wm.), 5/2/22.
Platyura nigricornis F. G., Bristol (Wm.), 13/6/25.
Rhymosia cristata Staeg. G., Blaise Castle Woods (Wm.), 20/8/22.
Sciophila hirta Mg. G., Bristol (Wm.), 16/9/22.

CERATOPOGONIDAE.

Bezzia nigritula Ztt. S., Rodney Stoke (A.), 6/4/29.
Dasyhelea = *Tetraphora.*

CHIRONOMIDAE.

Mr F. W. Edwards has published (December 1929) in "Trans. Ent. Soc.," a paper on "British non-biting Midges." This alters considerably the nomenclature of the species given in Part I. The main alterations, however, are in the genera and sub-genera, most of the specific names are unaltered and those that are superseded can be found among the synonyms. The following further records are given in Mr Edwards' paper.

Cricotopus speciosus Goet. G., Minchinhampton (Miss Ricardo).
,, *biformis* Edw. G.
Trichocladius (*Spaniotoma*) *foveata* Edw. G., Minchinhampton (Miss Ricardo).
Orthocladius (*Spaniotoma*) *thienemanni* Kieff. G.
Eukiefferella (*Spaniotoma*) *brevicalcar* Kieff. G.
Glyptotendipes (*Chironomus*) *paripes* Edw. S., Sharpham (A.), 7/8/25.
Stictochironomus (*Chironomus*) *maculipennis* Mg. G., Minchinhampton (Miss Ricardo).
Lundströmia (*Tanytarsus*) *bituberculatus* Edw. G., Minchinhampton (Miss Ricardo).

Bristol Botany in 1929.

By Jas. W. White, M.Sc., F.L.S.

We still find, unfortunately, evidence of a widespread lack of elementary botanical knowledge even amongst journalists and writers to whose printed word so many of us look for information and guidance. A conspicuous instance of this deficiency was furnished by the local press at the end of last July, when we read in the papers that a number of children had been poisoned by eating wild berries at St Anne's Park. Under the head-line, "Deadly Nightshade," it was stated that the victims "all showed the symptoms of Aconite poisoning." By the next day a University Professor had been interviewed, and a medical man had described and compared the properties of Aconite and Belladonna to a reporter, who forthwith published "those interesting particulars," although the reference to Aconite was admitted to be an inadvertence. "The Deadly Nightshade plant" became alone responsible for the poisoning of several children who by that time were practically well again. The facts of the case would be these. As the interviewer had been informed Deadly Nightshade (*Atropa Belladonna*) is a rare plant that does not grow at St Anne's, and its berries are so poisonous that had the children eaten any it is probable that few would have survived. The berries they did eat were doubtless those of the Bittersweet or Woody Nightshade (*Solanum Dulcamara*), a plant that climbs among bushes in many places and produces small clusters of red fruit which, though certainly unwholesome, is by no means deadly. Experiment with the wayside berry as an edible is an adventure best left to the expert, but one knows that wild flowers and fruits of the woods and hedges are so seldom seen in the schools or homes of our poorer districts that, to a city child, a cluster of red berries would be an attraction not to be resisted, especially as there is some resemblance to red currants. The fruits of Bittersweet and of its sister the Black Nightshade (*Solanum nigrum*) must be often eaten without disquieting effects. Should serious trouble occur, however, it is greatly to be desired that reports may be verified before, rather than after, publication; and that the Deadly Nightshade fallacy may be allowed to expire in peace.

If the attitude of the Press be viewed from another angle, it may be noticed that a more sympathetic interest in matters concerning the wild life of the country has become evident. The better education of the people is now reflected in the Press, and our popular dailies admit articles on birds, beasts and flowers agreeably with the public inclination towards natural history subjects. With admirable art the sub-editor dresses up and uses freely copy that in former days would have been rejected as too dry-as-dust for words. Not long ago an influential and well-meaning plant lover suggested that ornamental shrubs should be planted in our hedgerows and other situations with the idea of improving and beautifying the native flora. His proposals were widely published and commented on. A Bristol editor who desired information on the point was assured by the writer that no true botanist would approve of introductions which would give an artificial character to our flora. The feeling among scientists was that if the countryside could be preserved from modern defilements and left alone to develop as nature intended, nothing better could be devised. These views were given to the public the next morning.

In field-botany the season has not been unproductive. Several additions have accrued to the Bristol Flora, and there are also some first records for West Gloucestershire.

Ranunculus Godronii Gren. Field pond near Stanton Wick, S.; *H. J. Gibbons.* An excellent example of this sub-species or variety.

Geranium reflexum L. Alien. A rare and beautiful Continental species. Found on waste ground near Longwood House, Failand, S., and cultivated by Mrs Bell.

Agrimonia odorata Mill. Rough lane above Easton, near Wells, S.; *H. S. Thompson.*

Rosa arvensis L., var. *laevipes* Gremli. Clifton, Bristol, July 1849; *W. W. Saunders.* (In Herb. C. E. Salmon, fide Col. A. H. Wolley-Dod.)

Hieracium pulmonarioides Vill. "In plenty at Mells, S.;" *Dr G. C. Druce.*

Solanum Dulcamara L., var. *tomentosum* Koch = *S. littorale* Raab. "Caule foliisque tomentosis." The foliage is downy with patent hairs, soft and velvety to the touch and of a greyish-green hue, easily recognised at a distance. Among bushes on Clifton Down (the "Green Valley"); a first record for the variety at Bristol.

Scrophularia verna L. Alien. Cranbrook Road, Bristol, G.; *Mrs Bell.*

Scutellaria Columnae. Alien. "Quite naturalised at Mells, S.;" *Dr G. C. Druce.*

Rumex Weberi Prahl. In "Notes Supplemental to the Flora of Bristol," published in *Journ. Bot.*, 1918, I reported that *Rumex maximus* Schreb. had been found at Shirehampton, G., and by the Avon near Saltford, S. Much later, in the 11th edition of the *London Catalogue*, *R. maximus* is credited to 15 vice-counties in Britain. We now learn on excellent authority that there is no satisfactory evidence of the occurrence of the true *R. maximus* in this country, and that all the British plants so named must be referred to the hybrid *R. Hydrolapathum* × *obtusifolius* = *R. Weberi* Prahl. The Bristol specimens prove to be undoubtedly this hybrid.

Wolffia arrhiza Wimm. Pond at Sand Bay, Kewstoke, S., in good quantity; *H. J. Gibbons.*

Scirpus Tabernaemontani Gmel. In the river-bed below Wyck Rocks, G., July 1929; *Ivor W. Evans.* A first record for West Gloucestershire.

Carex riparia Curt., var. *gracilis* Coss. & Germ. = var. *gracilescens* Hartm. A slender plant with narrow leaves and the lower fertile spikes longly (6 to 12 in.) peduncled. Glumes of the fruiting spikes are often prolonged into cuspidate beaks characterising the sub-var. *aristata* Rouy. In a marsh ditch on Tickenham Moor, S., where it was first gathered by Miss Roper in 1915, and still persists. The variety is fully discussed in the Kew Bulletin, No. 4 (1920), where it is shown that the earliest name applicable to this North Somerset plant, together with others from Cornwall and the Isle of Wight, is var. *gracilis* Coss. & Germ.

Glyceria distans Wahlb. A short time ago Mr C. E. Salmon, of Reigate, who suspected that British examples of *G. distans* represented distinct forms, submitted some gatherings to a Scandinavian expert, and found that he had both *Puccinellia distans* Parl. and *P. retroflexa* Holmb. from England. (Scandinavian botanists use the name *Puccinellia* for this group.) The characters separating these plants lie mainly in the longer and more acute glumes of *retroflexa*, the thicker branches of the panicle which are more patent and deflexed, and the tapering spikelets. *P. distans* is the more slender and graceful species, and is probably the less common of the two. It has been collected by the writer near the Severn at Avonmouth, and we hope that further observation will reveal the presence of *retroflexa* in the Bristol district.

Fossil Shells and Some Problems of Evolution.

By A. E. Trueman, D.Sc., University College, Swansea.

IT is probably unnecessary at the present time to urge the importance of the study of palæontology in relation to problems of evolution, for of late years it has been recognised that the tracing of lines of descent, however imperfectly, in fossils collected at successive horizons, is essential to any full understanding of the nature of evolutionary problems.[1] This intensive investigation of fossils has been carried out for the sake of its stratigraphical value as much as for its biological interest, and it has been directed to the study of vertebrates as well as invertebrates. In the present notes reference is made chiefly to studies of fossil shells. Such studies, although less impressive than comparable studies of such groups as the fossil horses, are in some respects of equal interest, since the shells frequently occur in such large numbers at many horizons that they give useful results in spite of the difficulties in interpreting them.

LINES OF EVOLUTION.

The conception of a line of evolution, often spoken of as a lineage, such as would theoretically be represented by a series of directly related forms collected from successive horizons, has been familiar to palæontologists for many years. Several palæontologists (including the writer) have suggested that certain presumably related species of ammonites could be regarded as members of a lineage, but recent researches have made it clear that it is rarely safe to assert that any one known species is in the same lineage as any other known form, or in other words, is an actual direct descendant of that species. It is becoming increasingly evident that our present knowledge of most molluscan stocks is quite inadequate for the construction of these detailed phylogenies.

It is generally considered that the *Micrasters* of the Chalk (described by the late Dr Rowe[2]) and the series of simple corals related to *Zaphrentis delanouei* (described by R. G. Carruthers[3]) actually represent true lines of descent. Among the mollusca perhaps the one series in which close relationship can apparently be traced is that which leads to *Gryphæa incurva* (or *G. arcuata*). It is probable that these shells of the Bucklandi Zone of the Lower Lias are descended from the more or less typical oysters of the Planorbis Zone (*Ostrea liassica*) for a continuous chain of forms transitional between the latter species and completely incurved *Gryphæas* may be collected in many exposures of the

[1] In relation to these problems, reference should be made to Dr F. A. Bather's Presidential Address to Section C. of the British Association (Cardiff, 1920), and to Dr W. D. Lang's "Evolution: A Resultant" (*Proc. Geol. Assoc.*, xxxiv., 1923, p. 7).

[2] *Q.J.G.S.*, lv., 1899, p. 494.

[3] *Q.J.G.S.*, lxvi., 1910, p. 523.

lowest zones of the Lias (as for instance at Keynsham and along the Glamorgan coast).[4]

One notable feature in such a chain of forms is that gradation from one type to the other is continuous, and that no evidence is available of any sudden changes being introduced into the lineage. Although of course the shell of *Gryphæa* gives very little information concerning the living organism which constructed it, the continuity in the evolution of shell form at least lends some support to the view held at present by most palæontologists, that evolution has proceeded by small and almost imperceptible changes and not by "leaps" (mutations in the sense of De Vries). It is remarkable that palæontologists, the nature of whose materials might be expected to dispose them towards a theory of evolution which involved some measures of discontinuity, are among the most strenuous opponents of such views.

VARIATION AND DESCENT.

A study of the shells of the members of the *G. incurva* lineage at any one horizon shows that they are not all of similar character. While the majority show a similar degree of curvature of the valves, a small proportion have the left valve more curved and a somewhat similar proportion less curved than the majority. At a higher horizon the majority have a greater degree of coiling than the majority at the lower horizon, but include a number of forms which are respectively more and less advanced than the average.

It may be convenient to represent these features numerically for the sake of clearness of our subsequent discussion. Thus we may suggest that in the character of the left valve, the oyster with a flat valve is at stage 0 and the most completely curved *Gryphæa* is at stage 100; then we can recognise specimens at successive levels which represent every stage from 1 to 100: these numbers are used only for the sake of clearness in explaining certain suggestions, but it is not suggested that only one hundred stages could theoretically be recognised in such a series. Using this method of expressing the stages in the evolution of the *G. incurva* series, it may be that at some one horizon, for instance in the Angulata Zone, a greater proportion of the shells would be at stage 15. A large number in the same bed would also be in stages 14 and 16, a smaller number in stages 13 and 18, and perhaps only occasional specimens would show stages 10, 11, 19 and 20. At a slightly higher level the variations would range from 19 to 29 with a maximum number at stage 24, while in still higher horizons, such as a bed in the lower part of the Bucklandi Zone, the average would be higher, with perhaps the greater number of examples in stage 65 and with examples ranging from 60 to 70.

Thus at each successive horizon there appears to be an advance in the average stage attained in the character which is changing, but there is at each horizon a certain proportion of examples which are respectively behind and in advance of the general average. In the

[4] *Geol. Mag.*, lix., 1922, p. 256.

cases of *Zaphrentis* and *Micraster* referred to above, a similar feature was noticed.

One problem which naturally suggests itself is whether the *Ostrea-Gryphæa* series really consists of a great number of parallel lines of evolution, or whether there is a real unity within the series. In other words, did the most advanced members of any horizon, breeding among themselves, give rise to the more advanced examples at a later horizon, while the most retarded members gave rise again to the most retarded examples? If such were the case, then the *Ostrea-Gryphæa* series is to be thought of as a bundle of parallel lines. But it appears to be more probable that all co-existing members of the series were able to interbreed freely and thus the "lineage" of *Gryphæa incurva* must be thought of as a bundle or plexus of anastomosing lines. It is thought that every so-called line of evolution may be of similar character. A cross section of a lineage at any stage in time would thus always show a range of variation, similar to that found in the *Gryphæas* at any horizon; apparently in some series the variation may be very wide while in others there is comparatively little difference at any one time between the most and the least advanced forms.

The forms dealt with so far may be considered to be evolving in one single character only. But even in fossil shells it is usually possible to trace simultaneous changes in several characters. This may be illustrated by reference to certain of the lamellibranchs (of the genus *Carbonicola*) which occur in great numbers above many coal seams in the Upper Carboniferous rocks of Britain. At each horizon these shells show variation in thickness, in the ratios of height to length and of length of anterior end to length of shell, in the form of the lower border, etc.[5] Similarly wide variation is frequently shown by modern fresh-water mussels.

It will be convenient to consider the evolution of a series of *Carbonicolas* in which there is wide variation in two of these characters, which may be called A and B; in each character the stages passed through may be represented as ranging from 0 to 100. Thus a single specimen may be designated, in respect of these characters, by the formula A60 B60. At any one horizon the forms present may show, for example, a variation from 60 to 70 in each character. Experience in studies of variation of this nature tends to show that the variation in one character is relatively independent of variation in the other; in other words, any individual may show a high degree of advance in character A or B, without any corresponding advance in the other character. Thus at one horizon the greater number of the specimens may be represented by A65 B65, but other forms will occur with them, including A60 B60, A70 B70, A68 B68—with similar stages in each character—and also A60 B70, A70 B60, A65 B70, A62 B68, A66 B63, etc. It is not necessary to deal with the variation of such a series at successive horizons, but it will be apparent that the "lineage" must in this case be of considerable complexity.

[5] See *Q.J.G.S.*, lxxxiii., 1927, p. 210; 1929, p. 77.

THE SPECIES PROBLEM.

For many years biologists have been uncertain how to define a species, and the problems which arise in determining whether a certain form is to be accorded specific rank are familiar to the student of every group of living organisms. Recent biological research, so far from simplifying the problem, has made it more complicated, and has indicated that pure species in the strict sense may not exist in nature.[6]

If the neontologist has found the species problem increasingly difficult, the palæontologist is finding it almost beyond solution, and it is felt by some palæontologists that the binomial system of Linnaeus is proving inadequate for the needs of modern research. In the study of certain groups, particularly of those where the numbers of known specimens are small, it may be comparatively simple to assign specific names to the various known forms, but in many groups of common fossils, and especially in such variable forms as corals and certain molluscs, the recognition of separate groups to which specific names can be applied is no longer possible.

If we approach the matter first by considering an ideal lineage, which for the moment assumed may be to consist of a single line of evolving forms, it will be clear that the forms at lower horizons may be considered to merge into the higher forms. Although the latest known members of the lineage may be so different from the earliest that they cannot well be placed in the same species, yet they are connected by so complete a chain of transitional forms that it is impossible to fix any satisfactory boundary which divides the lineage into two or more species. Any boundary chosen must separate two members of the series which differ to an almost imperceptible degree. If, however, in such an ideal lineage, the known forms represent only portions of the line of evolution (for example, if the stratigraphical succession is broken by non-sequences) the known forms may then more easily be separated into "species."

But instances where the lineage is represented at each horizon by identical forms, as we have already noted, are unknown or very rare. Most lineages are represented at each horizon by apparently homogeneous groups of forms which vary in one or more characters, and which include occasional variants exhibiting stages of progression characteristic of higher or lower horizons. The problem of classification is clearly more complex in such cases, and any grouping of the members of such a series is open to criticism. Yet some method of recording and discussing individual fossils is necessary in order to meet the requirements of stratigraphy. True, the problem may be of little practical importance in the study of some groups of fossils (perhaps, for instance, the ammonites) where the range of variation (or what may be conceived as the "breadth" of the lineage) at one level is negligible in relation to the changes undergone by the lineage in a relatively short period of time (that is, in one or two hemerae). But in certain cases, such as the *Carbonicolas* of the Coal Measures already referred to, the variation at

6 See for example, G. C. Robson, "The Species Problem," 1928.

each horizon is considerable in comparison with any known changes undergone by the lineages, and the forms at one horizon cannot then satisfactorily be known under one name, although it may be admitted that they are members of a freely interbreeding group.[7]

The problem of what constitutes a genus also arises in this connection, but it appears to the writer to be much less urgent. The multiplication of generic names which has characterised so much recent work in palæontology may or may not be essential; some would hold that it is necessary to have additional names in order to make clear the presumed relationships of the forms dealt with, others would hold that the multiplicity of names adds to confusion. But an increase of names—specific names at least—is unavoidable if the needs of stratigraphical geology are to be met.[8]

The late Dr A. Vaughan proposed the term "gens" or species-group to cover "all the species which possess, in common, a large number of essential properties, and are continuously related in either space or time."[9] Vaughan had at first proposed to use the term "circulus" suggested by Prof. J. W. Gregory in 1896,[10] for such a species-group, but Dr Bather pointed out that this term was originally applied to an assemblage of homœomorphic forms, not necessarily related.[11] In a recent work Prof. Gregory has used circulus to cover such a series as we have been discussing.[12]

Vaughan's term gens, or if it be admitted, Prof. Gregory's term circulus, will cover the whole of any lineage, and the problem which faces us is that of the subdivision of such a species-group.

THE RECAPITULATION HYPOTHESIS.

Biologists have long been aware that the ontogeny or development of any individual, from the fertilised ovum to the adult state, tends to pass through a series of stages which to some extent recapitulate the stages passed through by the race to which the creature belongs, during its evolution from its protozoan ancestor. It is admitted that such recapitulation is incomplete, certain stages being of necessity omitted in order to allow the animal to reach maturity in a short time; the greater the complexity of the creature, the greater the concentration of stages in its development, and the more stages "skipped." It is also admitted that certain characters found in a developing organism are not related to its ancestral history (palingenetic) but are developed independently by the larval organism in order to fit it for its own peculiar mode of life (that is, the characters are cœnogenetic); the life of a young creature may differ from that of its own adult form and from that of its ancestors (for instance many marine animals have

[7] *Geol. Mag.*, 1924, p. 355.

[8] For a stimulating treatment of these problems, see Dr F. A. Bather's Presidential Address to the Geological Society (*Q.J.G.S.*, 1927).

[9] *Q.J.G.S.*, lxi., 1905, p. 183.

[10] British Museum *Catalogue of Jurassic Bryozoa*, 1896, p. 27.

[11] *Q.J.G.S.*, lxi., 1905, p. 306.

[12] In *Creation by Evolution*, 1928, p. 112.

floating or planktonic larvæ, but it is not suggested that all had planktonic ancestors).

The principle of recapitulation was applied in Britain by S. S. Buckman and in America by A. Hyatt to the study of fossil invertebrates. Buckman's masterly work, carried on over a period of forty years, often met with bitter criticism, but it may fairly be said to have revolutionised the study of palæontology in this country. He was almost always so far in advance of his contemporaries that his early work has only lately received its full recognition.

The contributions of Buckman and Hyatt to the problems associated with recapitulation had reference chiefly to the ammonites, but their views have influenced workers in most groups of fossils. In fossil shells, as in corals, the adult skeleton preserves a more or less complete record of the stages passed through in its development. Thus the inner whorls of an ammonite or the apical coils of a gastropod show the characters of the shell during the early stages of its ontogeny, and the ontogenies of fossil molluscs are for this reason better known than those for instance of trilobites. Nevertheless, in only a small proportion of the ammonites and perhaps a still smaller proportion of the gastropods are adequate details of the ontogeny at present known.

From studies in various groups of fossil molluscs it has been concluded that the ontogeny represents only a partial recapitulation of the stages passed through in phylogeny, various stages being unrepresented in ontogeny owing to their being "skipped." Such skipping of stages (lipopalingenesis) has been shown to lead in some cases to the omission of very early stages, and in other cases to the omission of very late stages, but the omitted stages are generally those which may be regarded as deviations from the direct development of a form.[13] For example, it is commonly supposed that ammonites similar to the almost smooth *Oxynoticeras oxynotum* of the Lower Lias are descended from the earlier ribbed members of the Arietidæ, but in the early shell of *Oxynoticeras* there is no trace of its ribbed ancestors, the shell developing direct from the smooth larval stage to the smooth adult stage, and skipping the ribbed stage which was presumably unnecessary to the adult condition.

So it is frequently found that in molluscs the shell develops by the most direct series of changes which lead to the adult from the protoconch. In such an ontogeny it is difficult to read any definite evidence of the nature of the ancestry. Indeed it may be suggested that some approximation to such a direct ontogeny may be expected if many species of life had not evolved at all (that is, if each species had been specially created), provided that each individual began life as a fertilised egg.

The most instructive ontogenies are those in which some deviation from the direct line of development can be recognised. Thus in many species of *Amaltheus*, an ammonite from the Middle Lias, which has a very similar adult form to that of *Oxynoticeras*, some of the early whorls

[13] See F. A. Bather, *op. cit.*, pp. 68-9; also *Trans. Roy. Soc. Edin.*, liii., 1925, pp. 700-4.

are strongly ribbed or even tuberculate. Buckman interpreted this as evidence that *Amaltheus* had descended from ornamented forms, and thus the phylogeny of *Amaltheus* would exhibit a parallelism to that of *Oxynoticeras*, but the traces of its ribbed ancestry were skipped in the ontogeny of *Oxynoticeras*. *Oxynoticeras* may therefore be regarded as a form in which the ontogeny is relatively direct, while *Amaltheus* apparently retains in its ontogeny evidences of a deviation from the direct line of development.

In relation to such instances, it must be noted that within recent years Dr L. F. Spath has stated that in his view the recapitulation hypothesis is now discredited.[14] From his writings, however, it appears that he regards certain ontogenetic characters as giving some clue to phylogeny but considers other characters in ammonite ontogenies as having been introduced during the young stages in relation to the mode of life of the young creatures; he also suggests that some such characters, having proved of value in infancy, were retained in later members of the series until the adult stage. This would of course represent a reversal of the sequence of events which the recapitulation hypothesis implies, for instead of a new character normally appearing first in the adult stage and being accelerated so that in subsequent forms it occurred in earlier stages of ontogeny, certain new characters are supposed by Spath to have appeared first in early life and to have been carried on into the adult stage. Theoretically there is perhaps no reason why changes such as Dr Spath suggests may not have occurred, for as already noted, it is well known that new characters (cœnogenetic) may be introduced into the early stages of an organism's life-history in order to fit the larva for some particular mode of life. On the other hand, it is to be remembered that evidences of recapitulation have been observed in most groups of animals, and indeed that some degree of recapitulation is to be expected in any organisms which have arisen from ancestors different from themselves.

It may perhaps be noticed here that there is frequently some variation among a group of fossils of the same species in any one bed in regard to their ontogeny, certain features appearing earlier in some than in others. Messrs T. H. Rowlands[15] and A. Stuart[16] have studied the variation in ontogeny in certain Eocene gastropods and have shown that in some species there is a very considerable variation in the ontogenies while in others the range of variation is small.

[14] See for example, *The Naturalist*, 1926, p. 139.

[15] *Geol. Mag.*, 1928, p. 529.

[16] *Geol. Mag.*, 1927, p. 545.

Carboniferous Limestone (Avonian) Succession in the Woodspring Promontory, Weston-super-Mare.

By G. E. Bush, B.Sc.

I. INTRODUCTION AND PREVIOUS WORK.

THE Woodspring Promontory is a ridge of Carboniferous Limestone two miles in length, lying two miles north of, and almost parallel to the Weston-Worle ridge. It is contained in Sheets IX, N.E., and X, N.W. Somerset, six-inch Ordnance map.

The promontory is of special interest on account of the contemporaneous igneous rocks which have been described in the following publications:—

(1) Sir A. Geikie and A. Strahan in Summary Progress of the Geological Survey for 1898, pp. 106-10.
(2) C. Lloyd Morgan and S. H. Reynolds, "The Igneous Rocks associated with the Carboniferous Limestone of the Bristol District," Q.J.G.S., vol. lx. (1904), pp. 139-44.
(3) C. Lloyd Morgan and S. H. Reynolds, "The Field Relations of the Carboniferous Volcanic Rocks of Somerset." Proc. B.N.S., new ser., vol. x., pt. iii., 1904 (issued for 1903), pp. 192-200.
(4) S. H. Reynolds, "The Igneous Rocks of the Bristol District," Proc. Geol. Ass., vol. xx. (1907), pp. 62-64.
(5) S. H. Reynolds, "Further Work on the Igneous Rocks associated with the Carboniferous Limestone of the Bristol District," Q.J.G.S., vol. lxxii. (1916), p. 33.

The following publications briefly describe the Avonian succession:—

(6) T. F. Sibly, "The Carboniferous Limestone of the Weston-super-Mare District," Q.J.G.S., vol. lxi. (1905), pp. 558-9.
(7) S. H. Reynolds, "A Geological Excursion Handbook for the Bristol District" (1921), pp. 94-100.

In the present paper a more detailed account is given of the structure and fauna of these rocks.

II. STRUCTURE.

The promontory consists of an almost E.-W. ridge of Carboniferous Limestone. The general strike of the beds is a few degrees S. of W. and N. of E., and the average dip is 30° in a southerly direction. Thus the north and south coastlines are practically parallel with the strike. The beds are traversed in many places by small dip faults which in three instances repeat the exposure of igneous rocks. A marked feature of the northern coastline is the prominent inland cliff and shore platform. Between the first and third igneous exposures an excellent example of a raised beach occurs.

III. THE DETAILED SUCCESSION.

A. The St Thomas's Head Succession.

The most complete sequence is that afforded by the cliffs facing Woodspring Bay, south of St Thomas's Head. These cliffs run practically at right angles to the strike and give a complete sequence from the *Caninia*-Oolite in the south of the bay to the Z2 beds at St Thomas's Head.

In the following account the strata are described from above downwards.

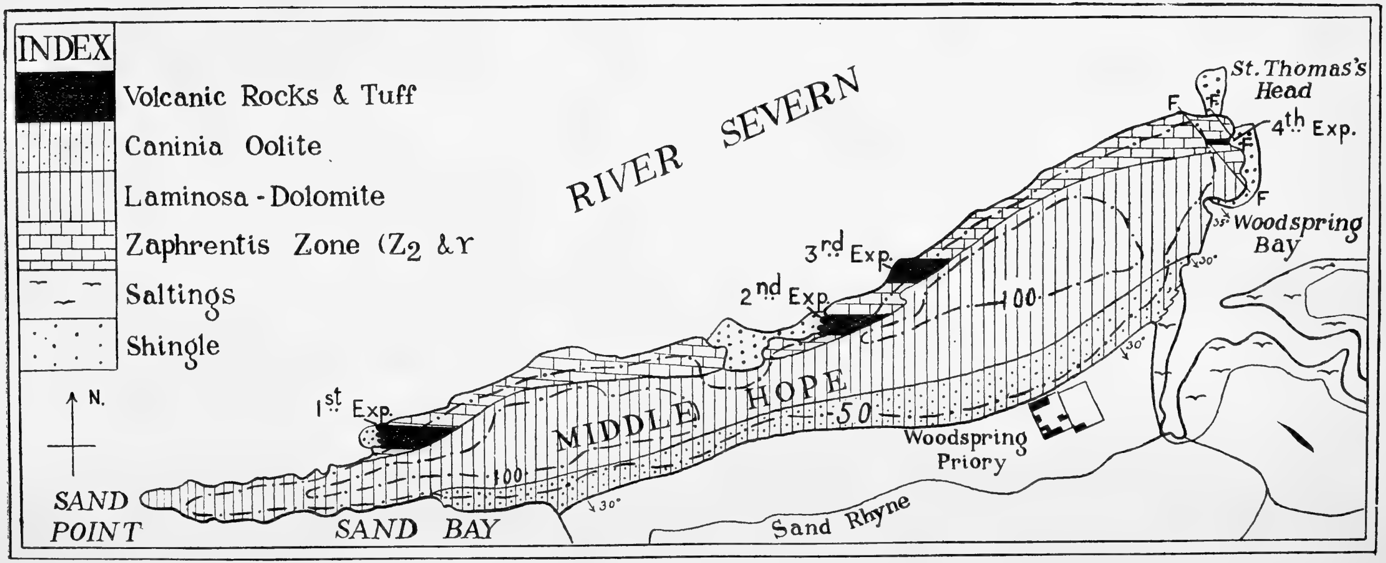
SYRINGOTHYRIS BEDS.

Laminosa-dolomite (C1).

		ft.	in.
1.	Coarse-grained crinoidal and oolitic limestone	26	6
2.	Shattered limestone, disturbed and veined with calcite	4	6
	The abundant fault-breccia and great development of calcite veining together with the increased dip indicate faulting at this level.		
3.	Jointed oolitic limestone	9	0
4.	Massive oolite	12	0
	For some distance the cliffs dwindle to grass covered slopes where small inland exposures indicate similar oolitic limestone about ...	100	0
5.	Very fine white oolite	6	0
6.	Oolite crowded with *Chonetes papilionacea.*		
7.	Band of brown decalcified weathered oolite packed with *C. papilionacea.* This band is the equivalent of the Sub-Oolite Bed in the Avon and other sections	1	0
	Here further disturbance accompanied by slight faulting is indicated.		
8.	Massive oolitic limestone	5	6
9.	Less oolitic slightly dolomitized limestone with *Chonetes hardrensis*	2	0
10.	Much jointed slightly oolitic and dolomitized limestone with calcite veining	22	0
11.	Jointed dolomitized limestone with weathered crinoids and brachiopods	2	3
12.	Grey and buff dolomitized limestone with occasional crinoids and brachiopods	35	0
13.	Strongly dolomitized unfossiliferous limestone	17	3
14.	Strongly dolomitized limestone with fossils	15	5
15.	Dolomitized limestone with ochreous partings	3	0
16.	Thinly bedded dolomite with *Chonetes*	19	0
17.	Dolomitized limestone with nests of calcite	2	6
18.	Dolomitized limestone	7	0
	Gap of 50 feet (horizontal measurement) with scattered bands of dolomite exposed.		
19.	Partly dolomitized limestone with fossils	6	3
	(Base of *laminosa*-dolomite.)		

List of Fossils from the *Syringothyris* Beds.

Chonetes papilionacea (Phill.). Very common.
Chonetes comoides (Sow.). Common at base.
Orthotetes crenistria mut. C. Vaughan. Common.
Syringothyris cuspidata Mart. Rare.
Productus hemisphericus Sow. At base.
Cliothyris glabristria (Phill.). Rare.



Geological Map of Woodspring Promontory
Scale :- 3 inches = 1 mile. Contours shown thus — · —

No corals were found in the *Syringothyris* beds. The brachiopods and crinoids occur in definite bands.

ZAPHRENTIS BEDS (horizon γ and Z2).

The *laminosa*-dolomites rest on the more massive, crystalline, and darker coloured γ limestones. These are characterised by the occurrence together of abundant *Caninia* and *Zaphrentis*. These corals and the very numerous crinoid ossicles are strongly silicified and stand out from the weathered surfaces of the rocks.

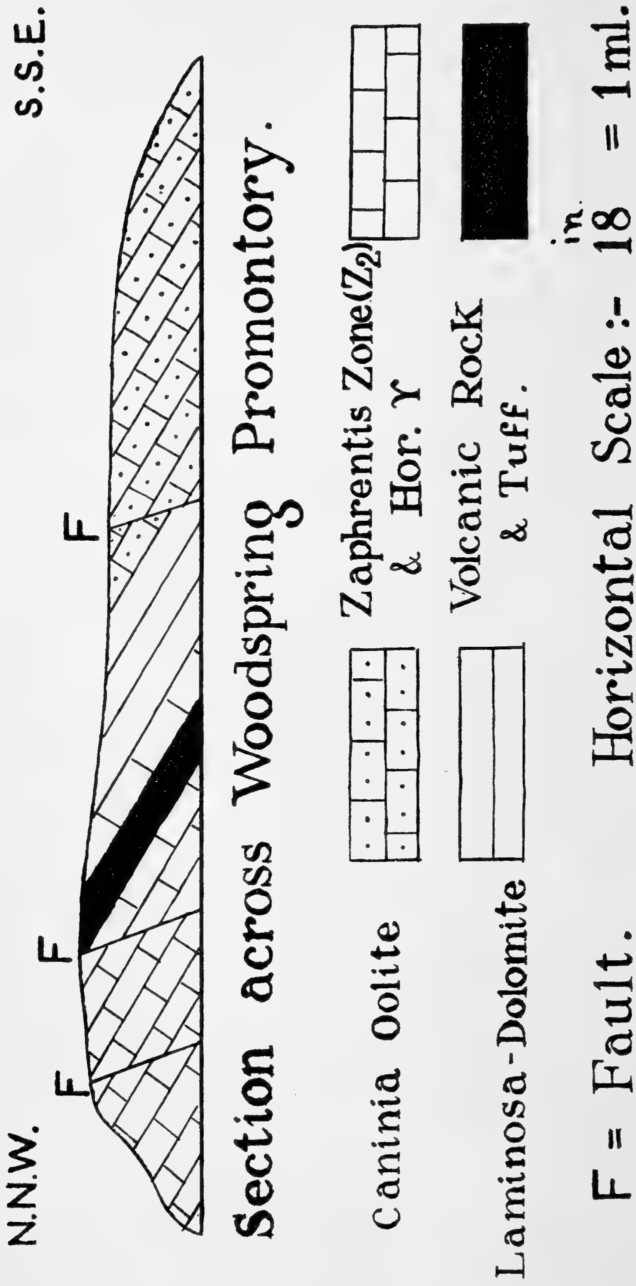
Beginning with the highest beds the succession is as follows:—

		ft.	in.
20.	Coarsely crinoidal limestone packed with *Zaphrentis* and *Caninia*	12	0
21.	Very coarsely crystalline limestone, with *Cliothyris*	9	0
22.	Limestone of "Petit granit" type	3	0
23.	Limestone crowded with brachiopods and corals including *Michelinia favosa*	2	6
24.	Crinoidal limestone	12	9
25.	Thin bands of crinoidal limestone alternating with bands of chert nodules and black shale	4	0
26.	Crinoidal limestone	16	0
27.	Ochreous parting	0	4
28.	Crinoidal limestone	11	0
29.	Thin bedded red limestone	4	0
	Gap of 9 feet to the 4th igneous exposure where only one foot of red ash is now exposed. A further gap of 10 feet follows, the limestone being covered with shingle.		
30.	Red crinoidal limestone	7	6
	A gap of 15 feet owing to the rocks being covered with shingle.		
31.	Thinly bedded, red and yellow fossiliferous limestone	9	0
32.	Crinoidal limestone	7	0
33.	Curiously weathered band of nodular limestone	0	6
34.	Thinly bedded platy limestone with chert nodules	4	0
35.	Fossiliferous limestone	4	0
36.	Thinly bedded dolomitized limestone	4	0
37.	Thinly bedded limestone with very large crinoidal ossicles	7	0
38.	Thinly bedded yellow limestone with chert nodules	3	6
39.	Black platy limestone crowded with crinoidal ossicles and polyzoa	14	0
40.	Thinly bedded dark crinoidal limestone with polyzoa and large *Caninia*	38	0
41.	More massive dark grey limestone	29	0
	The section is here cut through by a dip fault with a considerable throw, and marked by a development of fault breccia. Near St Thomas's Head masses of small blocks of decalcified Z2-limestone associated with ochreous material occupying cavities in the Z2-beds. West of the fault at St Thomas's Head the Z2-beds strike along the coast forming the cliffs.		

B. The Northern Coast Line W. of St Thomas's Head.

From St Thomas's Head westward to the third igneous exposure (see map) the cliffs afford a continuous and practically uniform section of γ and Z2. Two small dip faults occur just W. of St Thomas's Head. Near the third igneous exposure there is an excellent example of a raised shore platform backed by a conspicuous cliff of *laminosa*-dolomite.

The succession of γ and Z2 is as follows:—


N.N.W.
F
F
F
S.S.E.
Section across Woodspring Promontory.
Caninia Oolite
Zaphrentis Zone (Z_2) & Hor. γ
Laminosa-Dolomite
Volcanic Rock & Tuff.
F = Fault.
Horizontal Scale :- 18 in. = 1 ml.

		ft.	in.
42.	Thinly bedded poorly exposed limestone	15	0
43.	Massive dark grey crinoidal limestone with thin platy partings ...	15	0
44.	Black crinoidal shaly limestone packed with *Camarotaechia mitcheldeanensis*	0	9
45.	Thinly bedded crinoidal limestone	20	6
	(Base of section.)		

The succession at the third igneous exposure was measured with the following result:—

		ft.	in.
1.	Sandstone with vertical bodies	15	0
2.	Tuff	15	0
3.	Limestone with much haematite	2	0
4.	Calcareous tuff with lenticular limestone	13	0
5.	Fossiliferous limestone	2	6
6.	Green tuff	7	0
7.	Coarse green tuff with large blocks of *Michelinia favosa* and nodules of limestone	22	0
8.	Fossiliferous limestone	3	6
9.	Sandy greenish-brown tuff with red iron stained patches and bands of altered limestone	23	6
10.	Massive dark grey limestone crowded with Z2 corals.		
	(Base of section.)		

These measurements can only be regarded as approximate since considerable disturbance has taken place, obscuring the succession.

Further to the west the cliffs again afford a section of Z2 and γ broken by the second igneous exposure. This exposure together with the first has been described in some detail and figured in publications mentioned in the introduction to this paper.

The second exposure like the third is accompanied by considerable disturbance as is shown by the curvature of the strike, the increased dip and the distortion of the beds. This faulting is probably responsible for bringing in the *laminosa*-dolomite at the eastern end of the small bay just W. of the exposure.

At the top of the cliff above the igneous exposure occurs an excellent example of a raised beach similar to the well known one above the first and most westerly exposure. It consists of pebbles and shells of *Ostrea*, *Patella*, *Tellina* and *Littorina* cemented in a sandy matrix.

From the second to the first igneous exposure the cliff is still of Z2 and γ, but from the first exposure westward to the end of the promontory the cliffs consist of unfossiliferous *laminosa*-dolomite.

List of Fossils from γ and Z2.

Zaphrentis konincki E. & H. Very common.
Zaphrentis omaliusi E. & H. Common.
Caninia cylindrica (Scouler). Very common.
Caninia cornucopiae Mich. Rare.
Amplexus coralloides Sow. Rare.
Syringopora θ Vaughan. Common.
Michelinia favosa (Goldf.). Very common.
Cliothyris glabristria (Phill.). Common.
Spirifer tornacensis de Kon. Very common.
Reticularia lineata (Mart.). Common.
Syringothyris cuspidata mut. *cyrtorhyncha* North. Common.

Tylothyris laminosa (M'Coy). Rare.
Leptaena analoga (Phill.). Very common.
Orthotetes crenistria mut. Z. Vaughan. Very common.
Rhipidomella michelini (L'Eveillé). Common.
Productus subpustulosus Thomas. Common.
Productus hemisphericus Sow. Common.
Chonetes hardrensis (Phill.). Fairly common.
Chonetes papilionacea (Phill.). Fairly common.

C. The Sand Bay Section, i.e., the Southern Side of the Promontory.

The cliffs bounding the north-east corner of Sand Bay afford a good section of the *Caninia*-Oolite.

The upper beds are typical *Caninia*-Oolite more than usually rich in *Chonetes papilionacea* and *Orthotetes crenistria*. They rest on massive oolite, less fossiliferous and much veined with calcite.

At the base of the section the Sub-oolite bed is splendidly exposed in a large bedding plane, while the overlying beds contain very large *Chonetes comoides*. All the western part of the southern coast consists of *laminosa*-dolomite.

CONCLUSION.

The exposures described are similar in most respects to neighbouring exposures of the same zones. The coastal section of Z2 and γ in particular resembles that exposed at Wain's Hill, Clevedon.*

Pene-contemporaneous brecciation occurs in the Z2 beds at St Thomas's Head. The development of chert in the Z2 limestones is similar to that at Clevedon.

The *Caninia*-oolite and *laminosa*-dolomite are noteworthy for the absence of corals.

A careful examination of the fossils immediately below the igneous exposures indicates that all four occur at the same level.

In conclusion I wish to express my thanks to Major Vernon Hill for giving me permission to examine the area, and to the Colston Research Society for defraying the expenses of publication.

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TABLE OF CONTENTS.

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S	Harrison, G. P.	Springfort Cottage, Stoke Bishop
S	Haslam, Miss	36 Carnarvon Road, Redland
S	Hawker, G. A.	277 Stapleton Road, Bristol
S	Hawkins, L. A.	Cowslip Green, Wrington, Som.
	Hellyar, R. H.	18 Redland Grove, Bristol
†	Heslop, I. R. P., M.A., F.E.S.	34 Henleaze Gardens, Bristol
	Hiley, Miss M. D.	116 Portway, Bristol
S	Hiley, Miss W. F.	116 Portway, Bristol
S	Hill, R. M., J.P., B.A.	Dilton Ley, Limpley Stoke, Som.
S	Hockin, Miss G.	20 Fremantle Square, Cotham
	Hodgson, C. J.	5 Cotham Terrace, Bristol
S	Hopton, H. G. W.	32 Churchways Avenue, Horfield
	Horder, Miss M. G.	81 Redcliff Street, Bristol
S	Hudson, Miss	4 Belgrave Place, Clifton Park
	Humphries, Lady	Eastfield Lodge, Westbury-on-Trym
S	Hurst, G. W. S.	34 Upper Belgrave Road, Clifton
S	Hurst, Mrs	34 Upper Belgrave Road, Clifton
S	Hutchinson, Miss M. I.	57 Oakfield Road, Clifton
S	Imlack, Miss	16 Miles Road, Clifton
	Ivens, H. P.	18 Alexandra Road, Clifton, Bristol

	Jeffcoat, Rev. R., M.A.	5 Berkeley Square, Clifton
	Jenkins, F. G., M.B., Ch.B.	51 Redcliff Hill, Bristol
S	Jervis, W. W., M.Sc., F.G.S.	The University, Bristol
S	Jones, F. G., F.G.S.	8 Clifton Vale, Clifton
	Kearns, H. G. H., B.Sc., F.E.S.	The University, Bristol
S	Keeler, R. H.	76 Berkeley Road, Bishopston
S	Kellaway, G. A.	125 Howard Road, Westbury Park
	Knight, H. H., M.A.	The Lodge, All Saints' Villas, Cheltenham
S	Knight, Miss S. A.	Dorset House, Clifton Down
	Knowlson, Mrs	9 Downfield Road, Clifton
S	Kromler, A.	45 Summerleaze, Fishponds
S	Leach, A. C.	11 Percival Road, Clifton
	Lee, Miss E. M., M.Sc.	55 Logan Road, Bishopston
S	Lee, Mrs F. R.	St Heliers, Larkhall Place, Bath
S	Lloyd, H. T., B.Sc.	The University, Bristol
S	Long, Miss A. C.	Clifton Hill House, Bristol
S	Lucas, H. J., F.C.I.	14 Walcot Parade, Bath
S	Luxford, R.	15 Russell Grove, Westbury Park
S	Lynn, Miss	15 Arlington Villas, Clifton
	Macdonald, D.	Fosse Cottage, Nailsea, Som.
	Macpherson, Miss B. B.	4 Belgrave Place, Clifton Park
S	Madkins, W. E., B.A., F.R.G.S.	Fairfield Secondary School, Bristol
	Mappin, S. W.	100 Pembroke Road, Clifton
	Marsden, A., F.I.C.	161 Bishop's Road, Bishopston
S	Marsden, Mrs	161 Bishop's Road, Bishopston
S	Marshall, Miss D.	54 St John's Road, Clifton
*	Matthews, L. H., M.A.	37 Cornwallis Crescent, Clifton
S	Matthews, P. M.	Wharfedale House, Pulteney Road, Bath
	McMurtrie, G. E. J.	Eastfield House, Westbury-on-Trym
S	Merryweather, Miss D.	11 St John's Road, Clifton
	Miller, M.	7 All Saints' Road, Clifton
S	Mizen, H.	93 Coronation Road, Bristol
S	Mogg, G.	483 Fishponds Road, Bristol
A	Morley, Miss A.	17 The Avenue, Clifton
S	Morrison, Miss A.	8 Richmond Hill, Clifton
	Nierenstein, M., Ph.D.	30 Cavendish Road, Bristol
S	Nettle, Miss E. C.	3 Beaufort Road, Kingswood, Bristol
	Norgrove, J. W.	22 Alma Road, Clifton
S	Onn, H. A.	Glenlyn, Station Road, Nailsea, Som.
S	Osmond, D. A.	Agri. Station, Long Ashton
S	Parker, F.	150 Filton Road, Horfield
S	Parkhouse, Miss O.	St Crantock, Wotton-under-Edge
	Peach, A. H.	5 Hanbury Road, Clifton
*	Pearman, J. V., F.E.S.	32 Cornwallis Crescent, Clifton
S	Pearman, Mrs	32 Cornwallis Crescent, Clifton
S	Penruddocke, J. H. H.	Ensleigh, Limpley Stoke, Som.
	Pepperell, R.	9 Rayleigh Road, Coombe Dingle.
S	Pepperell, Mrs	9 Rayleigh Road, Coombe Dingle.
S	Perry, Miss M. P.	6 Chantry Road, Clifton
S	Pole, Mrs A. H.	60 Charlton Road, Keynsham
	Powell, J. J., M.D.	2 Gloucester Road, Bishopston
S	Pratt, Miss D., C.S.M.M.G.	1 Hughenden Road, Clifton
S	Preddy, Mrs K.	The Grange, Stapleton

*	Rafter, J., M.A.	32 Tyndall's Park Road, Clifton
*	Reynolds, S. H., Sc.D., F.G.S.	13 All Saints' Road, Clifton
	Richards, G.	10 Mortimer Road, Clifton
	Richardson, Frank	15 Percival Road, Clifton
S	Rockett, F. A., M.A., F.R.G.S.	Colston School, Stapleton
*	Roper, Miss I. M., F.L.S.	4 Woodfield Road, Redland, Bristol
	Rudge, Miss D. M.	17 Wellington Park, Bristol
	Rudge, Miss E. L.	17 Wellington Park, Bristol
	Rutter, Miss E. M.	Cambridge House School, St John's Rd., Clifton
A	Salmond, P. W.	20 Tyndall's Park Road, Clifton
S	Salmond, Mrs	20 Tyndall's Park Road, Clifton
	Sampson, Miss D.	5 Hatherley Gardens, Crouch End, N.8
*	Sandwith, Mrs	26 Canynge Square, Clifton
S	Searle, G. C.	Long Ashton Research Station
	Selley, A.	116 Coronation Road, Bristol
S	Selley, F.	116 Coronation Road, Bristol
	Shaw, Miss T.	12c Kingsdown Parade, Bristol
S	Shield, E. H.	78 Sefton Park Road, Bishopston
S	Shrimpton, T.	172 Brynland Avenue, Bishopston
S	Silveston, Miss	32 Pembroke Road, Clifton
S	Sisson, J. E.	Heath House, Gadshill Road, Eastville
	Skene, Macgregor, D.Sc., F.L.S.	The University, Bristol
	Smith, Stanley, M.A., D.Sc., F.G.S.	The University, Bristol
A	Smith, Mrs W.	17 Vyvyan Terrace, Clifton
A	Sprackling, F. D.	106 Coronation Road, Bristol
S	Stevens, F. H.	9 Osborne Villas, St Michael's, Bristol
S	Stone, R.	75 Clevedon Road, Weston-s.-Mare
S	Storey, R. G.	8 Oxford Chambers, St Stephen's Street, Bristol
	Sully, H. T.	Elmside, Stoke Bishop, Bristol
S	Sully, Mrs	Elmside, Stoke Bishop, Bristol
S	Sutton, H. C.	30 Cotham Road, Bristol
	Taunton, W. C.	36 Egerton Road, Bishopston
S	Taylor, W. R., M.A.	12 Pembroke Vale, Clifton
*	Tetley, H., B.Sc.	Ferncliffe Cottage, Leigh Woods
S	Thomas, Miss D. M. L.	79 Somerville Road, Bishopston
S	Thomas, J. I.	79 Somerville Road, Bishopston
*	Thompson, H. S., A.L.S.	11 Buckingham Place, Clifton
	Thompson, Miss J. G., O.B.E., B.Sc.	Foxstones, Westbury Hill, Bristol
S	Thornton, P. T.	5 Goldney Avenue, Clifton
S	Tomkins, Miss M.	62 Ashley Road, Bristol
	Tuckett, C.	St Just, Chew Magna, Som.
	Tuckett, R. C.	5 Beaufort Buildings, Clifton
	Turner, H. W., M.A. (Oxon.), F.G.S.	The University, Bristol
*	Tutcher, J. W., M.Sc.	57 Berkeley Road, Bishopston
S	Tyrrell, E. B., B.A.	5 Addicott Road, Weston-s.-Mare
	Vassall, H.	Oldbury Court, Fishponds
	Vaughan, Mrs	42 Fernbank Road, Redland, Bristol
S	Virgin, Miss	10 Cornwallis Crescent, Clifton
S	Vizard, Miss E. M.	25 Logan Road, Bishopston
	Waight, Miss M.	14 Osborne Avenue, Ashley Down
	Walker, L. E.	5 Crowndale Road, Knowle, Bristol
	Walker, R.	5 Crowndale Road, Knowle, Bristol
*	Wallis, F. S., D.Sc., Ph.D., F.G.S.	90 Coldharbour Road, Bristol
S	Walsh, W. G.	6 Alma Vale Road, Clifton
	Walton, T. C. H.	Compton Bishop, Som.

S	Waters, A. B.	53 Woodstock Road, Redland, Bristol
S	Waters, A. C.	53 Woodstock Road, Redland, Bristol
S	Waters, Mrs	53 Woodstock Road, Redland, Bristol
	Webb, H. Vicars	58 Belmont Road, St Andrews, Bristol
	White, E. Barton, F.E.S.	Mental Hospital, Fishponds, Bristol
	White, Mrs E. B.	Mental Hospital, Fishponds, Bristol
*	White, Jas. W., M.Sc., F.L.S.	18 Woodland Road, Clifton
	White, Mrs J. W.	18 Woodland Road, Clifton
*	Wickes, W. H.	84 St Michael's Hill, Bristol
S	Willcox, F. R.	Stoke Hill Cottage, Stoke Bishop
	Wills, Sir Vernon, Bt.	Langford Court, near Bristol
†	Wills, W. Melville	Bracken Hill, Leigh Woods, Bristol
*	Womersley, H., F.E.S., A.L.S.	Perth, Western Australia
S	Woolcott, J. W.	Bryars, Filton
	Woolley, W. H.	2 Nugent Hill, Bristol
S	Woollon, P. C. A.	30 St Paul's Road, Clifton
S	Woolls, Miss	5 Hamilton Road, Easton, Bristol
S	Wynne-Edwards, V. C., B.A.	McGill University, Montreal, Canada

Honorary Members.

Henry J. Charbonnier, Rose Cottage Bungalow, Olveston, Gloucestershire.

Prof. C. Lloyd-Morgan, LL.D., F.R.S., F.G.S., 59 Peversley Road, St Leonards-on-Sea.

R. M. Prideaux, F.E.S., Brastead Chart, near Sevenoaks, Kent.

W. G. Scott, Cardiff.

Prof. H. S. Hele Shaw, M.I.C.E., LL.D., F.R.S., 64 Victoria Street, Westminster, S.W.1.

Prof. W. J. Sollas, M.A., LL.D., F.R.S., F.R.S.E., F.G.S., University Museum, Oxford.

Prof. Sydney Young, D.Sc., F.R.S., Trinity College, Dublin.

REPORT OF COUNCIL.

TO DECEMBER 31st,

1930.

THE year opened with a new President, Dr A. L. Flemming. His great interest in Ornithology has enhanced activity amongst those workers who have done so much for the Ornithological Section under his presidency since its formation eight years ago. It is to be regretted that professional duties do not allow his term of office to be extended for another year.

The advantages offered by the Society for the study of Natural History are slowly appealing to the citizens, during the year no less than 44 having joined. More than two-thirds of this number, however, have been content to pay a low subscription to one of the Sections, and have not therefore materially helped the Society to maintain its Library and the publication of Annual Proceedings. During the year only four sectional members have sought full membership.

Entomology has suffered a loss in the departure from Bristol of Mr H. Womersley, a past President and a staunch supporter of the Society during his ten years' residence in the city. Early in the year he accepted an appointment for work on insect pests under the Commonwealth Council for Industrial and Scientific Research at Perth, Western Australia, and after a few months' study at the British Museum, he left England with his wife and family in July 1930. Our congratulations go with him, and it is hoped he will find opportunities in his new sphere of activity to continue the research that he did locally in working out the life history of the Apterygota, a little known group of primitive insects.

Congratulations are also offered to Dr F. S. Wallis on receiving the degree of Doctor of Science in the University of Bristol for original work on the geology of the district; and to Mr H. S. Thompson on his election as an Associate of the Linnean Society of London in recognition of his work on botanical subjects. He is the second member to receive this honour in recent years, and as the number of recipients is strictly limited our Society can be proud that another of its members has been chosen to fill a vacancy.

The Society took no official part in the meeting of the British Association in Bristol in September, but a number of members joined, three acting as local Secretaries of Sections. Dr S. B. Adams was responsible for the arrangements of the Anthropological, Mr H. W. Turner of the Geological, and Miss Ida M. Roper of the Botanical Sections. All worked hard to make the sectional excursions of outstanding importance. Papers were also contributed by members to the Association's handbook as well as to the excursion pamphlets of the Sections, and many were willing to act as leaders and impart their local knowledge for the benefit of the numerous visitors.

Mr James Rafter attended as delegate to the Conference of Corresponding Societies held during the meeting of the Association, and his comprehensive report on the desirability of establishing National Parks will be published in our "Proceedings." The Hon. Secretary represented the Society in October at the Jubilee celebration of the Birmingham Microscopical and Natural History Society, when a Conversazione and Exhibition of Natural History objects was given at Queen's College, Birmingham.

The programme of meetings has been carried out on the same lines as in past years. Dr H. L. Hawkins, Professor of Geology at Reading University, was the lecturer at the Open Meeting in October, and under the title of "The Way of the World," he told, in a fascinating style, of the ceaseless denudation which assails the solid crust of the earth.

The Annual Dinner in February again attracted a good number of members. Dr G. A. Buckmaster, of the University of Bristol, was the guest of the evening, and in proposing "Prosperity to the Society," congratulated the members on the rare beauty of the countryside in which they dwelt, and of the splendid opportunities afforded them to study all branches of Natural History. A programme of music and recitations added to the enjoyment of the evening.

The Summer Excursion to Bratton, in Wiltshire, was also well supported by the members who appreciated the enterprise of the officers of the Field Section in arranging a visit to such a picturesque spot.

That good and original work is being carried on by the Sections was noticeable in the excellent display of exhibits arranged by them at the annual Exhibition night.

Opportunities to discuss and compare notes one with the other could be increased if more members would take part and bring objects of interest that have come under their notice during the year. The bashful member need not be alarmed, because a descriptive label would protect him from the necessity of describing his exhibit.

The "Proceedings" for 1929 were published early in the year and distributed to the British and Foreign Societies with whom exchanges are effected. The contents maintained the high standard, and some excellent illustrations of Limestone scenery were included.

IDA M. ROPER, *Hon. Secretary.*

The Hon. Treasurer in Account with The Bristol Naturalists' Society.

Dr. GENERAL ACCOUNT FOR THE YEAR 1930. *Cr.*

	£	s.	d.
To Members' Subscriptions :—			
Ordinary, ...	46	10	6
Associate, ...	2	0	0
Arrears, ...	0	10	0
In advance, ...	4	5	0
,, Entrance Fees, ...	1	15	0
,, Field Section Capitation Fee, ...	4	2	0
,, Donations to Publishing Fund, ...	6	0	0
,, Sale of Publications, ...	9	10	9
,, Sale of Dinner Tickets, ...	16	17	0
,, Interest on Deposit, ...	2	12	7
,, Balance forward :—			
General Account, ...	105	4	6
Bookbinding Fund, ...	5	12	3
	£204	19	7

	£	s.	d.
By Subscriptions to Societies :—			
Ray, ...	1	1	0
Zoological Record, ...	5	0	0
S.W. Naturalists' Union, ...	0	11	0
,, Cost of *Proceedings*, 1929, ...	39	0	0
,, Printing, Postage, etc., ...	10	8	10
,, Lecture Expenses, ...	1	0	0
,, Rent and Fire Insurance, ...	1	11	0
,, Dinner Expenses, ...	16	3	6
,, Bookbinding	1	10	6
,, Cash in hand :—			
General Account, ...	124	12	0
Bookbinding, ...	4	1	9
	£204	19	7

December 31st 1930.

Audited and found correct.

ERNEST H. COOK,
CHARLES BARTLETT, F.C.A. } *Auditors.*

LIBRARIAN'S REPORT.

FOR THE YEAR 1930.

THE Library has been closed on two occasions during the year, which may have interfered with a regular use of the well-stocked collection of Natural History books, but now that conditions are normal again it is hoped full advantage will be taken of the opportunities offered to the members.

In the Spring the room was re-decorated, and additional bookcases, brought out of store, are now available for the useful books presented by our honorary member, Mr H. J. Charbonnier, and others.

There is still plenty of room for further books, and it is hoped members will look through their bookshelves and pass on any works no longer needed.

A modern book on Geology—" Stratiographical Paleontology," by E. Neaverson, has been purchased.

The application of the Local Secretaries of the British Association for the use of the Library as the Committee room of Section H. (Anthropology) was willingly granted, and proved of service to the visitors. The room is also now available during official hours for sectional Committee meetings by kind permission of the Director of the Museum and Art Gallery.

Copies of the earlier " Proceedings " and reprints of papers contained in them are still in demand, and although it is not possible to supply a complete series from the first volume published in 1863 onwards, a set with but few gaps has been purchased by a member for a fair price.

Information has been supplied to the Institute of Historical Research, London, of papers from our set of " Proceedings " dealing with subjects of archæological and historical interest for insertion in a Guide in course of publication by the Institute.

New exchanges have been arranged with the following Societies:—

Swansea Scientific and Field Naturalists' Society.
Eton College Natural History Society.
The Entomological Society of Hampshire and the South of England.

Three of the Sections continue to present current magazines and in addition from the Geological Section, the Paleontographical Society, vol. 83, 1929, and the recently published Index of the Proceedings of the Geologists' Association have been received.

IDA M. ROPER, *Hon. Librarian.*

BOTANICAL SECTION.

1930.

THE success of the Section during the past year may be gauged partly by the increase, both in our membership and average attendance, and by the variety and number of exhibits. The number of members during the year increased to thirty-six, and the average attendance for the eleven meetings was thirteen.

The informal discussions of exhibits and articles of botanical interest have been continued during the past year at the monthly meetings; these discussions are very valuable not only to beginners but also to more experienced botanists who often find additional information in the many references contained in the books placed at the disposal of the Section by Prof. O. V. Darbishire. The Section owes a debt of gratitude to Prof. Darbishire for the continued use of the Library.

The exhibits have included living and pressed specimens of native and foreign plants. Many useful comparisons have been made possible by collections of plants and fruits brought by Mrs Bell; in these collections were a number of Cones, many of the Saxifragas and Eucalyptus, Ricinus and Fatsia. Mr I. W. Evans, who joined the Section this year, has set a very high standard in the preservation of flowers, and has shown specimens of both native and alien plants. The Section was able to learn and see some of the less familiar Fungi in the autumn again, collected by Miss Bowen and Mr H. J. Gibbons.

Although many of the exhibits may appear difficult, prospective members, who are beginners in Botany, may rest assured that any simple specimens which they bring will be appreciated and discussed.

F. F. GLASSPOOL, *Hon. Secretary and Treasurer.*

ORNITHOLOGICAL SECTION.

1930.

THE number of members of this Section now stands at 30, the same as last year, the loss of a few members by resignation, owing to leaving the district, having been offset by new members, while the attendance at meetings has been a distinct improvement on that of last year.

For various reasons the progress in the list of Bristol birds has not been as rapid as was anticipated, but it is hoped that progress will be quicker during 1931.

The papers given at the meetings have included the results of original observations of considerable interest. Of these may be mentioned one by F. R. Willcox, on "An Eyrie of Peregrine Falcons;" by Rev. F. L. Blathwayt, on "British Breeding Terns;" by W. R. Taylor, on "Ducks of the Bristol Neighbourhood;" and by D. Macdonald, on "Photographing the Golden Eagle and Curlew," the last being illustrated by a number of beautiful slides from photographs taken by the lecturer.

The good relations existing between this Section and Bristol Museum have been emphasised by the gift to the Museum of a cabinet and small collection of local bird-skins.

H. TETLEY, *Hon. Secretary and Treasurer.*

ENTOMOLOGICAL SECTION.

1930.

IT is a curious fact that, year after year, the operation of gains and losses keeps our membership figures at a fairly constant level, so that in spite of an increase of five new members during the year we end up with our numbers no greater than they were five years ago. We should like to recruit more young members, especially those interested in the less popular insect orders.

Early in the year practical means were devised for the compilation (in co-operation with the Clifton College Scientific Society) of an up-to-date list of Bristol Lepidoptera, which were last systematically catalogued by A. E. Hudd in 1878. The area selected as the "Bristol District" is rather larger than that ordinarily so defined, extending northwards to the southern slopes of the Cotswolds and southwards to include the Peat Moor. Considerable progress has been made with the new list, and it is hoped that its publication may be commenced in 1932.

In July, on the kind invitation of Prof. F. Balfour Browne, an excursion was made to Winscombe Court. Some time was spent in collecting, and afterwards members were entertained to tea. During the evening Prof. Balfour Browne showed and explained his experiments in rearing certain Lepidoptera and aquatic Coleoptera.

In view of the preparation of the Lepidoptera list, most of the addresses given at meetings dealt with groups of British Butterflies and Moths. Our President (Mr C. Bartlett) reviewed two groups—the Psychides and the Sesiidae. In each case the subject was treated comprehensively and exhaustively, epitomising all that was known of the native species of the family. The addresses were illustrated by specimens from Mr Bartlett's extensive collection, the majority of the British species being shown, including an example of the Sesiid, *Trochilium flaviventris*, a recent addition to our native fauna.

Fully detailed also were the papers by Mr A. H. Peach on the Lycaenidae and by Mr J. W. Norgrove on the Satyridae. Both members paid particular attention to the occurrence of species locally, and Mr Peach entered into a close consideration of the complicated synonymy of the Lycaenids. Specimens were shown to illustrate the papers.

An entertaining account of Wicken Fen was presented by Dr Barton White, who also exhibited Lepidoptera taken on a collecting expedition to the Fen. This paper is published in full in the Society's "Proceedings," page 193.

The Hon. Secretary outlined the life histories and structural peculiarities of British Psocids. Short talks, illustrated by specimens, were given by Mr H. G. H. Kearns on the life histories of *Pterostichus madidus* Fab. (a local Strawberry pest), and the gall-making Aphid of the Norway Spruce.

In addition to those mentioned, other exhibits included the following:—

LEPIDOPTERA.—*Smerinthus populi* L. Five different forms, all taken within a restricted local area, Dr Barton White. *Taeniocampa incerta* Hufn. var. *instabilis*, Mr Peach. Brazilian Lycaenidae, etc., Messrs Matthews and Fonseca.

COLEOPTERA.—Various, including a fine series of *Corymbites castaneus* L., Mr Bartlett. *Tribolium ferrugineum* Fab., found in Chinese albumen, Mr Kromler.

ORTHOPTERA.—*Gryllotalpa gryllotalpa* L., found in coconut from Ceylon, Mr Kromler.

HEMIPTERA.—Large Cicada from Rhodesia, Mrs Sandwith.

Mr H. Womersley, who for the past ten years has been one of our most active members, left in July to take up an appointment in Economic Entomology with the Australian Government. Our good wishes go with him.

J. V. PEARMAN, *Hon. Secretary and Treasurer.*

FIELD SECTION.

1930.

MENTION was made in the last report that the Section was taking a firm stand against the tendency for its excursions to develop into mere rambles. This retrogression has been further checked during the past year by a resolution to substitute the term "Field Meeting" for "Excursion." Modern usage of the word "excursion" gives it a different connotation from its original idea.

Explanatory notes in the Summer Programme were more complete than in previous years, and this fact had a steadying influence in keeping the Section true to the aims of its founders.

At the Annual Meeting held in January, Mr H. F. Barke, F.I.C., was again elected President, and Miss M. D. Hiley continued to serve as Secretary. Miss T. Shaw succeeded Mr H. Womersley as Treasurer.

After the exhibition of specimens by various members the President spoke on the aims of a Field Section and incidentally deplored the fact that a city of nearly half a million inhabitants could only show a membership of less than one hundred. He pointed out that such a Section would be of immense value during the progress of a Regional Survey, and that its work would be of direct gain to the officers of the Geological Survey when they begin to map the Bristol area.

The first field meeting took place in May to Kelston Tump, under the general leadership of Messrs G. E. J. McMurtrie and T. Fry. Before tea many interesting features concerning the Church were pointed out by the Rector, whilst the Tump was ascended in the evening. Botanists were able to collect a number of interesting plants, but the exposures proved rather disappointing to the Geologists.

The annual combined excursion with the parent Society was led, in accordance with recent custom, by the Officers of the Section. The help of local Naturalists (Canon E. P. Knubley and Miss Hughes) was much appreciated on this occasion. Many members made the ascent to the White Horse, near Bratton. Devotees of all sections of Natural History found plenty of interest, the examination of fossils and associated flora and fauna of these chalk uplands making a special appeal to Bristolians.

Banwell was the district chosen for the third Field Meeting of the Section, which was held in July under the general leadership of Miss I. M. Roper, F.L.S. Archæology was pleasantly interwoven with Natural History interests, and long range visibility added to the enjoyment of the meeting.

Owing to the meetings of the British Association in September the experiment of holding an early October meeting was initiated. This was entirely successful, and Dr Wallis led a party over the Failand area. Hedge fruits, winter buds, mosses and fungi were much in evidence, and the geological structure was explained by means of diagrams distributed to members

Your Committee take the opportunity of congratulating Mr J. W. Tutcher, M.Sc., on his election as President of the parent Society for the year 1931.

Mr G. H. Beacham successfully organised a series of field meetings for Botanical observation, and Mr H. Vicars Webb for the bird life of our district. Their reports are here given in full :—

"As arranged, four Field Meetings have been duly carried out. They have been well attended (with an average of 9) by keen and enthusiastic members, although the weather on each occasion was far from good. General observation of the flowering plants, ferns, grasses and trees of the districts visited has been made, many specimens collected; questions, remarks and discussions have been frequent and instructive.

At the last meeting (Failand and Abbot's Pool) we were met by Mr H. C. Baker, the head forester of the estate, who very kindly conducted us over his nursery of trees and shrubs; here we were shown many varieties of Conifers in stages of development from the tiny plants in the seed beds to sturdy young trees of size and age ready to be transplanted to permanent quarters. Other trees and shrubs were pointed out, many questions were asked and much interesting information given by Mr Baker, whose kindness was much appreciated by the members."

"April 30th. (Evening.) From Filton to Stapleton. Twelve members came. Migrants seen were Swallows, House Martins, and Willow Warblers, also a good variety of resident species.

May 17th. Brean Down. Twenty members took part. An unsettled day, but good observations of adult Ravens, Peregrine Falcon, Kestrels, a Heron, Shelduck, Oyster Catchers, Gulls, Mallard, Green Plover, and many smaller species, such as Stonechats, Linnets, Pipits, Swifts, Swallows, House Martins, Hedge Warblers, Whitethroats, and Skylarks. Mr Harry Cox, "The Watcher," accompanied party round the Down.

May 21st. (Evening.) Hanham Woods. Party of seven. Nightingales heard and one seen. Blackcap, Willow Warbler, Chiffchaff, Hedge Warbler, and others in song. Flowers and foliage at beautiful stages. Hanham Abbots Church visited.

May 31st. Ashton Court Estate. Party of six. Unfortunately a drenching afternoon hindered observations, but a few warblers sang cheerily. Foliage of Giant Oaks, Beeches and other trees very beautiful."

M. DORIS HILEY, *Hon. Secretary.*

GEOLOGICAL SECTION.

1930.

THE year has been one of quiet uneventful progress such as so often occurs in the history of old-established Societies. A minor feature was the substitution of the old term "excursion" by the more expressive one of "field meeting." The former word has by modern usage lost much of its original meaning.

The informal discussion class well maintains its early progress and forms a valuable feature in the work of the Section. Many members have even confessed a preference for this round-table method to the more formal atmosphere of the lecture theatre. Mr J. W. Tutcher, M.Sc., is still chiefly responsible for its leadership, and we take this opportunity of congratulating him on his election to the Presidential chair of the parent Society.

At the Annual General Meeting held in January all the officers were re-elected. Afterwards the members adjourned to the Museum of the Speleological Society of the University where the various specimens of this unique collection were explained.

At the February meeting short papers were given by members. This is always a popular and interesting feature and Mrs E. M. Vaughan opened the evening with a paper on the Rhaetic and Lias of Cotham and Redland, giving, with the aid of large scale maps, the results of her detailed work in this neighbourhood. Mr R. W. G. Dennis followed with a paper on the geology of Guernsey, paying special attention to the petrology of the island.

Dr Stanley Smith, M.A., has recently published an account of the Carboniferous succession at Wick and the Section was favoured by a résumé of his results. Dr Smith also conducted one of the field meetings, and was thus able to demonstrate his conclusions. Later in the year he lectured on Carl Linnaeus, when, in addition to tracing the life and work of this great Naturalist, he took the opportunity to discuss the themes and ideas of 18th century scientific investigations.

At the November meeting the intrusive rocks of the Bristol District were dealt with. The President (Prof. S. H. Reynolds, M.A., Sc.D.) described the multiple dyke at Bartestree and showed how the original dolerite dyke had been invaded by a slightly later basalt one. The Secretary (Dr F. S. Wallis) then gave an account of the monchiquite, near Chepstow, and of the diorite, near Hestercombe. Whilst the former was explained as the remains of a volcanic plug or a large dyke, the latter most certainly represented a dyke or sill.

Messrs H. F. Barke and J. W. Tutcher led the first field meeting of the summer session to Keynsham; exposures in the Lower Lias were visited, and a gravel pit between Keynsham and Saltford claimed attention. In July members were entertained by the Directors (Messrs E. A. Young and B. A. Baker, F.G.S.) of the Bristol Mineral and Land Company. The mode of occurrence and uses of celestite were explained and a tour of inspection of the principal workings made.

The year closed with a membership of 58 (a nett increase of 8), and a substantial credit balance in the bank.

The Section has continued to subscribe to the Geological Magazine and the Palæontographical Society, and has also presented to the Society the recently published Index of the Proceedings of the Geologists' Association.

F. S. WALLIS, *Hon. Secretary and Treasurer.*

Account of the Annual and General Meetings.

THE 67TH ANNUAL MEETING.

January 16th, 1930.

Dr A. L. Flemming was elected President and Mr G. E. J. McMurtrie a Vice-President with minor alterations in Council. The retiring President, Mr James Rafter, M.A., gave his Annual Address for his third year of office 1929, entitled "Commons and Footpaths." (See p. 96.)

THE 546TH GENERAL MEETING.

February 6th, 1930.

THE 3RD ANNUAL DINNER.

The President, Dr A. L. Flemming presided over a company of upwards of 60 members and friends, and an enjoyable evening was spent.

Dr George A. Buckmaster, of Bristol University, was the guest of the evening, and in a short address he congratulated the Society on its long existence and of the splendid opportunities given to its members to study all branches of Natural History in a district of such rare beauty as the countryside around Bristol. Some people like himself found pleasure in the work of the laboratory, but there were other things that one could enjoy with a free and open spirit. Such Societies as this brought easily to the mind what the laboratory could not give —a whiff of the outside country; the sunsets, the animal life, the birds, the rivers, in fact all that gave pleasure to life.

The speaker had lived in many parts of the country but nowhere had he found so much beauty as in the short walks that could be taken within easy reach of the city of Bristol.

An excellent musical programme was contributed by Mrs James Rafter, Miss McMurtrie, Dr H. Chitty, Dr Stanley Smith, and Mr J. A. Froude.

THE 547TH GENERAL MEETING.

March 6th, 1930.

"Timber Beetles," by Mr H. G. H. Kearns, B.Sc., F.E.S.

There are many species of beetles that attack timber during and after growth. Briefly these beetle attacks can be divided into four groups according to the condition of the wood, viz.:—

(1) Those beetles (or more correctly their larvae) that attack the wood of trees just felled (up to three weeks), *e.g.*, the Shot Hole Beetles.

(2) Those beetles that attack unhealthy trees, or trees felled more than six weeks, *e.g.*, Bark Beetles.

(3) Beetles that attack certain parts of certain species of seasoning or recently seasoned hardwoods, *e.g.*, Lyctus or Powder Post Beetles.

(4) Beetles that show a marked preference for old wood, *e.g.*, Death Watch Beetle and Furniture Beetle.

The first two groups of beetle principally concern the forest entomologist, but as the results of their attacks occur frequently in imported timber, it is important that the damage they cause should be recognised so that their holes found in woodwork shall not be confused with those of Furniture or Lyctus beetles.

It is the larval stage of most wood beetles that cause all the damage. These grubs cut galleries in the wood and feed on the cell contents and cell walls, or in some cases on moulds that develop in the galleries. Each species of beetle makes a definite kind of tunnel in the wood and also produces a specific kind of faecal wood dust, and from a knowledge of these two characters an accurate diagnosis can be made.

The Death Watch Beetle, *Xestobium rufo-villosum*, of which so much is heard on account of its ravages on the timbers of churches and old buildings, has been given much prominence, but it appears that in some cases the damage due to these beetles has been considerably overestimated. Dry rot and this beetle develop in the same environment, namely, a damp stagnant atmosphere, and it is difficult to assess with any accuracy which pest has caused the greater amount of damage.

Everyone is familiar with the damage of the Furniture Beetle, *Anobium punctatum*; it is invariably associated with old wood of all species, and does not attack under normal circumstances any wood less than ten years old. Not only does it cause the rapid depreciation of furniture, but it attacks structural timbers, panelling, etc., and is one of the most serious pests that attack the woodwork of buildings.

The adult brown beetles, which can fly, are to be seen in June and July, sometimes they may be seen in rooms in which there is infested woodwork; the males tend to collect on the ceiling and walls near a window, whilst the females frequent the holes made in the wood. The presence of the beetles is easily detected by small piles of dust collecting on the floor, this wood dust is made by the adult beetles cutting a way out of the wood, producing the familiar round hole.

The female lays about 15-20 whitish eggs on the end grain, which is exposed on the edges of furniture, strained joints and in the exit-holes. All species of wood are attacked, but the beetle has a preference for Beech and Birch and some coniferous woods, but Oak and Mahogany are also badly attacked. When the eggs hatch the larvae bore their way into the wood making larger and larger galleries as their age increases; they are full grown in most cases in about ten months, and they then bore to beneath the surface of the wood, where they prepare a special chamber in which they go into a resting stage (the Pupa). This pupal stage lasts for a month, after which they change into an adult beetle and bore their way out through the thin piece of wood which separates them from the surface.

The control of these beetles is a difficult problem and not only is it necessary to consider the relationship of the insect to the wood, but a knowledge of the properties of the attacked woods and the manner they have been finished. Excellent results may be obtained by soaking the infested woodwork in certain insecticides such as ortho-dichlorbenzene, special acetate mixture. It has been shown conclusively by experiment that the females will not lay their eggs on smooth surfaces. Therefore if end grain, exit-holes and rough surfaces have all their crevices stopped, the beetles will not oviposit on that wood.

There are many methods of carrying out the above "filling" process, and the following simple and successful one can be easily carried out in any household. A home-made wax is made from beeswax, turpentine and cedar oil of the consistency of a thick cream. This mixture is applied to the woodwork, paying special attention to all the egg-laying sites, and the applications are best made in late May and again in June. A complete control cannot be expected in one season.

Another preventative measure is the application of repellents in the forms of liquids, such as dichloro-benzenes, paraffin oil and certain essential oils to the woodwork during the egg-laying periods, but in many cases the odour is objectionable.

The Lyctus Powder Post Beetles are perhaps one of the most serious menaces of the cheap furniture trade, especially as the beetle infests Oak, Walnut and Ash, which are now used so extensively. Its presence has been noticed more of late years owing to the fact that the percentage of the sapwood of Oak used in cheaper furniture is very high. Sapwood is the outer circle of lighter coloured wood seen in a section cut through an Oak tree, and heartwood is the central portion. Not only is there a colour difference but a structural, physical and chemical difference. The sapwood contains a large number of wood vessels which are like tubes, with their lumens empty, and they form the "grain" of the wood. In heartwood, however, these vessels are filled up with gums, etc.

The adult Lyctus beetles emerge from infested sapwood about April-June, making holes somewhat similar to those of the Furniture Beetle. The female lives for about six weeks, feeding on particles of wood and often cutting open wood vessels of the sap. She lays a number of large eggs at intervals, which are only laid inside the vessels and this explains why sapwood is attacked. It has been found that certain woods are free from Lyctus attack and the explanation is found in that these woods are species in which the vessels are smaller than the diameter of the eggs, hence the eggs cannot be laid in them.

The larvae do not migrate from the sapwood to the heartwood, but they are voracious feeders of sapwood and very quickly, if many be present, reduce the wood to a very fine powder. The life of the larvae is about the same length as that of the Furniture Beetle.

The control of these beetles is needed:—(a) In the timber yards. (b) In the furniture manufacturers' shops. (c) In finished furniture (*i.e.*, stained, lacquered, etc.), and woodwork, such as panelling in buildings.

Each of the above headings demands separate and different methods of control. But the two main features consist of killing the larvae in the wood and preventative measures. In this case, in contrast to that of the Furniture Beetle the killing of the larvae is fairly simple as certain insecticides have been found of great penetrating powers and are fatal to Lyctus life. They kill the larvae by disturbing the respiratory metabolism, and under laboratory conditions only a minute dose is required to produce fatal results, but as a general rule it is safest to aim at saturation of the sapwood.

Miss I. M. Roper exhibited from the Fox Library of local books a copy of "Gramina Pascua," 1790, a work on grasses, illustrated with dried specimens gathered in the parish of Pucklechurch, Gloucestershire, by the Rev. George Swayne, vicar.

THE 548TH GENERAL MEETING.

April 3rd, 1930.

"The Natural History of the Lower Amazon," by Mr Hugh B. Cott, M.A., F.Z.S.

Printed on p. 181.

THE SUMMER EXCURSION.

June 21st, 1930.

Bratton in Wiltshire was selected for the Summer excursion under the leadership of Mr H. F. Barke and Miss M. D. Hiley, the President and Secretary of the Field Section. Leaving Bristol the outward route was specially interesting as showing the inter-relationships of geology and scenery. Beginning with the Coal Measures of Bristol, the route taken traversed the New Red Sandstone at Brislington, the Lias at Keynsham, the Oolites of Hinton Charterhouse and the Greensand and Chalk near Bratton. Canon E. P. Knubley, vicar of Steeple Ashton, met the party at Bratton and with the aid of a large scale map explained the geological features of the area. Miss H. M. Hughes, a local resident had kindly placed on view a large number of plants of the chalk downs, and was able to show the botanists some of them growing, but the time at their disposal was too short to do justice to the rich flora.

After tea the party visited the "White Horse," the conspicuous land mark cut out in the chalk of the hillside. The homeward route was via Edington, Steeple Ashton, Bathford and Bath.

THE 549TH GENERAL MEETING.

October 2nd, 1930.

"The Way of the World," by Prof. H. L. Hawkins, D.Sc., F.G.S., University of Reading.

There are three well-defined stages in the study of any kind of problem. In the first, self-confident ignorance finds the prospect easy; in the second, chastened experience struggles through a welter of detail with bewilderment bordering on despair; in the third, insight born of patient effort finds a perspective in which the details are resolved into a scheme. These stages are represented in scientific matters by Speculation, Research and Theory. The Newtonian theory of Gravitation and the Darwinian theory of Organic Evolution are notable examples of the third stage of study, which correlates and simplifies where all seemed meaningless and involved.

The Science of Geology seems to be approaching this happy phase—not for the first time, and assuredly not for the last. Less than a century and a half ago, the Uniformitarian theory (so ably expounded in this country by Lyell) gave a rational basis for the study of Earth-History. The contention that the present is the key to the past remains unassailable in its essence; but it is not wholly effective, for the door that guards Nature's secrets has many locks.

The aspect of Earth-evolution most easily watched is one of ceaseless destruction of the land by the combination of processes known as "weathering." The effort of air and water to subdue and submerge the land is ultimately aroused and maintained by change of temperature: hence the sun, together with the earth's rotation, is the prime factor in most of the "change and decay" that is so evident.

But the weather is an expression of imperfect equilibrium, especially in its influence on the land. Dry land is a "mistake," for rocks are heavier than water, and should therefore remain wholly beneath it. Just as water can float temporarily in the air as clouds, so the material of continents projects up through the ocean beyond its proper sphere. The water falls as rain or snow, and ultimately finds its way back to the sea where it belongs; the continents crumble away, and their ruins are carried piecemeal to the sea-floor, which is their proper station. But new supplies of water-vapour are for ever rising to form fresh clouds; slowly and less continuously new land arises to replace the lost ground. For balance must be maintained; without compensation the earth would soon be in a plight like that of a ship whose deck-cargo has shifted to one side.

The reaction of the earth to its shifting land is in some ways comparable with the behaviour of a rubber ball insufficiently inflated. Every attempt to dispose of a dent makes a new one elsewhere; and conversely, the making of a new dent bulges out the old one. The compensating movements in an intractable substance like the rock of the earth's "crust" are apt to be irregular and spasmodic, and may give occasion for the production of the jerks that are earthquakes and the blisters that are volcanoes.

There seems to be a rhythm pulsing through the ups and downs of the earth's "crust." Perhaps it is a composite rhythm, like that of ripples on a wave. But the scale great or small, long periods of slow wasting and depression of the land are interrupted at apparently regular intervals by relatively short stages of recovery and upheaval. The major throbs of the rhythm may well be due, as Joly's brilliant hypothesis suggests, to the influence of radioactivity in the deeper layers of the "crust;" the minor "cycles" are probably caused by periodic efforts of the earth to redress the balance destroyed by the weather. Hence the "way of the world" is one of constant striving after a perfection that cannot be attained. We have reason to rejoice that the earth, like ourselves, finds its ideal for ever out of reach; for to struggle is to live, while perfection is death.

THE 550TH GENERAL MEETING.

November 6th, 1930.

Exhibits of Natural History by the Members.

The exhibits laid out by the Botanical Section included autumn flowers and fruits with appropriate quotations shown by Miss I. M. Roper; South African fruits by Mrs Sandwith and Miss Bowen; carefully prepared herbarium specimens of the genus Geranium by Mr Ivor W. Evans; photographs of West of England plants and of types of Riviera vegetation by Mr H. S. Thompson; botanical micro-slides by Messrs Shrimpton and Munsen. Entomology was represented by Dr E. Barton White's collection of Lepidoptera Heterocera from the Cambridge Fenland; "Clear Wings" (Sesiidae) by Mr C. Bartlett; and large sized drawings showing the life history and structural features of Psocids by Mr J. V. Pearman. Geological exhibits included a collection of specimens illustrating a fossil Crocodile, model of a small Dinosaur and a collection of geological photographs shown by Prof. S. H. Reynolds; examples of fossils figured by William Smith in 1816 by Mr J. W. Tutcher; Minerals from Yate and local specimens including the rare Selenite by Mr B. A. Baker; local ammonites from recent exposures and Silican minerals by Messrs Kellaway and Luxford.

In the Ornithological Section Dr A. L. Flemming exhibited water colour drawings of birds by F. Carey Coombs; Mr H. Tetley, Weaver Birds and their Nests from S. Africa and India; and Mr H. Vicars Webb, some tragedies amongst local birds.

The recent additions to the Society's Library were also on view.

Coffee was served during the evening.

THE 551ST GENERAL MEETING.

December 4th, 1930.

"Mushrooms and Toadstools of the Countryside," by Dr W. R. Ivimey Cook, B.Sc.

To the mind of the average person all fungi, with the exception of one or two which he terms mushrooms, are poisonous. Yet, while accepting this rule, he, at the same time, is frequently willing to experiment with other forms, using as his guide certain arbitrary tests such as the ability of the fungus to peel, or the behaviour when rubbed with a silver spoon. The results are sometimes fatal and a coroner's jury bring in a verdict of "accidental death." It is a definitely proven fact that none of these tests are of the slightest value in assessing the esculent value to a particular fungus, and that while many edible fungi are readily peeled several of the most poisonous ones also behave in this way. The fact that more deaths do not occur in this country is due rather to the relatively small number of poisonous species than to any attempt on the part of the general public to distinguish between them.

The characters by which the edible and poisonous species may be distinguished from one another is not by arbitrary tests but by a study of the structure of the morphology of the fruiting body itself. The most important features which distinguish the very poisonous species from all the rest are the presence of both an annulus or ring around the stem, and a cup-shaped volva lying at the base of the fructification. It is a safe general rule to conclude that any form showing both these characters is poisonous. Although this is not strictly true since one edible form does possess these characters yet the way to distinguish this species are difficult for one who is not well versed in the minor differences in species of the higher fungi. The Common Mushroom possesses a ring but no volva, a character which is shared with a number of other genera. It may be distinguished, however, by the colour of the spores. Many of these other genera are perfectly edible though not generally indulged in by most people.

A genus which, in the opinion of many, is especially prized is *Coprinus*. The species may be recognised by the long cap which covers a large part of the stalk. Two of the larger species which are very common are by some considered superior to the mushroom. In France the Chantarelle, *Cantharellus cibarius*, is greatly prized, though in this country few would willingly eat it. It may be distinguished by the yellow orange colour and by the gills which run down into the stalk. A number of genera have some of the species which are excellent for food but at the same time possess a few which are under suspicion, and the difficulty in distinguishing between them results in few becoming popular. It has been established that in nearly every case thorough boiling before the specimen is eaten frequently converts a poisonous species into one which may be eaten safely, since the poison is extracted into the water. This, however, is not true of *Amanita phalloides*, which is responsible for at least 98 per cent. of the deaths by poisoning which occur in this country. It is therefore essential that before trying any experiments in eating fungi a thorough knowledge of this species should be obtained. It is important, further, to remember that species merge into one another and that many characteristics may become masked in dry weather and in specimens which are abnormally developed.

Report of Delegate to the British Association.

At the Bristol meeting of the British Association two meetings of Corresponding Societies were held, at both of which I was present. The subjects mainly dealt with were:—The Provision of National Parks and Folk Museums and Co-operation between local Scientific Societies.

The President of the Conference, Professor P. Abercrombie, in his address, insisted that parks must be national in scale, and that beyond this should be considered scenery, flora and fauna and recreation. In the case of flora and fauna rare species should not be made easily accessible.

Sites were suggested, *e.g.*, a part of Northumberland along the Roman Wall, Cannock Chase, the Black Mountains, the Forest of Dean and Exmoor, and that building enterprises and working of minerals might be officially controlled.

The zoning of National Parks was also advocated so that the whole of the country might be provided for.

With regard to National Folk Museums, Sir H. Miers and Professor J. C. Myres advocated the establishment of one within easy reach of London. A suggestion that the Royal Botanic Gardens, Regents Park, which are to be closed in the near future, would make an admirable place for an open Folk Museum, was critically received. In the first place the site was too small to admit of much expansion. Fifteen acres were regarded as the minimum size for a start, as apart from the types of buildings used in this country prior to the close of the 18th century, to be erected on it, say in the form of a village, space would be needed for the performance of folk dances, folk songs and mummers'-plays, etc. The buildings to be transplanted would be chosen from among suitable ones in various parts of the country that are in danger of demolition.

Speaking for myself, I consider that a Folk Museum in London would naturally attract the cream of exhibits, and that more might be effected in the aggregate in different localities. For example, Cardiff has a fine collection which would pay for proper display. Bristol might easily follow suit, assisted, perhaps, by the Bristol Naturalists' Society, and so with other great cities. We cannot hope to rival the wonderful Folk Museums in Sweden and the United States.

I was much struck with what had been done in the comparatively small city of Norwich. One of the delegates gave a lantern lecture on the " Strangers Hall " there which showed how wonderfully interesting a Folk Museum can be if arranged on proper lines. This is the first of that character to be established in this country.

A valuable hint was thrown out by one of the speakers that local Societies should get busy, and, using what repositories they could, secure material in advance. Apart from the local side of the question

Societies could do much to strengthen the desire for such a national monument.

The Conference finally passed a resolution approving the establishment of a National Folk Museum.

As regards the discussion on Co-operation between local Scientific Societies it appears that endeavours are being made to cover the country with Unions. In the Northern Union the young people are taken in hand at Field Meetings and coached up in names of plants, etc., the opinion being that this formed a good ground for recruiting new members.

JAMES RAFTER.

September 1930.

PRESIDENTIAL ADDRESS, 1930.

The Migration of Birds.

By A. L. Flemming, M.B., Ch.B. (Bris.).

MY reason for choosing an avian topic as my subject to-night is that the interest taken in birds seems to be wonderfully widespread, owing, I suppose, to the numerous and manifold services which they render to mankind, whether willingly or unwillingly.

To our artistic senses they must often appeal as creatures of elegant form, graceful movement, and beautiful colouring, and at times as songsters of inimitable talent, not surpassed even by many of their human rivals; their feathers provide us with the most comfortable form of head rest yet devised, and their plumes are borrowed to adorn the headdress alike of savage men and civilised women.

Economically, by destroying pests and vermin, they do us a service without which agriculture, in this country, would be well nigh impossible, and we must all appreciate the generous way in which they yield us food in the form of eggs, chicken and game.

Moreover, considerable food for thought may be derived from a study of some of their habits or customs, of which migration is perhaps by no means the least fascinating.

During the past 50 years the problems of migration have attracted the attention of many energetic and competent observers with the result that an enormous mass of reliable records has been collected from all parts of the world, and a number of these have been analysed by Eagle Clarke, in 1912, and by Landsborough Thomson in 1926, from both of whose books I am taking the liberty of quoting freely, the latter book has the advantage of being written after the introduction of systematic ringing had made it possible to record with precision the flights of individual birds. Migration was recognised in early days and was referred to in the Bible, in Job and in Jeremiah; but from that time until the last century very little progress was made in the study of the subject, a fact which is not altogether surprising in view of the many difficulties involved in observing a phenomenon so largely nocturnal. Nevertheless one cannot but wonder at the fantastic nature of some of the wild theories which from time to time have been propounded in explanation of the regular disappearance and re-appearance of birds at certain seasons of the year. In fact it seems incredible that men of intelligence could have seriously considered such extravagant notions. Aristotle, and later Pliny, thought that certain birds, such as the Swallow, the Kite, the Ousel and the Lark were able to hibernate; and both of these writers held the view that by a process of transmutation an interchange took place between birds of different species, as in the case of Robins, which were alleged in this way to become Redstarts during the autumn. In the sixteenth century many educated men believed that Swallows spent the winter submerged at the bottom of lakes or marshes, Olaus Magnus, Archbishop of Upsala, describing in detail how fishermen often brought them up in their nets, generally in pairs placed mouth to mouth, wing to wing, and foot to foot, rolled up in mud, a tale which even Linnaeus appears to have accepted. In the eighteenth century George Edwards derided the possibility of the submersion theory, but John Hunter, 1728-1793, the anatomist, thought it worth while to submit the point to experiment, for which purpose he kept Swallows in his greenhouse furnished with tubs of water, but the birds did not accept the invitation. In the same century we have " A person of learning and piety declaring that birds fly to the moon in order to spend the cold season, 60 days being allowed for the trip, by which time, owing to the moon's movement round the earth it is in the same line of direction for the return flight."

In this subject, as in others, old cherished views are constantly falling into disrepute in the light of modern methods of observation; and speculation is ever giving place to knowledge; as a result we are learning much as to the routes and destinations of migration, but some of the questions involved, such as the causes which lead to the regularity and punctuality of the flights, are but imperfectly understood, while others, such as the powers of pathfinding, seem likely to remain incomprehensible.

The movement, to warmer winter quarters, of birds who spend the summer and breed in temperate or cold regions is one that appeals to most of us as reasonable and, in fact, forms a familiar picture in our minds, but a closer inspection of the background of this picture reveals some mysterious details. It is obvious that if insectivorous birds, for instance, attempted to winter in the colder of their two habitats they would perish from want of food or from lack of daylight in which to search for it; or, on the other hand, if they remained during the breeding season in the warmer of their two habitats they would run a serious risk of losing their offspring through exposure to heat.

The mystery, of course, lies in the fact that these creatures should know when to embark upon their long journeys, and which direction to take. It is remarkable that they often seem to anticipate rather than to await unfavourable events, as in the case, for instance, of the Swifts who frequently emigrate just at the time when their food supply is most abundant, as if they knew that a shortage was soon due. As to the direction of these migratory movements it is determined by some agency capable, apparently, of acting, when necessary, without the advantage of previous experience as in the case of the young Cuckoo born in England, who is left by his rascally parents to fend for himself and find his own way to his winter retreat in Africa. Even if we are content to accept the need of food and light, on the one hand, and the need of different climatic conditions on the other hand, as sufficient explanation of the urge to migrate we can hardly pretend to understand how the migratory custom has been arrived at, and become hereditary.

If we are inclined to discredit the statement that young birds can conduct these flights without the guidance of their parents, we may turn for a parallel to the amazing story of the Common Eel, as revealed by the Danish naturalist, Schmidt, showing that this creature, after its birth in the deep waters of the S.W. region of the North Atlantic, although invariably born an orphan, owing to the mother eel making a practice of devouring her mate or mates before spawning, and of dying herself after spawning, is able to undertake a three years' journey to the mouths of European rivers up which it proceeds in countless myriads, forming a procession known as the running of the Elvers, a phenomenon well worth a trip from Bristol to the Usk during the week of its occurrence every spring. That the movements of migrants is controlled by some inborn tendency rather than as the result of a stimulus produced by immediate surrounding conditions, is suggested by the migratory performances of certain arctic birds which actually cross the equator, thus passing through the north temperate zone, in order to winter in the southern temperate zone, the advantage reaped by this being a perpetual summer as regards daylight.

The motive served by most migratory movements appears obvious but that we must be cautious in judging the methods of animals by human standards is suggested by the apparently stupid and suicidal customs of certain insects, as, for example, of the Painted Lady Butterfly, which comes over from France, at times, in great numbers, breeding here if the weather proves favourable, with the result that both generations must perish as they are unable to survive our winter, and they do not make any return journey to the Continent.

The whole subject is beset with so many difficulties and has given birth to such a variety of theories that we shall probably be wise to confine our attentions to the practical aspects of our topic. In the first place it is obvious that methods of observation fall into two categories, the individual and the collective, the former must, of necessity, be left in the hands of the few, who must be equipped with an intimate knowledge of birds and an unlimited store of patience. Such observers have fortunately been found in Hudson, Eagle Clarke, Gatke, Thomson, and Witherby, and others, whose work has provided us with a store of remarkably exact information. The favourite points from which to make observations have been such islands as Heligoland, Fair Isle, midway between the Orkney and Shetland groups, the Isle of May, at the mouth of the Forth, and the Eddystone, and the Kentish Knock Lights. Islands such as these are especially useful because, owing to their small size they do not afford hiding ground for a number of birds so that when a flock appears and disappears it is certain that it has come and gone oversea.

And our powerful shorelights act as search lights by which the movements of some of these nocturnal travellers may be watched. The light-keepers furnish a good deal of information and collect the bodies of birds killed by impinging against the lanterns. Some of our leading authorities have lived, for weeks on end, at light-stations in order to make observations; and both Gätke and Eagle Clarke describe, in vivid terms, " the babel of hundreds of thousands of voices " and the " hosts of glittering objects . . . crossing at all angles the brilliant revolving beams of light." Eye witnesses of migratory movements are generally impressed by the large numbers of individuals involved. Levick, in "Antarctic Penguins" (1914), describes the spectacle of Adélie Penguins arriving at S. Victoria Land in the following manner, the line of birds reaching as far as one could see across the ice, "First would pass a string of them walking, then a dozen or so tobogganing. Suddenly those that walked would flop on their breasts and start tobogganing, and conversely strings of tobogganers would as suddenly pop up on their feet and start walking. When within half a mile or so of the beach they would become excited and break into a run." Within a month the colony must have numbered about 750,000.

By collective methods of observation, where the data are collected by a number of widely separated observers and analysed by a central authority, much useful information is obtainable, especially as to the routes followed. Thus Schenk, in Hungary was able to show that the Woodcock arrived in Hungary, first in the S.W. and last in the N.E. and to deduce that the direction of immigration was N.E. from the Adriatic region. And in the British Isles it is found that Swallows are two weeks later to arrive in Scotland than in the south of England. By a collective process of this sort a committee of the British Association in 1880 got together the valuable data which was subsequently to form the foundation of Eagle Clarke's well-known book published in 1912. At the present time H. F. Witherby, through the medium of "British Birds," has ensured the best use being made of individual records.

The total distances covered by different species vary enormously. With some it is only necessary to remove from their breeding station among the hills to low-lying valleys, and with others the journey covers thousands of miles, extreme examples being found in the migration of Curlew, Sandpipers, and Arctic Tern, a distance of 11,000 miles being covered in all probability by certain individuals, and the system of marking birds has given us definite evidence of several kinds of birds performing journeys of 6000 miles.

The distances covered in a single flight are not so great as one might suppose. Some of the North Sea routes entail a flight of 400, and other ones of 220 miles. Trans-Mediterranean routes do not exceed 450 miles; but to and from New Zealand entails from 600 to 900 miles. How long the travellers rest between flights is not always certain, but at observation posts such as Heligoland it is found that flocks which alight at nightfall remain 24 hours and resume their journey the following night. In the case of land migration the halts seem to be more deliberate and restful, for it is a common experience to see birds, strange to the district, appear annually at some spot, and after a sojourn of a week or so depart again until the following year. In some instances the migrants will proceed on foot searching the ground for food as they go. Hudson has described the behaviour of a large flock of Military Starlings which he watched travelling in this manner in the Argentine, and he noticed that "the birds farthest in the rear would continually fly on to drop down in advance of those at the front, so that every two or three minutes a new front line would be formed, and in this way the entire body would be progressing."

The manner in which these long flights are conducted has been the subject of a deal of controversy, but modern methods of investigation have shown that some of the accepted views as to height and speed were extravagant. It was maintained by Gätke that the usual altitude at which birds on migration flew was 20,000 feet, and that 40,000 was not impossible. In order to test these figures Lucanus experimented with stuffed birds suspended from a balloon and found that a Sparrow Hawk was lost to view at 2800 feet, and a Rook at 3300 feet. The experience of aviators points to an almost total absence of birds above an altitude of 3000 feet, but airmen have reported Cranes as high as 15,000 feet and Lapwings at 8500 feet. The consensus of opinion, however, among experienced observers as Eagle Clarke, Patten, and Thienemann is that in most instances a few hundred feet is the maximum altitude at which these journeys are conducted.

Again, as regards velocity, members of the Air Force have shown that former estimates tend to be too high. The Golden Plover was alleged to attain and keep up for several hours, a speed of 250 m.p.h. Crows were accredited with a speed of 125 m.p.h., Pigeons with 100 m.p.h., and Swallows with 106 m.p.h. Careful measurements by Thienemann suggest that most birds fly at a velocity between 30 and 50 m.p.h. Similar conclusions were arrived at by Meinertzhagen who, during the War, made the men in charge of anti-aircraft instruments use these, as practice, for estimating the rate at which passing birds were flying. Similar estimates of speed were arrived at by airmen flying alongside birds on the wing.

The geographical situation and climate of the British Isles make them an interesting migration area, having many species which come for the summer, a large number which come from colder climes to spend the winter here, besides a number which come in their passage between winter and summer quarters. In addition to the true migrants such as the Cuckoo, Nightingale, Swallow, Swift, etc., in the summer, and the Fieldfare, Redwing, Brambling, Jack Snipe, Knot, and so forth in the winter, that is, birds which are totally absent except during a particular season of the year, we have many species of which some individuals are stationary and others migratory. The Lapwing, for instance, comes into all categories, some being stationary, some winter, and some summer visitors, and others seeming to be merely birds of passage here.

All attempts to make an accurate study of these complicated movements must have remained well nigh fruitless had it not been for the introduction of a practical means of marking individual birds and of collecting records. The system of ringing, now practised in many parts of the world, was, in 1909, started methodically in the British Isles by Thomson in Aberdeen and Witherby in London.

The utility of the system has recently been enhanced by trapping and ringing adult birds so that winter visitors and birds of passage, as well as nestlings, can be examined or marked.

It is claimed that trapping is in no way injurious to the birds and that some species even form " the trap habit " and show no alarm on being trapped and handled, in fact Baldwin is alleged to have stated that a trapping station becomes a bird sanctuary owing to the food and protection it provides.

In order to encourage those of my audience who carry rings and habitually mark a dozen or two of nestlings in the course of a season and feel disappointment if none of these are reported as recovered it may be well to refer to some of the published results. Under the " British Birds " scheme out of 10,744 Swallows marked up to 1924, 73 or .7% had been recovered by the end of 1925. In the case of Starlings, the combined efforts of the Aberdeen and British Birds investigations resulted in 11,426 Starlings being marked, and of these 537 or 4.7% were recovered, and a remarkable fact is brought to light. Of all the young or adult Starlings marked in Great Britain during the summer none have been recovered outside of Great Britain, with the exception of one bird, only, which was recovered in the Calais district. As there is no emigration of our native Starlings, and as enormous numbers come from abroad to spend the winter in England it is not to be wondered at that our winter Starling population is very large. Some conception of their numbers may be obtained by a visit to a roost to see them congregating for the night. The sight is impressive and well worth the trouble of the short journey it involves for Bristolians.

Research Items.

BRISTOL BOTANY IN 1930.

EVERY autumn this chronicler turns with confidence to his younger associates in field-botany for results of their observations during the past season. Notes worthy of record seldom fail to be reported, referring either to species or varieties previously unknown in the district or to additional localities for the rarer plants.

In the earlier weeks of the year we were more concerned with losses than with gains, for the devastating hurricane that swept the country destroyed innumerable trees around Bristol, blocking every road and lane with their fallen trunks. As many as 1500 were blown down on the single estate of Longleat. A large percentage of these were Elms. Oak and Beech held the ground more sturdily, and catkin-bearing trees generally escaped, though the fine row of Grey Poplars at Charlton was so battered and bent that one or two fell to the next gale.

There has been a bountiful crop of hazel nuts. Respecting these a woodland student has pointed out and illustrated with specimens the fact that at least eight differing forms can be recognised, always persistent on the same bushes. They range from almost globular nuts through ovoid and obovoid shapes down to some that are purely cylindrical. These variations are accompanied by differences in the cupule. It may be that the bushes can furnish other perceptible characters of foliage, etc., and, if so, here is the chance for some critical enthusiast to split up our *Corylus* into quite a group of named sub-species or varieties.

Ranunculus triphyllus Hiern. Pond on the Moat Farm near Ubley, S.; *H. J. Gibbons.*

Fumaria Bastardii Bor. Field between Axbridge and Cheddar; *C. and N. Sandwith.* New to North Somerset.

Agrimonia Eupatoria L., with white flowers. Mr Nelmes states that plants raised from seeds of those discovered near Oldbury-on-Severn have bred true and reproduced the variation. In Central Europe this form has been known as var. *leucantha* Kuntze since 1842.

Peplis Portula L. Luxuriant on marshy ground by a stream at the lower end of Lord's Wood, Houndstreet, S.; *H. J. Gibbons.* The Water Purslane is on record from very few localities in North Somerset.

Oenanthe pimpinelloides L. About fifty plants on a roadside common near Stone, G.; *W. and E. Nelmes.* New to our West Gloucester division.

Gnaphalium sylvaticum L. A single plant in woodland on the Tickenham side of Cadbury Camp, S.; *H. J. Gibbons.* Another instance of the plant's inexplicable solitary occurrence in this district.

Xanthium Strumarium L. A large colony in the Docks area at Avonmouth, G.; *W. D. Miller.*

Carex extensa Good. This sedge, which had been destroyed by golf extensions at Berrow some years ago, has reappeared on the Gore Sands salt-marsh whence several clumps have been reported by two observers.

Spartina Townsendi H. & J. Groves has established itself here and there at spots distant from those where it was originally planted some years ago on the mud-flats of the North Somerset coast, and has at length reached the Severn bank above Avonmouth, G. Two strong clumps are reported by Mrs Sandwith.

Bromus britannicus Williams. This new species was described and figured in the Journal of Botany, 1929, p. 65. Specimens were found in many herbaria labelled as forms of *B. hordeaceus* or *B. brachystachys*, and in the Nat. Hist. Museum, South Kensington, were some gathered in 1915 on Tickenham Hill, S., by Miss I. M. Roper.

Bromus interruptus Dr. A large patch on made ground by Avonmouth Docks in May, *Mrs Sandwith*. More rubbish was tipped on the spot shortly afterwards and the grass was buried. A first record for West Gloucester.

J. W. White.

GEOLOGY, 1930.

With such a varied area to operate in, the Geological Section has always held the production of original research as one of its cherished ambitions. Many of its members are engaged upon problems of a local nature, and the following notes show how the traditions of the past are being worthily maintained.

The President, Prof. S. H. Reynolds, M.A., Sc.D., in collaboration with Mr C. L. Gardner, has just completed a piece of work on the Loch Doon Granite, and has now, with Dr T. F. Sibly, commenced work on the Carboniferous Limestone of the Mitcheldean area. During the year the Palaeontographical Society has published his monograph on the Giant Deer (Irish Elk) and a similar treatise on the Red Deer, Reindeer, and Roe is in course of preparation.

The Vice-President, Mr J. W. Tutcher, M.Sc., has now decided to record his unique knowledge of the Liassic deposits on the main hill mass of Dundry, and his paper will be presented to the Section early in the year.

A new recruit, Mr G. H. Kellaway, is working on the recent and transient exposures of Rhaetic and Lower Lias beds in the Henleaze, Filton, and Southmead areas, whilst Mrs E. M. Vaughan has made numerous contributions to our knowledge of the same formations in the Redland and Cotham districts.

A paper on the Carboniferous inliers at Codrington and Wick (Q.J.G.S., vol. lxxxvi. (1930), pp. 331-54, and Pl. XXX.) has recently been published by Dr Stanley Smith. The same author is continuing his researches on corals, and during the year has published several papers which record the intensive study of selected genera or groups.

Dr F. B. A. Welch has published his work on the Central Mendips (Q.J.G.S., vol. lxxxv. (1929), pp. 45-76, and Pls. VII.-VIII.), and has nearly completed a similar piece of field work on the Eastern Mendips.

Mr T. Fry, in collaboration with the late Mr J. A. Davies, has compiled an important paper on the constitution of some of the gravel terraces of the Bristol Avon (Proc. Univ. of Bristol Spel. Soc., vol. III., No. 3, pp. 162-172).

Major A. Gorham's exceptionally careful and detailed study of the Midford sands at Limpley Stoke were published in the Geological Magazine for 1930, vol. LXVII., pp. 289-297, and Mr D. S. Cleak's paper on the Lithology of the Inferior Oolite of Dundry in the same volume, (pp. 517-21).

Dr F. S. Wallis with Mr E. D. Evens has published a paper on the well-known Hestercombe " syenite " (now shown to be a diorite) in the Geological Magazine, vol. LXVII. (1930), pp. 193-199, and Pl. XI. Dr Wallis is now engaged upon a study involving the description of the various species of the genus *Cardinia*.

Finally, several members contributed articles to the handbook on the Geology of the Bristol District which was issued in connection with the Bristol meeting (1930) of the British Association.

F. S. Wallis.

[*Photo., H. B. Cott.*

TROPICAL RAIN FOREST, NEAR PARA.

Plate I.

[*Photo., H. B. Cott.*

A.—OXYBELIS ACUMINATUS.

[*Photo., H. B. Cott.*

Plate II. B.—BUFO MARINUS.

The Natural History of the Lower Amazon.

By Hugh B. Cott, M.A., F.R.P.S., F.R.G.S., F.Z.S.
(University of Bristol).

In all the world, the Amazon valley is unique as regards the vast and unbroken extent of its mighty rain forests. The wonderful luxuriance of their vegetation, and the abundance, variety and gorgeous beauty of their peculiarly interesting animal population combine to make the region a biologist's paradise, and one, moreover, where much still remains unexplored by the geographer and unseen by the naturalist.

The following notes are based upon observations made during a short trip to the Lower Amazon during the months of September 1925-February 1926. My object in making this expedition was to study the habits of certain examples of the remarkably interesting fauna of the region, and to obtain a series of photographs, from life, showing these forms in their natural environment. A collection was also made of zoological material, both living and preserved, specimens of which were ultimately deposited in Regent's Park and the British Museum (Natural History).

Apart from a brief voyage to Manaos, two localities were visited in particular, namely, the rain-forest in the neighbourhood of Belem (Pará), and the open plains or *campo* in the north east of Marajó.

It is with great pleasure that I take this opportunity to express sincere thanks to my friend, the Rev. A. Miles Moss, English Chaplain at Pará, for his generous hospitality and assistance, and for innumerable kindnesses which he showed me throughout my visit. I have also to thank a Brazilian gentleman, Snr. Demetrio Bezerra for his hospitality and kindness during five most enjoyable weeks at his *fazenda* on Marajó Island. Finally, I am indebted to the Colston Research Society for financial assistance in connection with the publication of the present paper.

TROPICAL RAIN FOREST.

In the neighbourhood of Pará, the climate is widely different from that obtaining throughout the lower Amazon region as a whole, the typical wet and dry seasons being modified, so that frequent spells of fine weather and sunshine break the monotony of the rainy season, while during the dry period a week seldom passes without a heavy thunder-shower. These showers are, in fact, almost of daily occurrence, and serve to freshen the atmosphere and render the climate very agreeable. The forests are therefore continually saturated with moisture, and the humidity and high temperature which prevails throughout the year, together with a fertile soil rich in humus, are conditions ideal for rapid and luxuriant plant growth. (vide Pl. I.)

Silence reigns here, and a dense roof of foliage darkens the forest with a perpetual gloom, which few rays of sunlight can penetrate. The oppressive atmosphere, the sombre stillness, the indescribable grandeur and solemnity of the scene, all impress the traveller with a sense of wonder and admiration, not unmixed with awe. This is nature's tropical masterpiece—the primeval forest.

The immense diversity of growth and variety of species are utterly bewildering. Gigantic tree trunks, supported at the base by wooden buttresses (vide Pl. III.), tower pillar-like a hundred feet or more in the air before giving off their lowest branch, almost hidden beneath a burden of parasitic and epiphitic plants; vines circle in long spirals round the branches; ferns, bromelias, and broad-leaved arums find a footing in every fork and crevice; lianas trail over the foliage, arching in festoons from tree to tree or hanging down like ropes in some great gymnasium. Below an impenetrable tangle of vegetation struggles upwards towards the light from a thick carpet of fallen leaves.

The immense size attained by some of these forest giants is well shown in the accompanying photograph of the bole of a "Sumauma" (*Ceiba pentandra* Bomb.). (Pl. III.) Even the palms have climbing representatives, such as the "Jassitara" (*Desmoncus*), a remarkable growth whose long fronds terminate in a series of great recurved hooks, enabling it to scramble over the adjacent vegetation.

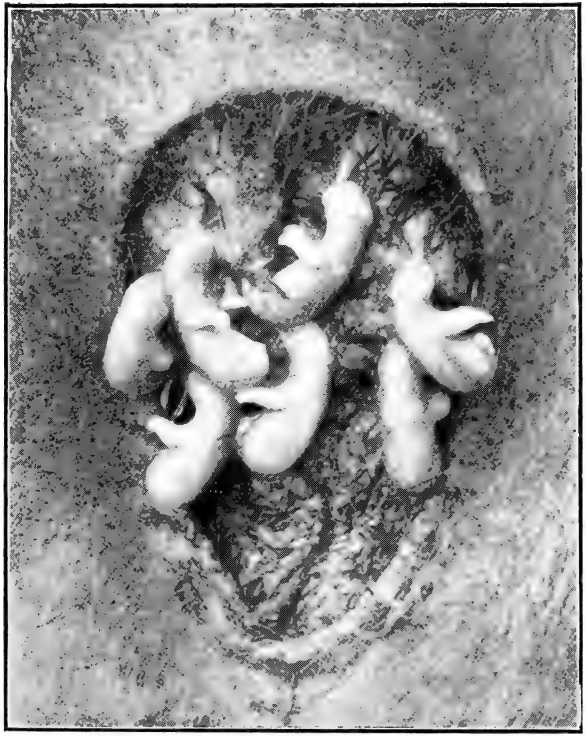
In this environment animal life is typically arboreal. There are no large ground-living forms, and there is a marked tendency for animals belonging to widely different groups to become climbers. The majority of forms are therefore adapted in one way or another for a life in the branches, and this applies not only to the Mammals, but to Birds whose representatives in the Old World are ground dwellers, to Reptiles, to Batrachians and to Insects. All the Brazilian Monkeys are climbers; Tree Porcupine, Coati, Kinkajou, Opossum, Tamandua, Sloth, as well as many Birds, Snakes, Lizards, Frogs, and Beetles are specially adapted to an arboreal existence, having grasping hands and feet, prehensile tails or other features rendering them efficient as climbers.

Among the lizards may be mentioned *Polychrus marmoratus* L., an arboreal form with opposable digits on the hands, and with a very long prehensile tail, which in some specimens exceeds two and three-quarter times the combined length of head and body. This organ, in addition to its prehensile function, is used as a balancer while the creature clambers among leaves and branches in search of insects. The animal is green in colour, and harmonises with its surroundings to a wonderful degree, the tail itself being not unlike a slender twig, and the body, with its diagonal stripes, resembling the under side of a leaf.

Anolis ortonii Cope, a sombre-coloured tree lizard, is thoroughly arboreal and an expert climber. In this species the gular sac, which can be widely distended by means of the hyoid bones, is brilliant orange in colour. When folded (rather like an umbrella) beneath the chin, it is almost invisible; but on being alarmed or approached, the creature throws open the sac, and it is probable that the sudden flash of colour may have a protective value by scaring away enemies.

The study of colour and form in animals, considered as a means of protection by concealment or advertisement, or as a means of obtaining food, forms one of the most fascinating chapters in biology. And

Plate III, GIANT BUTTRESS TREE (CEIBA PENTANDRA). [Photo., H. B. Cott.



[Photo., H. B. Cott.

A.—DIDELPHYS MARSUPIALIS.
Newly born young in pouch.

[Photo., H. B. Cott.

B.—PREPARATION OF RUBBER.

Plate IV.

it is in the tropics especially, where there is such a wealth of life and where competition is correspondingly acute, that these methods of defence and offence evolved by insects and other groups present problems of peculiar interest. Moreover, although the most perfect examples of protective and aggressive resemblance, warning colours and mimicry are to be found among certain orders of insects, notably Orthoptera, Hemiptera, Coloeptera, Lepidoptera and Hymenoptera, yet these phenomena are of wide occurrence throughout the animal kingdom, both among Vertebrates as well as Invertebrates.

One of the most perfect examples of protective resemblance which I came across on the Amazon is the small toad *Bufo typhonius* L. Very depressed in form, with a pointed snout and a sharply-edged lateral fold running from the eye to the hind limb, this little creature lives among the leaves on the forest floor, and is itself so like a leaf that it can only be detected when it moves. The flattened back, greenish in colour, has a faint dorsal line suggesting the mid-rib of a leaf; the legs are held in such a manner as to be inconspicuous; and the picture is completed by two small black spots in the sacral region, which look like holes in the leaf! Moreover, like the young of birds such as the Ringed Plover and Stone Curlew, who depend for safety upon their general resemblance to their surroundings, the toad has the instinct to crouch motionless in the face of danger, and to this habit it must frequently owe its life.

Many snakes are almost equally difficult to distinguish from the tangle of vegetable growth in which they live; although here, if we allow that form and colouring have any biological significance, their function is aggressive rather than (or as well as) protective. *Oxybelis acuminatus* Wied. is a case in point. This snake is extremely attenuated in form. (One of my specimens measured 1190 mm. in length, while the *maximum* diameter was less than 8 mm.) With its slender whip-like body coiled among the branches, it becomes almost indistinguishable from the twisted lianas and other climbing plants that trail everywhere in endless confusion (vide Pl. II., A.).

Toads and Tree-frogs are abundant in great variety, and their mournful croaks, plaintive piping and bell-like calls form a characteristic and prominent part in the nocturnal concert programme. Especially is this the case during the rains, when *Bufo marinus* L. (vide Pl. II., B.), the giant toad of the Amazons, utters his loud barking notes—audible for a distance of half a mile or more.

Among the tree frogs, Hylidae are characteristic, and numerous both in species and individuals. *Hyla venulosa* Laur. is not only an expert climber—taking incredible leaps, and landing with sure foot-hold, to cling to any convenient surface by means of its terminal discs on hands and feet—but may well be called a "flying-frog," for it is able to indulge in parachuting flights among the branches. This it accomplishes by spreading out its limbs and extending its digits so as to expose as great a surface to the air as possible in its descent. Experiments were made to show that this frog can glide from a vertical height of 140 ft. without sustaining the slightest injury on alighting. By enabling it to escape from enemies (such as tree-snakes) this ability to take aerial leaps must be an invaluable achievement.

One sees little of the bird life, largely, no doubt, because most species are hidden from view high up in the forest roof. Colonies of golden and black Cassiques (*Cassicus persicus*), which hang their bottle-shaped nests in the crown of large trees such as the Brazil Nut (*Bertholletia excelsa*) and Silk Cotton (*Bombax*), are a glorious sight, never to be forgotten, as are the Macaws, Tanagers, Humming Birds, and many other species.

Insects are abundant in great variety, and attract attention by reason of their number, strange appearance, and beautiful colouring. Huge Grasshoppers, with brightly coloured wings of red, yellow, purple or blue, and in some cases measuring nearly seven inches across, rustle clumsily past like miniature airplanes, vanishing from view as soon as they alight; gorgeous Morpho Butterflies cross the forest paths in their swift powerful flight; the Heliconids are conspicuous, gliding in leisurely fashion, as if fully aware of their nauseous qualities. Armies of Saüba ants (*Oecodoma*) are seen everywhere, busy with their destructive work of defoliation, while Cicadas disturb the silence with their shrill music.

THE CAMPO, MARAJÓ ISLAND.

Marajó Island has not received the attention from naturalists which it deserves. Situated in the mouth of the Amazon, or more accurately, between the Amazon River proper and the Pará River, it is larger in area than Wales. Entirely low-lying, with no land above the 20 ft. mark, it is intersected by numerous creeks and tidal channels, known as "igarapés," and by swamps and lakes, all of which vary more or less in extent according to the time of year. The island is divided almost equally into two ecological regions. That in the south-west consists of dense and impenetrable swampy forest; the north-eastern part, *i.e.*, that towards the Atlantic, is open "campo," on which large herds of cattle are reared.

Marajó enjoys a climate strikingly different from that in the neighbourhood of Pará, the marked wet and dry seasons producing alternate periods of flood and drought. During the wet season (January-June) rain is almost continuous, and the whole region is converted into a swamp, with large areas standing under several feet of water for weeks on end. In the dry season (July-December) little rain falls, and towards the end of the year, especially if the rains are late, desert conditions prevail, and many cattle fall victims to the drought.

With the exception of strips of dense vegetation which border the *igarapés*, and of a few isolated spinneys or "Ilhas de mato" (islands of forest) as they are very appropriately called, trees are scarce, and one has an uninterrupted view in every direction of the great level plains, broken perhaps here and there by a cluster of graceful "Tucuma" palms (*Astrocaryum tucuma* Mart.) (vide Pl. V.).

A comparison of the fauna of this region with that of the Pará forests is interesting and instructive. While the forest fauna is chiefly remarkable, perhaps, on account of the extraordinary wealth and variety of *species*, animal life on the campo is characterised by the

[*Photo.*, *H. B. Cott.*

Plate V.

TYPICAL VIEW OF CAMPO, N.E. MARAJO

[*Photo., H. B. Cott.*

A.—CAIMAN NIGER, MARAJO ISLAND.

[*Photo., H. B. Cott.*

B.—CAPIBARAS (HYDROCHOERUS CAPIBARA).

Plate VI.

immense number of *individuals* of certain forms; and it is clear that the respective faunae are as widely different in many respects as are the climatic conditions and vegetation.

In the first place, Marajó is the headquarters and breeding ground of two species of Alligator, *Caiman niger* Spix. and *C. sclerops* Schneid. The former (Pl. VI., A.) is the largest of the New World Crocodilians, specimens attaining a length of twelve feet being common, while monsters of twenty feet are not unknown. *C. sclerops* is smaller, measuring only six or seven feet.

Having no natural enemies (except, perhaps, the Jaguar), and furnished as it is with a constant and plentiful supply of food, in the form of water-fowl and fish, with which the lakes are well stocked, their abundance is easily accounted for. Many of the swamps contain an almost incredible number of the brutes, lying submerged, with only the snout and prominent eyes showing above the surface. The immense number of "jacarés" can best be appreciated at the end of the dry season, when the pools and *igarapés* are much contracted in size, so that by the end of the year the reptiles are concentrated into very restricted areas. Many of the lakes which they inhabit dry up altogether, and the creatures then bury themselves in the mud, aestivating until released by the first rains of January. Both species are a source of danger and loss to the ranch owners, in that they attack cattle, and especially the calves, when the latter came down to drink. (The cattle frequently get bogged in the soft mud and aquatic plants surrounding the lakes, and their fate is then a horrible one, for they are devoured alive by the alligators.)

At this time of year, therefore, when they are more readily approachable, great alligator-slaughters are organised, the cowboys driving the creatures together at one end of the lake, where they are dispatched with axes and long hunting knives. It may well be imagined that this sport is as exciting as it is dangerous. On some fazendas it is not unusual for many hundreds to be killed in this way in an afternoon. Yet in spite of such persecution the *jacaré* is holding his own.

The breeding season of *C. niger* reaches its height during the latter part of the dry season, and the large untidy nests, containing from thirty to fifty eggs, may be found from September to January.

Besides the alligator, the reptile fauna includes many other striking forms. Iguanas (*Iguana tuberculata* Laur.) are common in suitable localities, particularly favouring the Mangrove trees (*Rhizophora*), where they lie along the branches and are difficult to distinguish among the foliage. These great lizards are hunted by the Coati (*Nasua*) and also, incidentally, by man, the flesh being used for human consumption (as also is the tail of *C. sclerops*), and commonly offered for sale in the market at Pará.

Another fine lizard is the Tegu (*Tupinambis nigropunctatus* Spix.), a form somewhat resembling the Monitors of the Old World. Known locally as "Jacruarú," it is fairly common, and is frequently hunted with dogs by the natives.

Anacondas (*Eunectes murinus*) are plentiful in the rivers, though seldom seen; they attain a huge size, specimens of thirty feet or more having been recorded. The handsomely marked Water Snake (*Cyclagras gigas* Dum. & Bib.) is a striking form. In spite of its reputation of being very aquatic in habits, I have taken this species at least three miles from the nearest water. Both on land and in water it is very swift, and it is a remarkable sight indeed to see one of these creatures travelling across country, with the fore-part of the powerful body raised well from the ground, and moving at about 7 m.p.h.

Of the fish, perhaps the most noteworthy is the "Pirarucú" (*Arapaima gigas*), the largest fresh-water fish in the world. This is obtained in great quantities, and is an important article of diet to the Paraense, the flesh being salted and stacked to dry in the sun, until ready for shipment to Pará. *Lepidosiren*, the South American Lung Fish, also occurs on the island, where it lives under conditions which doubtless place at a premium the mud dwelling habit and the high development of the lung as a breathing organ.

In dealing with the Avifauna of Marajó, the chief difficulty lies in deciding what species to include in a brief survey of the bird life which, in its abundance and variety, undoubtedly forms one of the most distinctive and impressive features of the campo region.

Flocks of beautiful snowy-plumed Egrets (*Ardea egretta*) which formerly were subject to much senseless and merciless slaughter to satisfy the demands of millinery, may be seen standing beside the swamps, together with Herons (*Ardea cocoi*), Storks (such as the fine Maguary Stork, *Euxenura maguari*), Wood Ibises (*Tantalus loculator*), and Scarlet Ibises (*Eudocimus ruber*). The latter, like the Egrets, feed in great flocks in the shallows, and are one of the most beautiful sights which the campo can provide. These swamps are also the home of countless Roseate Spoonbills (*Platalea ajaja*), Plovers (*Vanellus cayenniensis*), known locally as "Teú-teú," and Jacanas (*Parra jacana*), whose long toes enable them to run with light tread over the floating leaves of lilies and other water plants. Several species of Duck, such as *Sarcidiornis carunculata*, *Dendrocygna viduata*, *D. discolor*, etc., are plentiful to a degree, finding cover and food in the groves of giant Arums (*Caladium arborescens*), which commonly border the lakes. The immense number of these birds may be estimated from the fact that I have seen a *vaqueiro* kill four brace of duck with a single 12. bore cartridge; on the report of the gun, the birds got up in thousands, flying off in a cloud that must have covered several acres.

Equally striking is the bird life of the campo itself. Here are to be found many birds of prey (which form a high percentage of the total species) such as *Asturina magnirostris*, *Urubitinga zonura*, *Accipiter tinus* and *Rostrhamus* sp. Turkey Vultures, notably *Catharistes urubu*, share with myriads of small Red Ants the important work of scavenging, and are to be seen soaring gracefully overhead or feasting on the carcases of cattle. Several species of Toucans hide in the tree-tops, but are rarely visible, except when on the wing. Cuckoos too are plentiful, especially *Guira guira* and *Crotaphaga ani*. Flocks of Parroquets

(*Conurus aureus*), often numbering many hundreds of individuals, chatter and scream all day in the Mango trees; Parrots (*Chrysotis amazonica*) and Nightjars (*Podager* sp.), Kingfishers and Snake Birds (*Plotus anhinger*), Doves (*Columbula* sp.), Finches and Woodpeckers, all these and more are here in infinite variety, to claim our admiration and wonder.

Considered in relation to the reptiles and birds, mammals are relatively scarce on the campo. However there are many forms of striking interest. Jaguars (*Felis onça*) are still fairly plentiful, especially in the north and north-east. Equally at home in the trees and on the ground, they will also enter the water and are said to attack the largest alligators, though their chief prey is the Capibara. Allusion may also be made to the following:—Kinkajou (*Cercoleptes caudivolvus*), Coati (*Nasua* sp.), Tamandua (*Tamandua tetradactyla*), Three-toed Sloth (*Bradypus tridactylus*), Peba Armadillo (*Tatusia septemcincta*), and several species of Monkey.

Opossums (*Didelphys marsupialis*) are very abundant. Though largely arboreal, the Opossum will travel over wide stretches of country at night, in order to raid poultry yards. On account of these incursions, the *vaqueiros* never lose an opportunity of killing them, and they frequently pay the penalty of their thieving habits with their lives. The breeding season is in full swing towards the end of the dry season, and most females taken late in December have young in the pouch. A litter numbers seven or eight, and the young, which are born in a very immature condition (vide Pl. IV., A.) remain permanently attached to the teats for at least 65 days, and remain in, or return to, the pouch for a much longer period.

Marajó has been described as " um verdadeiro El-Dorado " for the Capibara (*Hydrochoerus capibara*). These great rodents are common in many parts of the island, although on account of their shy and cautious habits it is only with great difficulty that they can be approached, or even caught sight of. Occasionally they are met with in herds numbering as many as seventy or a hundred individuals. They seldom stray far from their native river or lake, and on the first sign of danger, bound off towards the water at full gallop (vide Pl. VI., B.). Here they are in their proper element, being strong swimmers, and escaping observation by diving, to reappear at a distance, with just the top of the head above the surface. In this position, half-hidden among water plants and vegetable debris, they are practically invisible. Capibaras are greatly persecuted by the Jaguar, who will even enter the water after his favourite quarry.

In conclusion we must mention the Bats. In spite of the deficiency of trees in this region, three species of tree-living Bats are present in great numbers, almost every available hollow tree on some fazendas being occupied by a colony. *Noctilio leporinus* L. is perhaps the commonest species. With a reddish-brown back, orange under-parts and blackish ears and wing-membranes, it is a strikingly handsome species, and is of great interest on account of its fish-eating habits. *Dirias albiventer* Spix. and *Molossus obscurus* Geoff. also live in hollow trees during the day time and are very numerous also in the fazenda buildings. The true Vampire or Blood-sucker (*Desmodus rufus* Geoff.) is a pest, responsible for much damage to the health of cattle and horses, its repeated attacks causing severe anæmia and even proving fatal. This species also attacks man if afforded the opportunity.

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Bird Ringing and Science.

By R. H. Hellyar.

BEFORE the study of any particular subject matter can be dignified by the name of Science, it must comply with certain conditions. The aim of Science is the investigation and elucidation of relations, with a view to making concepts that shall grow more and more embracing as Science advances. Fundamentally, Science consists in the measurement of sensations. In most sciences, however, the materials of study are sensations arranged in most highly elaborate systems, *e.g.*, a living bird.

On the one hand there lies the estimating and calculating entity—measurement and the logical method of induction and deduction. On the other hand lies the material under estimation. The first is infallible; it is, quite simply, exactness itself. The second, however, involves an instrument which in itself is very fallible and very inexact—the human mind. Material has to be observed before logical deductions can be made from it; and observation inevitably involves a possibility of error —the inexactness and possibility of confusion that lie in the very powers of observation themselves in eye, and hand and ear.

To avoid this latter defect, man has created an endless number of instruments—clocks, scales, measures, gauges, compasses, barometers, thermometers and the rest. It is my intention in this paper to give a brief indication of the manner in which ornithology has adopted a similar instrument. Ornithology of to-day is a very different thing from what it was at the beginning of the century. I have no space to investigate causes, but undoubtedly it is to bird ringing that very much of the advance is owing. It is unnecessary at this date to describe the method; and, as my space is short, I will assume a knowledge of the bird ringing system in the mind of the reader.

The most important use of bird ringing lies in the information that it gives of bird movements. Until the practice of ringing birds came into being, only the vaguest ideas were current on the direction and distances of the migratory movements which to-day we are beginning to visualise in their full complexity. While, of course, naturalists had a rough idea of the main movements, nothing detailed was known, because no accurate method was in practice.

Now, however, it is possible to make quite definite statements on many points; and as more birds are ringed, and more recoveries reported, so this vast problem will be brought into the clear region of scientific thought. As an example of the value of bird ringing schemes, one has but to turn to their lists of recoveries. I turn for instance, to the last issued report of recoveries of Mr H. F. Witherby's scheme (" British Birds," March 1930). One finds there, among others, a long list of about 20 recoveries of the Robin; and in every single case there occurs the phrase " recovered where ringed," and dates which cover most months of the year.

Turning to the Song Thrush, one notes that of the first three birds, two were recovered at some distance from the spot where they were ringed. One ringed near Dundee in May 1928 was recovered at Tomar, Portugal, in December 1929; another ringed in Dumfries in April 1927 was recovered in County Clare, Ireland, in January 1930. But the remaining bird of these three was ringed on the Scone Estate, Perth, in April 1929, and was recovered at the same place, January 1930.

One more example will suffice. Cormorants ringed in Wigtown in June 1929 were recovered as follows:—One was recovered at Newport, Mon., in September 1929; a second at La Manche, France, in September 1929; a third in Brittany in October 1929; a fourth at Lugo, Spain, in December 1929.

I have enumerated these few examples, not with the intention of proving anything, but as a means of illustrating the possibilities of the method which bird ringing has brought into being. When the originator of the scheme considers that a sufficient number of recoveries have been made, he will be enabled to form certain conclusions as to the movements of the species under consideration. In the case of the Song Thrush, for example, it is already evident, even from the three cases only, that this bird may be either a resident or a migrant. When hundreds of examples come to be investigated, it will be possible for the ornithologist to give a fairly comprehensive idea of the main movements of Song Thrushes at different seasons.

To study the movements of birds is of very great importance in the elucidation of their life histories. The aim of the science of ornithology is to give an "intelligible account" of the way in which birds live their lives, and to trace out the complex of causes, physical and mental, which result in the actions manifested to the observer. Birds do not move from place to place without cause; and the causes prompting any particular bird to perform any particular act may be very numerous, ranging from an increase in the temperature of the air—(predominantly physical causation)—to the initial stirrings of the migratory impulse—(predominantly mental causation). I say predominantly, for on any given occasion the influences brought to bear on an organism are so complicated. It may be objected that they are so complex that attempts at elucidation are hopeless. At present such pessimism might appear justifiable. The list of influences seems unending. Time of year, temperature, atmosphere pressure, humidity of the air, direction of the wind, height above sea level, age of the bird and possible past experience, with a host of more local conditions in addition.

But until some form is impressed on this multiplicity, to call ornithology a science is merely pretentious. As I have observed previously, however, I do not believe the attempt at all hopeless, though advance must necessarily be slow. Bird ringing in its present methods, besides affording actual evidence of movements, can, when results are studied in bulk, give considerable aid to understanding them; and when in future years it has become much commoner than at present, and when the system is so far developed as to embody in its results all the local conditions prevailing, the value of bird ringing will be enormous. The time will probably not be for many years to come; but as exact methods come into use, so the practice will increase. For not until there is precise method, a base line to work upon, and a possibility of prediction with accuracy, will the subject of ornithology attract intelligent men so fully as it might.

It is of interest to note how this new scientific instrument operates in practice. Take for example these three Scottish born thrushes, one of which remained in the same habitat, one of which went far south to Portugal, and one which went south-west to Ireland.

In what way, it may be asked, can bird ringing separate the predominant from the inessential in the tissue of causes that are brought to bear on the birds' movements? To give a satisfactory reply, one must envisage the problems that are set by these three records. Are we to conclude for instance that there are three distinct kinds of song thrushes—sub-species whose migration habits vary quite distinctly one from the other; one breed remaining all the year round, another going hundreds of miles to the south, another crossing over to Ireland? And do these birds use a regular winter quarter, or do they just happen to get so far? Is it, indeed, a real migration at all (in the sense of the Swallow's migration); or is it a consequence of external weather changes?

Bird ringing when widely utilised, and when good recoveries can be made, will be able to help in explaining whether there is a specific impulse to winter in a specific place. For instance, of the Cormorants I have mentioned, two have rings numbered consecutively. I do not know whether these birds came from the same nest, but for the sake of argument, I will assume this. Of these two birds one was found in Brittany, the other in La Manche. Here, one might say, is a faint indication of the sort of evidence one desires; for ties of blood between parent and offspring, and family relationships, should reveal impulses in common—if the impulses are specific, and not merely vague inclinations. But perhaps there is no specific impulse. Perhaps the migratory tendencies of these birds were merely irregular and indefinite, depending upon external conditions, as temperature or lack of food rather than any innate impulse. Or perhaps there is merely a tendency to move south, not following any particular route. The evidence that accumulated results of bird ringing will afford will reveal the presence or absence of a specific migratory impulse. The effect of external conditions such as I have mentioned will not, it is true, be revealed by this method until it is elaborated more fully, and until detailed attention is paid to local weather conditions and their effects. Only then will it be possible to trace out in full the causes affecting the movements of migrating birds. Bird trapping will be an immense aid in thus following a bird on migration. This method is on the increase, and there have been several articles in "British Birds" illustrating uses and practical methods. When trapping is widespread and many records can be made, it will be possible to trace movements of a particular bird; and when such records are combined with notes of local conditions, it is evident that a great step will have been achieved in separating out causes affecting the movements of such migrants as these thrushes I have quoted.

The value of trapping is evidenced in many ways. It will, for example, allow conclusions to be drawn from the movements of winter immigrants, such as the Starling; for it permits adult birds to be ringed, as distinct from nestlings. Another important advantage is that the bird when recovered is still alive, and will continue its life history again when released.

I have had to omit many points of interest owing to pressure of space. But before concluding this paper, I would like to indicate what, in my opinion, will be the future development of this method. When bird ringing is thoroughly organised and a complete system of workers and methods formed under one central scheme, opportunity for development will be given for what is really the basic element of any science—study of the individual at any time and at any place.

In ornithology this is extraordinarily difficult. It is, of course, occasionally possible; but generally speaking distinguishing marks are not sufficient for the absolute precision of statement which Science demands. Perhaps in the future certain species which are found to be resident or whose movements are exactly known, can be chosen by a local society or person for detailed investigation of individual movements. A small area would be isolated, and as many as possible of the birds of one species ringed with coloured rings. By the use of seven colours, and by placing two rings on each bird, it is possible to distinguish a hundred separate units; placing one colour over the other on alternate legs. These rings would act as observation rings—demanding accurate study, of course, but allowing for individual distinction. Care would have to be taken that individuals in one area do not migrate into, and hence be confused with individuals of another area. It will probably be many years before even a tentative use of this method is possible; but on some such lines as this ornithology must develop.

A Visit to Wicken Fen.

By E. Barton White, F.E.S.

It was in July of last year that I decided to visit that Mecca of the reed entomologist—Wicken Fen. Accordingly, on the 24th of the month, we set out fully equipped, and after a drive of some 170 miles through Oxford, Buckingham, Bedford, and Cambridge we reached the village of Wicken in the early afternoon.

The surrounding country was depressingly flat, though here and there relieved by yellow corn fields. All that seemed to rise above the distant horizon were the noble pile of Ely Cathedral and the wings of scattered windmills, some derelict and some working apparently for pumping water.

Lying between Ely and Newmarket, Wicken is a straggling hamlet, and less than half a mile from our lodging was the entrance to the fen.

The history of this Fenland is most attractively written by Prof. Stanley Gardiner, who tells us the reason Wicken Fen is so famous for rare and local species and the most suitable for preservation. Fenland, so called, was originally an area of over 2500 square miles lying in the counties of Lincoln, Norfolk, Suffolk, Cambridge, Northampton, and Huntingdon, to the south of the Wash.

In pre-historic times, successive layers of silt and peat were laid down, indicating respectively marine and freshwater conditions; hence the appearance to this day of several coast species as far inland as Wicken, which must be some 70 miles from the Wash.

From Roman times onwards, periodic attempts were made both to keep out the sea and to drain the shallow basin of the fens.

Through this land the river Ouse once found its sluggish way, losing itself here and there in large meres with off-shoots of stagnant mosquito-infested pools surrounded by morass. In winter, all was flooded and boats were used for communication between the islets and the shores.

At Wicken was an area of concentration for the drainage from the higher lands. This was quickly covered by reeds and semi-aquatic plants. The Commissioners built a great bank round Wicken Sedge Fen, and digging within it Wicken Lode and several cross dykes.

This Fen is now an area of 320 acres which has not only never been cultivated but it has never been deliberately drained. It is, therefore, a real bit of the original fenland, and to preserve it as such, for rare fen species, the National Trust keep it in its natural state, and the sedge is cut regularly every fourth year to give the flowering plants the chance to survive.

The bushes that are scattered amongst the sedge are hawthorns, sallows, buckthorns, sloes, and guelders.

There are several ferns, including the Adder's Tongue and the Marsh Fern. There are flag irises and two kinds of Horsetail.

Other plants seen were the Purple and Yellow Loosestrifes, Valerian, Meadowsweet, Milkworts, and Marsh Milk Parsley. Rarer ones recorded are Sweet Gale, Greater Spearwort, Fen Violet, Bog Myrtle, Red Rattle, Bladderworts, Marsh Pea, and Fen Aster. The water reens and ponds produce both white and yellow Water Lilies, and these were both in full bloom during our visit.

Many interesting birds have left the fen, probably owing to collectors. These include the Crane, Spoonbill, Gray-lag Goose, Bittern, Avocet, Black Tern, Ruffs and Reeves and the Little Grebe.

Savi's Warbler has now gone, and also the Bearded Titmouse. The Grasshopper Warbler is still there, and we heard it every night. Other birds still reported are the Short-eared Owl, Montagu's Harrier, the Red-backed Shrike, Turtle Dove, Redpoll, Whinchat, Sedge Warbler, Ray's Wagtail, Reed Bunting, and Meadow Pipit.

The species of Water Beetle are said to number 129, and 737 species of Lepidoptera are recorded from Wicken Fen.

The Reed Tussock Moth, *Loelia coenosa*; the Gipsy Moth, *Ocneria dispar*, and the Large Copper butterfly are all now extinct, and *Acronycta strigosa* has not been seen of late.

Those species said to be still found only in Wicken Fen include *Arsilonche albovenosa*, *Senta maritima*, and the "micros" *cilialis*, *orobana*, *quaestionella*, *morosa*, and *divisella*.

The handsome Swallow-tail butterfly is fairly common, but it is also found in the northern parts of Fenland, chiefly on the Norfolk Broads, where it is not yet preserved. My wife was the first of us to find the larva, which was feeding on *Peucedanum palustre* and almost full grown, though one young one was found still with its central whitish band. At the time of writing, these are all healthy pupae.

Having produced our permits, and after signing the Custodian's book, in accordance with a notice outside his house, we proceeded about 350 yards along a grassy ride from which at a right-angle the Sedge Fen Drove is cut for 1000 yards straight into the heart of the fen, ending by a water reen which separates the private preserve which is kept for the protection of rare and local species and the re-establishing of certain extinct ones.

This drove is the only practicable hunting ground available, and though we wandered elsewhere, we soon discovered that most insects were only to be taken in the drove.

After 50 yards or so as a narrow lane, the drove opens out by some willow trees and a derelict windmill into the sedge proper, which is mostly over four feet high on either side. Though some twelve feet wide, it is only passable along a foot track on each side of the sedge, along which stakes 3½ feet high are driven in about 15 paces apart, and on each of these is nailed a piece of rough bark for sugaring.

Though we went armed with our own sheets and poles, petrol lamps, etc., we found that the Custodian is accustomed to provide these with a small table for his acetylene lamp and a chair. These, to order, were all in place before dusk, the sheets stretched across the drove at intervals of about 80 yards, and the posts already sugared by the Custodian or his sons. These "pitches" were often booked months ahead, and below these, one would find oneself enveloped in a creeping mist rising from the reens and dykes which surround the private preserve.

Under no pretext was anyone allowed to enter this sacred ground. Indeed, it is inaccessible by deep reens. Here *P. dispar*, the Large Copper butterfly, is being re-introduced, and we heard that eggs were present on the Great Water Dock and one or two imagines had been seen.

There is a full account of this re-introduction into this country of this fine insect, with coloured plates of the different races, in the " Transactions of the Entomological Society " of July 31, 1929.

By 8.30 p.m. (S.T.), while it was still light, we would reach the Sedge Drove to find moths already on the sugar, and long before a hand lamp was necessary nine *affinis* were seen on one piece of bark.

At dusk, many light-coloured moths were flying rapidly over the sedge and were difficult to net. They proved to be mostly *impura*, *pudorina*, and *lithoxylea*, with a few *straminea* and *phragmitidis*. One or two large females of *potatoria* were hovering about.

Returning again to the sugared bark, on almost every piece we found hiding behind it or in a large crevice a species of large grey spider. Sugar was not his object, for by ten o'clock or so, each one had a moth in his clutches, and he was quite indifferent to the glare of the hand lamp. The majority of the victims were *impura* and *leucostigma*.

On lighting our petrol lamps by the sheets about 10 o'clock, we were soon surrounded by *caja*, *neustria*, and *potatoria* in increasing numbers. Indeed, it was difficult to avoid treading on them as they fluttered on the ground. One or two of the beautiful golden males of *potatoria* peculiar to Wicken were taken, also a series of the many forms of *neustria*.

A heavy " plop " on the sheet, followed by rustling in the reeds below, heralded the arrival of *quercifolia*. These were frequently found resting under the lamp table.

Fuliginosa preferred dashing wildly round the lamp and seldom pitched on the sheet. He had to be netted quickly.

Albovenosa was shy, and his welcome arrival was often unnoticed, so gently would he pitch on the sheet, usually near the ground. *Arundinis*, too, was seldom seen to arrive, and the first was taken by my wife fluttering up an adjacent reed stem.

Hellmanni was much excited by the light and several were missed in their wild gyrations round the lamp before they dashed off into the darkness once more.

We were mostly very busy at our sheets, which were soon dotted over with *senex*, three of the footmen and countless " micros," and we were inclined to forget our visits to the sugar patches with their *ravida*, *interjecta*, *ophiogramma*, and others.

Before the night was over, we were visited regularly by the Custodian, and we had an interesting argument with him as to the respective merits of our high power petrol lamps and his acetylene ones. He maintained that the acetylene was preferable though far less powerful. He argued that our lamps lighted up the sedge for some distance, and that moths settled on illuminated reeds in preference to coming to the sheet.

However, we went prepared with shades to cover half the arc of light, more to prevent any interference with our neighbours and to allow ourselves to stand in the shadow.

The weather was mainly unsettled and cloudy, with a S.W. wind, and occasionally some thunder and showers of rain. Often the clouds would clear away and leave us beneath the stars, but in spite of this, there was really no bad night for collecting *lepidoptera*.

Shortly before 2 a.m. the dampness in the air would increase, and a chilly breeze spring up, when all moths ceased to fly.

We sometimes found it profitable to examine the abandoned sheets of our late neighbours on our way home. One *arundinis* was found in this way. It was a relief to reach the lane where smoking was once more permitted!

Killing our captures took till about 3 a.m., and after a few hours' rest and a late breakfast, we spent the morning setting and feeding our machaon larvae on our landlady's carrot tops.

To those interested in the Culicidae, we strongly recommend a visit to Wicken Fen at the end of July. The accumulated results of the attacks of these insects was appalling.

Below is a list of those insects taken (I) at light, and (II) at sugar:—

(I)—TAKEN AT LIGHT.

S. salicis
G. quercifolia
N. ziczac
P. palpina
P. tremula
L. camelina
C. potatoria (vars.)
M. neustria (forms)
P. fuliginosa
L. griseola
v. *stramineola*
L. lurideola
A. albovenosa
C. rufa
T. hellmanni
C. phragmitidis
T. fulva
L. straminea
N. neurica
C. senex
A. caja (vars.)
P. arcuosa
T. cespitis
P. comitata
E. apiciaria
M. arundinis (castaneae)
C. phragmitellus
S. gigantellus
N. cilialis

(II)—TAKEN AT SUGAR.

E. chlorana
A. nigricans (forms)
A. tritici (forms)
v. *aquilina*
T. interjecta
T. fimbria
T. janthina
C. affinis
B. viminalis
A. ophiogramma
A. secalis (vars.)
H. leucostigma (forms)
L. pallens (red)
L. impura
L. impudens
A. obscura
X. monoglypha (black)
M. dissimilis

Bristol Insect Fauna.

DIPTERA (Part III.).

By H. Audcent.

BRACHYCERA.

The second sub-order of Diptera. These flies have only three joints to the antennae though the third joint may be ringed. The third joint often bears a side-branch, called Arista, and this may be bare, pubescent or plumose. Palpi short, composed of one or two joints.

For the study of the families I.-IX., the best book is G. H. Verrall's "British Flies," vol. v., 1909. Vol. xiii. of "Faune de France," 1926, deals with families I.-VIII., and vol. xvii. with the Asilidae. "Diptera Danica," vols. i.-iv., by W. Lundbeck, 1907-12, also deal with these families. "Durham Diptera," by W. Wingate, 1906, although out of date, is a most excellent work, including all families, but this book is almost unobtainable.

I. STRATIOMYIIDAE.

Most of these flies have either bright yellow markings on a black ground or metallic colours. The antennae are carried erect, the third joint is ringed and ends in a thin style of varying length. No tibial spurs. The costa of the wing (thickened upper edge) does not reach beyond the apex of the wing. The larvae are aquatic or live in decaying plants. The flies frequent flowers near water.

Sub-family Pachygastrinae.

Pachygaster (s.g. *Vappo*) *atra* Panz. G., Hallen (B.), 22/7/27; Kingsweston (Wm.), 25/6/27. S., Langport (Dale), Backwell (A.), 17/7/26; Tickenham (A.), 22/7/23.

„ (s.g. *Praomyia*) *Leachii* Curt. G., Stroud (Wt.), Bristol (B.), 22/7/26. S., Wincanton (Verrall); West Town (Wm.), 27/7/27; Tickenham (A.), 22/7/23; Portishead (H.), Crook's Peak (Rd.).

„ (s.g. *Zabrachia*) *minutissima* Ztt. S., Wells (L.).

„ (s.g. *Eupachygaster*) *tarsalis* Ztt. S., Portishead (H.).

Sub-family Clitellariinae.

Oxycera (*Hermione*) *pardalina* Mg. S., Wells (L.).

„ „ *pulchella* Mg. G., Painswick (Wt.), 10/8/92; Hallen (B.), 17/7/24; Cheltenham (Wm.), 5/7/19. S., Batheaston (Bl.).

„ „ *trilineata* F. G., Hallen (B.), 17/7/24. S., Berrow (A.), 13/7/30; Puddimore Milton (Bl.); Shapwick (Wm.), 10/6/21.

„ (*Paroxycera*) *formosa* Mg. G., Wotton-under-Edge (P.). S., Batheaston (Bl.).

Nemotelus nigrinus Fln. S., Nailsea (J.), 29/5/20; Shapwick (B.), 22/6/24.

„ *notatus* Ztt. G., Hallen (A.), 12/7/24; Shepperdine (A.), 12/8/24; Kingsweston (Wm.), 16/6/22. S., Berrow (A.), 13/7/30.

„ *pantherinus* L. G., Chalford (Wt.). S., Tickenham (A.), 23/6/29.

„ *uliginosus* L. G., Shepperdine (A.), 12/8/24; Hallen (B.), 11/7/29. S., Minehead (Bl.); Tickenham (A.), 19/7/24; Sharpham (B.), 17/7/27.

Sub-family Stratiomyiinae.

Odontomyia (s.g. *Eulalia*) *hydroleon* L. S., Sharpham (A.), 2/8/23.
,, ,, *ornata* Mg. S., Taunton (Wm.), 7/6/24.
,, (s.g. *Hoplodonta*) *viridula* F. S., Shapwick (J.), 17/7/19; Sedgemoor (Sl.), 21/7/21; Minehead (Bl.).
,, (s.g. *Neuraphanisis*) *tigrina* F. S., Shapwick (A.), 16/5/21, and (Wm.), 10/6/21.
Stratiomyia chamaeleon L. G., Wotton-under-Edge (P.). S., Highbridge (C.); Shepton Mallet (C.).
,, *furcata* F. S., Wellington (Bl.); Berrow (A.), 13/7/30; Shapwick (J.), 22/6/17.
,, *potamida* Mg. G., Bristol (C.); Painswick (W.); Shepperdine (A.), 12/8/24; Dursley (A.). S., Wellington (Bl.); Tickenham (A.), 26/7/24, and (Wm.), 12/8/24.

Sub-family Geosarginae.

Chloromyia formosa Scop. G. and S., common.
Chrysochroma (*Chrysonotus*) *bipunctatum* Scop. G., Wotton-under-Edge (P.); Olveston (A.), 2/9/23. S., Batheaston (Bl.); Shepton Montagu (Verrall); Leigh Woods (H.); St Audries (A.), 20/8/29.
Geosargus (*Sargus*) *cuprarius* L. G., Painswick (W.); Stroud (Wt.); Wotton-under-Edge (P.). S., Portishead (A.), 24/9/21; Backwell (A.), 17/7/26; Shapwick (A.), 10/8/23.
,, ,, *iridatus* Scop. (*infuscatus* Mg.). G. and S., common.
,, ,, *splendens* Mg. (*flavipes* Mg.). G., Wotton-under-Edge (P.); Olveston (A.), 2/9/23. S., Shepton Mallet (C.); Batheaston (Bl.); Tickenham (A.), 16/9/22.
Microchrysa cyaneiventris Ztt. G., Stone (A.), 27/6/28. S., Leigh Woods (C.), 8/18; Nailsea (H.), 5/7/16.
,, *flavicornis* Mg. G., Painswick (W.); Olveston (C.); Hallen (A.), 12/7/24; Shepperdine (A.), 30/7/24. S., Leigh Woods (H.); Tickenham (A.), 20/7/23.
,, *polita* L. G. and S., common.

Sub-family Berinae.

Beris chalybeata Forst. G. and S., common.
,, *clavipes* L. G., Wotton-under-Edge (P.). S., Leigh Woods (H.).
,, *geniculata* Curt. G., Blaise Castle Woods (A.), 8/21. S., Banwell (C.); Leigh Woods (C.), 20/6/16; Flax Bourton (H.), 28/5/18; Tickenham (A.), 25/6/26; Prior Park, Bath (A.), 18/7/25.
,, *Morrisi* Dale. S., Porlock (Verrall).
,, *vallata* Forst. G. and S., common.
Chorisops tibialis Mg. G., Painswick (W.); Hallen (A.), 12/7/24; Olveston (A.), 5/9/22. S., Batheaston (Bl.); Clevedon (W.); Tickenham (A.), 22/7/23.

II. ERINNIDAE (of some authors).

Black, ichneumon-like fly. All tibiae spurred, costa goes round wing. Larvae in rotten wood. (This applies to our only local species.)
Xylophagus (s.g. *Archimyia*) *ater* Mg. S., Leigh Woods (C.).

III. TABANIDAE.

These flies, known as Clegs, Horseflies, Gadflies and Breezeflies, are all large or medium in size, black with grey, in some species yellowish red, markings. All have coloured stripes on the eyes, and it is well to note the colour, shape and number of these stripes on the living or freshly killed fly, as these colours, which disappear soon after death, are made use of in classification. The females are ferocious blood-suckers and readily attack man. The males, recognised by their eyes which meet in front, may be found on flowers or at ponds where they come to drink. The antenna consists of three joints, of which the third is large and often constricted into lobes. The larvae live in damp earth and are carnivorous. Besides the books already mentioned, there is "Les Tabanides de France," by Dr J. M. R. Surcouf, Vol. v. of "L'Encyclopédie Entomologique," 1924. A monumental work, entitled "Die Fliegen der palaearktischen Region," has been begun under the editorship of Dr E. Lindner, of Stuttgart. Among the volumes published so far there is one on the Tabanidae, by O. Kröber.

Genus Haematopota (Chrysozona).

Third joint of antennae not constricted, wings spotted in rings, no tibial spurs.

Haematopota (*Chrysozona*) *Bigoti* Gob. S., Tickenham (A.), 3/7/22.
" " *crassicornis* Wahl. S., Tickenham (A.), 23/7/22; Nailsea (Wm.), 27/7/22.
" " *pluvialis* L. G. and S., common.

Genus Tabanus.

Third joint of antennae constricted and toothed at base, wings clear, no tibial spurs.

Sub-genus Therioplectes.

Ocellar tubercle present (*i.e.*, dark mark on vertex between the eyes), eyes dark, hairy in both sexes.

Therioplectes distinguendus Verr. S., Cannington (Sl).
" *luridus* Fln. G., Painswick (St.), 19/6/24.
" *micans* Mg. G., Olveston (C.). S., Wellington (Bl.).
" *solstitialis* Mg. G., Painswick (W.), 22/6/89.
" *tropicus* Mg. G. and S., common.
" *tropicus* var. *bisignatus* Jaen. G., Olveston (A.), 5/16; Hallen (A.), 19/6/20. S., Shapwick (A.), 16/7/27, and (Wm.), 3/6/22.

Sub-genus Ochrops (Atylotus, Dasystipia).

No ocellar tubercle, eyes yellow.
Ochrops fulvus Mg. S., Wellington (Bl.).

Sub-genus Tabanus.

No ocellar tubercle, eyes dark, bare.
Tabanus autumnalis L. G. and S., fairly common.
" *bovinus* L. G., Wotton-under-Edge (P.). S., Wellington (Bl.).
" *bromius* L. G. and S., common.
" *sudeticus* Ztt. G., Wotton-under-Edge (P.).

Genus Chrysops.

Third joint of antennae constricted but not toothed, wings with dark patches, spurs on hind tibiae, eyes golden green with purple bands.

Chrysops coecutiens L. G. and S., common.
" *pictus* Mcq. (*quadratus* Mg.). S., Ashcot (Rd.); Sharpham (A.), 8/8/25.
" *relictus* Mg. G., Painswick (W.); Wotton-under-Edge (P.); Olveston (C.), 8/16. S., Shepton Mallet (C.); Sharpham (A.), 22/8/22; Tickenham (A.), 19/7/24.

IV. LEPTIDIDAE (RHAGIONIDAE).

Medium to small flies. Eyes bare, green in living fly; third joint of antenna never constricted, abdomen almost cylindrical. Occur in woods and shady places. Feed on other flies. Larvae live in damp soil and are carnivorous.

Atherix Ibis F. S., Freshford (C.).
,, *marginata* F. S., Tarr Steps (J.), 18/8/22.
Chrysopilus auratus F. (*cristatus* Verr.). G. and S., common.
,, *aureus* Mg. G. and S., widely distributed.
Leptis (*Rhagio*) *annulata* Deg. G., Cirencester (T.), 4/7/23.
,, ,, *conspicua* Mg. S., Leigh Woods (H.).
,, ,, *lineola* F. G., Stroud (W.); Wotton-under-Edge (P.); Painswick (St.). S., Shepton Mallet (C.); Sharpham (A.), 4/8/23; St Audries (A.), 25/8/29.
,, ,, *nigriventris* Lw. G., Hallen (A.), 19/6/26; Blaise Castle (Wm.), 22/6/22. S., Shepton Mallet (C.); Cheddar (C.); West Town (Wm.), 6/27; Tickenham (A.).
,, ,, *scolopacea* L. G. and S., common.
,, ,, *tringaria* L. G. and S., common.
,, ,, *Perrisi* Gob. G., Kingsweston (A.), 9/6/23. ? var. of *tringaria* L.
Symphoromyia immaculata F. S., Charterhouse-on-Mendip (Wm.), 30/6/23.

V. ONCODIDAE (ACROCERIDAE, CYRTIDAE).

Small flies with a tiny head and large, spherical abdomen. Wings small with few veins, squamae (membranous projections behind wings) large. Flies inactive, generally swept off dead branches. Larvae live as parasites inside spiders.

Oncodes gibbosus L. S., Sharpham (A.), 27/7/23.
,, *pallipes* Lat. G., Hallen (A.), 12/7/24; Winterbourne (K.), 20/7/23. S., Wells (L.); Leigh Down (C.).
Paracrocera globulus Pz. S., Shepton Montagu (Verrall).

VI. BOMBYLIIDAE.

Size: medium to small, antennae erect, proboscis long, body covered with long hair which rubs off easily. Bee-like flies found chiefly in the spring hovering over flowers in sunshine. Larvae in nests of Wild Bees and Wasps.

Anthrax (*Hemipenthes*) (sub-gen. *Villa*) *paniscus* Rossi. S., Dunster (A.), 8/16.
Bombylius canescens Mik. G., Wotton-under-Edge (P.). S., Hanham (C.); Brockley (C. Bartlett); Tickenham (A.), 6/20.
,, *discolor* Mik. G., Painswick (W.); Bristol (C.); Olveston (A.). S., Shepton Mallet (C.); Sharpham (A.), 20/4/24; Keynsham (A.), 2/4/23.
,, *major* L. G. and S., frequent on Primrose.
Phthiria pulicaria Mik. S., Berrow (Wm.), 6/21, and (B.), 5/7/30.

VII. THEREVIDAE.

Size: medium, proboscis normal, eyes yellow, body covered with silvery hair which rubs off easily. Flies found sitting on the ground in the sun in open places; they are carnivorous. Larvae live in soil and are carnivorous.

Tabuda (*Dialineura*) *anilis* L. S., Berrow (A.), 27/8/24.
Thereva annulata F. S., Berrow (A.), 8/8/23.
,, *bipunctata* Mg. G., Wotton-under-Edge (P.); Blaise Castle (A.), 7/21. S., Berrow (A.), 29/9/24.

Thereva fulva Mg. G., Cranham (C.).
„ *nobilitata* F. G., Painswick (St.), 29/6/24. S., Freshford (C.); Tickenham (A.), 6/21; Sharpham (A.), 16/8/23.
„ *plebeja* L. G., Cirencester (T.), 20/6/24. S., Freshford (C.).

VIII. SCENOPINIDAE (OMPHRALIDAE).

Small, beetle-like flies occasionally found on windows. The larvae live in dry, dusty detritus and old birds' nests.

Scenopinus (*Omphrale*) *fenestralis* L. G., Olveston (C.); Bristol (A.), 24/6/25. S., Shepton Mallet (C.); West Town (Wm.), 14/7/26.
,, ,, *niger* Deg. G., Bristol (Wm.), 30/6/28.
,, ,, *senilis* F. G., Bristol (A.), 21/6/30. S., West Town (Wm.), 10/7/25.

IX. ASILIDAE.

Size: medium to large, long bodies, powerful wings and strong, spiny legs. Known as Robber-flies because they feed on other insects. Found sitting in open, sunny places. The larvae live in the earth and feed on detritus. When predaceous flies are seen with prey both should be captured and the prey identified, as data of this kind are invaluable.

Asilus crabroniformis L. G., Painswick (W.); Wotton-under-Edge (P.); Bristol (C.). S., Tickenham (A.), 8/19; Glastonbury (A.), 12/8/23.
Dioctria atricapilla Mg. G., Painswick (St.); Selsley (Wt.); Cirencester (T.); Dursley (A.), 9/6/25; Kingsweston (A.), 5/21. S., Freshford (C.).
,, *linearis* F. S., Weston-super-Mare (J.); Backwell (A.), 17/7/26.
,, *oelandica* L. G., Wotton-under-Edge (P.). S., Holford (Miss B. Punfield).
,, *Reinhardi* Wied. (*cothurnata* Mg.). G., Bristol (Verrall).
,, *rufipes* Deg. G. and S., common.
Dysmachus trigonus Mg. G., Bitton (C.). S., Axbridge (Rd.); Kewstoke (J.); Berrow (A.), 17/6/23.
Epitriptus cingulatus F. G., Olveston (A.), 7/16. S., Taunton (C.).
Isopogon brevirostris Mg. G., Painswick (St.), 7/7/23; Selsley (Wt.); Bristol (C.). S., Withycombe (Sl.); Charterhouse-on-Mendip (Wm.), 30/6/23.
Laphria marginata L. G., Forest of Dean (J.).
Leptogaster cylindrica Deg. G. and S., fairly common.
,, *guttiventris* Ztt. G., Selsley (Wt.); Cleve Hill (St.).
Machimus atricapillus Fln. G. and S., fairly common.
,, *rusticus* Mg. G., Bristol (C.); Painswick (St.), 7/7/23.
Neoitamus cyanurus Lw. G., Painswick (St.), 7/7/23.
Pamponerus germanicus L. G., Bristol (Millard vide Curtis).
Philonicus albiceps Mg. G., Bristol (C.). S., Dunster (A.), 8/16; Berrow (A.), 17/8/24; Leigh Woods (C.).

X. EMPIDIDAE.

Size: medium to small, body long and slender, legs long, arista terminal on third antennal joint, proboscis, long or short but always stiff, costa of wing reaching only to apex. These flies feed on other insects, inserting the proboscis and sucking them dry. They occur chiefly in woods or near water, over which they sometimes dance in swarms. The larvae live in the earth and are carnivorous. Besides the books already mentioned there are additions and alterations to list of British Empididae published by Mr J. E. Collin in "E.M.M.'s," June 1926 to May 1927.

Sub-family Hybotinae.

Bicellaria (*Cyrtoma*) *nigra* Fln. G., Cirencester (T.), 3/6/24. S., Leigh Woods (A.), 23/6/25.

,, ,, *simplicipes* Ztt. (*melaena* Hal.). S., Shepton Mallet (C.); Shapwick (A.), 31/7/24.

,, ,, *spuria* Fln. G., Cirencester (T.); Stone (A.), 21/5/27. S., Freshford (C.); Tickenham (A.), 16/9/23; Sharpham (A.), 22/8/22.

Hybos culiciformis F. G. and S., common.

,, *femoratus* Müll. G., Shepperdine (A.), 12/8/24. S., Leigh Woods (H.); Sharpham (A.), 9/8/23; St Audries (A.), 20/8/29.

,, *grossipes* L. G., Hallen (A.), 18/7/24. Most of the old records for this species were probably *H. culiciformis* F.

Sub-family Empidinae.

Empis (s.g. *Coptophlebia*) *albinervis* Mg. G., Shepperdine (A.), 30/7/24. S., Tickenham (A.), 23/4/25.

,, (s.g. *Pterempis*) *caudatula* Lw. G., Cirencester (T.), 6/23; Kingsweston (A.), 6/5/23. S., Wells (L.).

,, ,, *chioptera* Fln. G., Kingsweston (A.), 31/5/24. S., Shepton Mallet (C.); Nailsea (A.), 21/4/27.

,, ,, *decora* Mg. S., Cheddar (C.).

,, (s.g. *Pachymeria*) *fermorata* F. G., Painswick (W.); Cirencester (T.); Kingsweston (Wm.), 20/5/22. S., Ashton (C.); Freshford (C.); Tickenham (A.), 27/5/22.

,, (s.g. *Leptempis*) *grisca* Fln. S., Tickenham (A.), 26/6/24.

,, (s.g. *Empis*) *lineata* Col. G., Painswick (W.).

,, ,, *livida* L. G. and S., common.

,, (s.g. *Xanthempis*) *lutea* Mg. G., Painswick (W.); Gloucester (C.); Shepperdine (A.), 30/7/24. S., Leigh Woods (H.), 28/6/18; Tickenham (A.), 24/6/24.

,, (s.g. *Lissempis*) *nigritarsis* Mg. G., Painswick (W.); Cirencester (T.); Kingsweston (A.), 31/5/24. S., Shepton Mallet (C.); Pill (H.); Leigh Woods (A.), 22/5/25; Banwell (A.), 6/6/25; Clevedon (W.).

,, (s.g. *Pterempis*) *pennaria* Fln. (*vernalis* Mg.). G., Olveston (A.), 8/4/23; Kingsweston (A.), 6/5/23. S., Cheddar (C.); Wells (L.); Brockley (J.); Backwell (A.), 25/4/25.

,, ,, *pennipes* L. G., Dursley (A.), 4/6/30. S., Cheddar (C.); Freshford (C.).

,, (s.g. *Pachymeria*) *picipes* Mg. (*brevicornis* Lw.). G., Cirencester (T.), 22/5/23

,, (s.g. *Xanthempis*) *punctata* Mg. G., Bristol (C.); Kingsweston (A.), 20/5/22; Stone (A.), 21/5/27. S., Freshford (C.); Tickenham (A.), 11/5/25.

,, ,, *stercorea* L. G., Winterbourne (A.), 13/5/23; Stone (A.), 21/5/27. S., Pill (H.); Shapwick (A.), 20/5/23; Tickenham (A.), 27/5/21.

,, (s.g. *Empis*) *tesselata* F. G. and S., common.

,, (s.g. *Xanthempis*) *trigramma* Mg. G., Painswick (W.); Kingsweston (A.), 14/7/21; Olveston (A.), 29/4/29. S., Shepton Mallet (C.); Shapwick (A.), 20/5/23; Tickenham (A.), 16/5/25.

,, (s.g. *Coptophlebia*) *vitripennis* Mg. G., Kingsweston (A.), 6/8/24. S., St Audries (A.), 30/8/29.

Hilara chorica Fln. G., Cirencester (T.), 30/5/23; Kingsweston (A.), 9/6/23. S., Leigh Woods (H.); Backwell (A.), 25/4/25.

,, *clypeata* Mg. S., Leigh Woods (H.).

,, *cornicula* Lw. S., Leigh Woods (H.).

,, (*Oreogeton*) *flavipes* Mg. S., St Audries (A.), 30/8/29.

,, *fuscipes* F. (*carinthiaca* Beck.). G., Wotton-under-Edge (P.); Olveston (A.), 18/6/22. S., Prior Park, Bath (A.), 4/6/30.

Hilara griseifrons Coll. S., no loc. given (Collin in " E.M.M.").
,, *litorea* Fln. G., Tormarton (A.), 20/5/26. S., Wells (L.); St Audries (A.), 24/8/29.
,, *longevittata* Ztt. (*bivittata* Strobl.). G., Westbury-on-Trym (Wm.), 15/3/21; Filton (A.), 12/6/26. S., Nailsea (A.), 22/4/27.
,, *lurida* Fln. G., Stone (A.), 30/6/28. S., Leigh Woods (H.).
,, *maura* F. G., Painswick (W.); Olveston (A.), 4/6/22. S., Shapwick (A.), 30/5/23; Tickenham (A.), 27/5/22.
,, *nigrina* Fln. G., Bristol (C.). S., Long Ashton (C.).
,, *niveipennis* Ztt. G., Cirencester (T.). S., Shepton Mallet (C.).
,, *pilosa* Ztt. S., Shepton Mallet (C.).
,, *quadrivittata* Mg. G., Cirencester (T.), 2/6/24; Awkley (A.), 5/6/22; Olveston (A.), 4/6/22. S., Keynsham (A.), 1/6/29; Taunton (A.), 9/6/24; Westbury-on-Trym (Wm.), 23/5/20.
,, *subpollinosa* Coll. G., Kingsweston (A.), 6/5/28. S., Tickenham (A.), 19/7/24; Sharpham (A.), 11/8/23.
,, *thoracica* Mcq. G., Stone (A.), 27/6/28. S., Leigh Woods (H.).
Rhamphomyia albohirta Coll. G. and S., common.
,, *barbata* Mcq. (*pennata* Mcq.). G., Awkley (A.), 4/6/22.
,, *dentipes* Ztt. G., Kingsweston (A.), 2/5/26; Blaise Castle (A.), 24/4/25.
,, *filata* Ztt. S., Shepton Mallet (C.); Tickenham (A.), 24/5/26.
,, *flava* Fln. G., Kingsweston (A.), 31/5/24; Blaise Castle (A.), 28/5/27. S., Leigh Woods (H.); Tickenham (A.), 24/6/24; Winscombe (A.), 5/8/30.
,, *geniculata* Mg. (*plumipes* Fln.). G., Cirencester (T.). S., Shapwick (A.), 20/5/23; Tickenham (A.), 12/5/29.
,, *nigripes* F. G., Tormarton (A.), 20/5/26; Stone (A.), 21/5/27. S., Leigh Woods (H.), 11/5/16; Tickenham (A.), 27/5/22; Prior Park, Bath (A.), 4/6/30.
,, *sciarina* Fln. (*hybrida* Ztt.). S., Sharpham (A.), 25/8/25.
,, *subcinerascens* Coll. S., Cleeve Combe (J.).
,, *sulcata* Fln. G. and S., common.
,, *tarsata* Mg. G., Dursley (A.), 9/6/25. S., Brecon Hill (Chm.), 19/6/26.
,, *variabilis* Fln. G., Kingsweston (A.), 6/8/24. S., Long Ashton (H.); Holford Glen (A.), 6/18.

Sub-family Ocydrominae.

Leptopeza flavipes Mg. S., West Town (Wm.), 9/26; Leigh Woods (H.), 31/5/17.
Microphorus anomalus Mg. S., Leigh Woods (C.).
,, *holosericeus* Mg. (*velutinus* Mcq.). S., Wells (L.); Leigh Woods (A.), 22/5/26.
Ocydromia glabricula Fln. G. and S., common.
Oedalea flavipes Ztt. S., Cheddar (C.).
,, *holmgreni* Ztt. G., Kingsweston (A.), 31/5/25. S., Leigh Woods (A.), 25/5/19.
,, *stigmatella* Ztt. S., Holford Glen (Miss Punfield); Stourton Wood (J.).
Oropezella (*Leptopeza*) *sphenoptera* Lw. S., Portishead (H.); Leigh Woods (A.), 22/6/25; Backwell (A.), 17/8/26.
Trichina clavipes Mg. S., Sharpham (A.), 9/8/23.
,, *flavipes* Mg. S., Freshford (C.).

Sub-family Hemerodrominae.

Chelifera (*Hemerodromia*) *aperticauda* Coll. G., Bibury (A. H. Hamm.).
,, ,, *precatoria* Fln. G., Olveston (A.), 6/21; Awkley (A.), 4/6/22. S., Portbury (H.).
Chelipoda (*Phyllodromia*, *Thamnodromia*) *albiseta* Ztt. S., Sharpham (A.), 18/8/25.
Dolichocephala (*Ardoptera*) *guttata* Hal. S., Wells (L.).
,, ,, *irrorata* Fln. G., Hallen (B.), 20/8/24.

Gloma fuscipennis Mg. S., Brockley Combe (H.).
Hemerodromia baetica Coll. G., Bibury (A. H. Hamm.).
,, *laudatoria* Coll. G., Bibury (A. H. Hamm.).
Phyllodromia (*Chelipoda, Lepidomyia*) *melanocephala* F. G., Hallen (A.), 19/6/16. S., Leigh Woods (Wm.), 15/6/21; Sharpham (A.), 5/9/25; Holford (A.), 6/19.
Trichopeza longicornis Mg. S., Leigh Woods (H.) and (A.), 8/9/29.

Sub-family TACHYDROMINAE.

Tachista annulimana Mg. G., Painswick (W.). S., Sharpham (A.), 11/8/25.
,, *arrogans* L. (*cimicoides* F.). G., Olveston (C.); Cirencester (T.), 19/5/24. S., Shepton Mallet (C.); Shapwick (Wm.), 20/4/21; Abbot's Leigh (A.), 16/5/26.
Tachydromia agilis Mg. G., Cirencester (T.), 12/5/24; Tormarton (A.), 20/6/26; Blaise Castle (A.), 15/5/26. S., Portbury (H.); Keynsham (A.), 15/5/22; Abbot's Leigh (A.), 16/5/26.
,, *albicornis* Ztt. S., Leigh Woods (H.), 20/6/16.
,, *albiseta* Pz. S., Shapwick (A.), 17/6/23.
,, *annulata* Fln. G., Bristol (C.); Olveston (C.), 7/19.
,, *articulata* Mcq. G., Bristol (C.).
,, *calceata* Mg. G., Hallen (A.), 26/6/26. S., Tickenham (A.), 21/6/23.
,, *ciliaris* Fln. G., Bristol (C.).
,, *coarctata* Coll. S., Sharpham (A.), 6/8/23.
,, *fasciata* Mg. G., Westbury-on-Trym (Wm.), 4/7/20.
,, *fulvipes* Mg. S., Berrow (A.), 29/9/24; Sharpham (A.), 3/9/22.
,, *longicornis* Mg. (*pubicornis* Ztt.). S., Flax Bourton (H.); Sharpham (A.), 23/8/22.
,, *maculipes* Mg. S., Shepton Mallet (C.); Sharpham (A.), 27/8/25.
,, *major* Ztt. G., Dursley (A.), 9/6/25; Olveston (C.). S., Leigh Woods (H.), 30/5/16.
,, *minuta* Mg. G., Bristol (C.); Kingsweston (A.), 9/6/23; Olveston (A.), 28/6/25. S., Sharpham (A.), 27/8/25; Tickenham (A.), 20/8/23.
,, *nigritarsis* Fln. S., Weston-super-Mare (J.).
,, *pallidiventris* Mg. G. and S., common.
,, *pallipes* Fln. G., Shepperdine (A.), 30/7/24; Kingsweston (A.), 29/8/24.
,, *varia* Wlk. (*candicans* Fln.). S., Wells (L.); Shapwick (A.), 20/5/23; Abbot's Leigh (A.), 16/5/26.

XI. DOLICHOPODIDAE.

Size: small to medium. Predaceous flies with usually a more or less metallic sheen, found near water. The middle vein of the wing is usually more or less arched upwards at some distance from its end. The second joint of the antenna often overlaps the third. In most species the male has a long tail, with large side pieces, bent under the body. When at rest these flies seem to stand on tiptoe. The larvae, which are carnivorous, live in damp earth or decaying wood. Mr G. H. Verrall published a list of British Dolichopodidae, with tables, in " E.M.M." for 1904-5.

Sub-family CHRYSOSOMATINAE.

Psilopus (*Sciopus*) *longulus* Fln. G., Cirencester (T.), 6/7/23.
,, ,, *platypterus* F. G. and S., common.
,, ,, *Wiedmanni* Fln. S., Shepton Mallet (C.).

Sub-family DOLICHOPODINAE.

Dolichopus arbustorum Stan. S., Shepton Mallet (C.).
,, *atratus* Mg. S., Holford Glen (Miss Punfield).
,, *atripes* Mg. S., Tickenham (A.), 19/7/24.

Dolichopus brevipennis Mg. S., Dunster (A.), 8/6/24; Taunton (A.), 9/6/24; Keynsham (A.), 1/6/29.
,, *campestris* Mg. S., Shepton Mallet (C.); Sharpham (A.), 9/8/23.
,, *claviger* Stan. G., Cirencester (T.), 13/6/24.
,, *confusus* Ztt. S., Shepton Mallet (C.); Axbridge (Rd.).
,, *discifer* Stan. G., Cirencester (T.), 23/6/23; Olveston (A.), 30/7/22. S., Shepton Mallet (C.).
,, *festivus* Hal. G. and S., common.
,, *griseipennis* Stan. G. and S., common.
,, *latilimbatus* Mcq. S., Sharpham (A.), 10/9/25; Shapwick (F. W. Edwards), 7/9/30.
,, *lineaticornis* Ztt. S., St Audries (A.), 19/8/29.
,, *linearis* Mg. G., Stone (A.), 26/7/28.
,, *nubilus* Mg. G., Shepperdine (A.), 23/7/24. S., Sharpham (A.), 7/8/23; Berrow (B.), 13/6/30.
,, *pennatus* Mg. G., Painswick (W.); Hallen (A.), 1/8/29. S., Tickenham (A.), 11/5/29.
,, *plumipes* Scop. S., Batheaston (Bl.); Shapwick (A.), 3/9/22; Tickenham (A.), 24/5/26.
,, *popularis* W. S., Sharpham (A.), 3/8/25; Charterhouse-on-Mendip (Wm.), 22/6/29.
,, *simplex* Mg. S., Shapwick (A.), 3/9/22; Tickenham (A.), 20/7/23.
,, *trivialis* Hal. G., Painswick (W.); Tormarton (A.), 20/6/26. S., Shepton Mallet (C.); Sharpham (A.), 22/8/22; Taunton (A.), 9/6/24.
,, *ungulatus* L. (*aeneus* Deg.). G. and S., common.
Gymnopternus aerosus Fln. S., Sharpham (A.), 2/8/25.
,, *cupraeus* Fln. S., Shapwick (A.), 24/5/25.
,, *metallicus* Stan. S., Shapwick (A.), 20/5/23.
Hereostomus cretifer Wlk. S., Leigh Woods (H.), 27/8/18.
,, *flavicaudis* Wlk. G., Bristol (vide G. H. Verrall).
,, *germanus* Wied. G., Olveston (A.), 15/9/28. S., Leigh Woods (A.), 8/9/29.
,, *gracilis* Stan. S., Berrow (A.), 27/8/24.
,, *nanus* Mcq. G., Olveston (A.), 4/6/22.
,, *nigripennis* Fln. S., Berrow (Sl.), 21/7/28; Leigh Woods (H.).
,, *nigriplantis* Stan. S., Tickenham (A.), 20/7/23.
,, *parvilamellatus* Mcq. G., Olveston (A.), 4/6/22.
Hypophyllus obscurellus Fln. G., Stone (A.), 28/7/28. S., Leigh Woods (H.), 3/9/24; Tickenham (A.), 20/7/23.
Poecilobothrus nobilitatus L. G. and S., common.

Sub-family Hydrophorinae.

Hydrophorus bisetus Lw. G., Shepperdine (A.), 6/8/24; Aust (A.), 9/23. S., Kewstoke (H.); Wick St Lawrence (J.), 8/8/16; Burnham (A.), 28/8/22.
Liancalus virens Scop. G., Painswick (W.); Aust. (A.), 6/9/22; Blaise Castle (A.), 7/9/29. S., Leigh Woods (A.), 3/9/24.

Sub-family Medeterinae.

Medetera dendrobaena Kow. G., Cirencester (T.). S., West Town (Wm.), 20/8/28.
,, *jacula* Mg. G., Whiteshill (W.); Wotton-under-Edge (P.).
,, *micacea* Lw. S., Shapwick (J.), 5/8/16.
,, *petrophiloides* Par. S., Berrow (A.), 28/6/25.
,, *truncorum* Mg. G. and S., fairly common.

Sub-family Rhaphiinae.

Eutarsus aulicus Mg. S., St Audries (A.), 25/8/29.
Machaerium maritimae Hal. G., Aust (C.) and (A.), 6/9/22. S., Burnham (Rd.).
Porphyrops consobrina Ztt. G., Shepperdine (A.), 5/8/24.
,, *crassipes* Mg. S., Leigh Woods (H.), 22/5/17; Newton St Loe (Chm.), 9/6/25.

Porphyrops nemorum Mg. S., Wells (L.).
,, *spinicoxa* Lw. G., Stinchcombe (Chm.), 20/6/25.
Syntormon biseriatus Lw. var. *denticulatus* Ztt. G., Queenhill (A.), 1/11/25. S., Leigh Woods (H.).
,, *pallipes* F. G., Aust (A.), 6/9/22. S., Shapwick (A.), 26/8/25; Leigh Woods (H.); Uphill (J.), 9/9/16; St Audries (A.), 27/8/29.
Xiphandrium appendiculatum Ztt. S., St Audries (A.), 27/8/29.
,, *caliginosum* Mg. S., Leigh Woods (A.), 28/5/25.

Sub-family Neurogoninae.

Neurogona pallida Fln. G., Cirencester (T.). S., Leigh Woods (A.), 22/5/27; Portbury (H.).
,, *suturalis* Fln. G., Dursley (A.), 9/6/25; Cirencester (T.); Olveston (C.). S., Wells (L.), 7/03.

Sub-family Diaphorinae.

Argyra argyria Mg. G., Shepperdine (A.), 18/8/24. S., Portbury (H.); Tickenham (A.), 16/5/25; Sharpham (A.), 4/9/25.
,, *atriceps* Lw. S., Prior Park, Bath (A.), 18/7/25.
,, *diaphana* F. G., Olveston (A.), 18/6/22; Stone (A.), 28/7/28; Selsley (Br.). S., Freshford (C.); Brockley (J.); Tickenham (A.), 24/5/26; Keynsham (A.), 1/6/29; Prior Park, Bath (A.), 20/5/29.
,, *leucocephala* Mg. G. and S., common.
Chrysotus blepharosceles Kow. G., Olveston (A.), 30/7/22; Hallen (A.), 12/7/24. S., Dunster (A.), 8/6/24; Keynsham (A.), 14/7/26.
,, *cilipes* Mg. S., Tickenham (A.), 19/7/24.
,, *gramineus* Fln. G. and S., common.
,, *loesus* Wied. S., Freshford (C.); Shepton Mallet (C.).

Sub-family Campsicneminae.

Bathycranium bicolorellum Ztt. S., Sharpham (A.), 10/9/25.
Campsicnemus curvipes Fln. G. and S., common.
,, *scambus* Fln. S., Sharpham (A.), 9/8/23.
Chrysotimus molliculus Fln. S., Sharpham (A.), 27/8/25, and (F. W. Edwards), 7/9/30.
Micromorphus albipes Ztt. S., Clevedon (W.).
Sympycnus annulipes Mg. G., Stone (A.), 30/7/28. S., Shapwick (J.), 5/8/16; Sharpham (A.), 28/8/22.
Xanthochlorus tenellus Wied. G. and S., fairly common.

XII. LONCHOPTERIDAE.

Small flies, generally caught in numbers when sweeping through grass. Third joint of antenna almost globular with long, slender, subapical arista. The wings are long, elliptical with two long veins, then a third vein which branches twice, then a fourth short vein which in the male ends in the edge of the wing but in the female turns up and ends in the vein above. The larvae live in vegetable detritus. This family is dealt with in "Diptera Danica," Part V., 1916, by W. Lundbeck.

Lonchoptera furcata Fln. var. *lacustris* Mg. G. and S., common.
,, *lutea* Panz. var. *lutea* Mg. G. and S., common.
,, ,, var. *cinerea* Meij. G., Blaise Castle (A.), 16/3/24. S., Shapwick (A.), 1/5/27; Tickenham (A.), 24/4/22.
,, ,, var. *flavicauda* Mg. G. and S., common.
,, ,, var. *palustris* Mg. G., Olveston (A.), 22/9/22. S., Sharpham (A.), 7/9/25.
,, ,, var. *trilineata* Ztt. G. and S., common.

ADDITIONAL NOTES AND CORRECTIONS TO PARTS I. AND II.

MYCETOPHILIDAE.

Anatella setigera Edw. G., Dursley (A.), 12/10/30.
Apoliphthisa (*Tetragoneura*) *subincana* Curt. (*melanoceras* Hal.). S., Leigh Woods (F. W. Edwards), 6/9/30.
Boletina dispecta Dz. S., Leigh Woods (F. W. Edwards), 6/9/30.
Brachypeza helvetica Wlk. (*spuria* Verr.). G., Blaise Castle (A.), 3/9/30.
Exechia dorsalis Staeg. G., Dursley (A.), 12/10/30.
Macrocera phalerata Mg. S., Kewstoke (Wm.), 25/7/22.
Mycetophila guttata Dz. S., Leigh Woods (A.), 15/9/30.
Mycomyia flavicollis Ztt. G., Dursley (A.), 12/10/30.
Phronia forcipata Winn. S., Leigh Woods (F. W. Edwards), 6/9/30.
Sciophila lutea Mcq. G., Stone (A.), 27/6/28.
Synapha (*Empalia*) *vitripennis* Mg. G., Dursley (A.), 12/10/30.
Rhymosia inacrura Winn. S., Blagdon (A.), 19/4/28.

SCATOPSIDAE.

Scatopse pulicaria Lw. Part I., p. 49, should read *S. fuscipes* Mg. (*incurva* Lw.).

SIMULIDAE.

Simulium aureum Fries. G., Stone (A.), 27/6/28.

CHIRONOMIDAE.

Macropelopia notata Mg. Part I., p. 50, delete G., Stone (A.), 21/5/27; insert S., Brockley Combe (Wm.), 23/4/27.
Pentapedilum tendipediforme Goet. S., Shapwick (F. W. Edwards), 7/9/30.
Spaniotoma (*Smittia*) *trilobata* Edw. S., Shapwick (F. W. Edwards), 7/9/30.
Tanypus (*Pentaneura*) *lentiginosus* Fries. G., Stone (A.), 21/5/27.
,, ,, *nubila* Mg. (*dubia* Staeg.). S., Blagdon (A.), 18/4/28.
Chironomus pilicornis F. (*moerens* Wlk.). S., Blagdon (A.), 19/4/28.

CERATOPOGONIDAE.

Culicoides obsoletus Mg. S., Backwell (Wm.), 2/9/28.
Tetraphora (*Dasyhelea*) *egens* Winn. (*flavoscutellata* Ztt.). S., Backwell (Wm.), 29/7/28; Shapwick (F. W. Edwards), 7/9/30.
Forcipomyia bipunctata L. (*trichoptera* Mg.). S., West Town (Wm.), 26/8/28.
,, *palustris* Saund. S., Shapwick (F. W. Edwards), 7/9/30.
,, *titillans* Winn. S., Shapwick (F. W. Edwards), 7/9/30.
Stilobezzia flavirostris Winn. S., Nailsea (Wm.), 20/7/29.

CULICIDAE.

Dixa amphibia Deg. S., Shapwick (F. W. Edwards), 7/9/30.

LIMONIIDAE.

Dactylolabis sexmaculata Mcq. (*frauenfeldi* Egg). S., Bank of Avon (A.), 11/4/30.
Gonomyia lateralis Mcq. G., Nibley (A.), 14/6/30.
,, *tenella* Mg. G., Stone (A.), 28/6/28.
Ormosia albitibia Edw. S., Leigh Woods (F. W. Edwards), 6/9/30.
Poecilostola pictipennis Mg. S., Nailsea (Wm.), 14/8/25.

The Scenic Features of Igneous Rocks.

By S. H. Reynolds, M.A., Sc.D.,
Professor of Geology in the University of Bristol.

IN a paper published in the "Proceedings of the Bristol Naturalists' Society" for 1929, an attempt was made to describe and illustrate the scenic features of limestones. The present paper aims at giving a corresponding account of those of *igneous* rocks, *i.e.*, rocks which have consolidated from a molten state. The subject of the present paper is, however, a far wider one than that of the previous paper, owing to the great variety in composition and structure of igneous rocks and their diverse methods of occurrence in the field.

Briefly stated, the methods of occurrence in the field which need be alluded to in the present paper are:—

a. Bosses or stocks—large irregular masses of igneous rock often miles in diameter, which originally consolidated deep within the earth and have been exposed at the surface by prolonged erosion.
b. Dykes—relatively small, nearly vertical masses which have broken more or less transversely across pre-existing strata.
c. Intrusive sheets or sills which are approximately horizontal masses forced into pre-existing rocks and tending to follow the bedding planes.
d. Lava flows poured out on the surface.
e. Volcanic necks, *i.e.*, the worn-down stumps of old volcanoes. They represent material which consolidated in the throat or vent.

Igneous rocks are commonly divided into:—

1. Plutonic rocks which consolidated deep within the earth but now are exposed at the surface owing to erosion and form the material of bosses or stocks.
2. Minor intrusive rocks which resemble plutonic rocks in the fact that they consolidated within the earth's interior and owe their exposure at the surface to denudation. From the point of view of the present paper they may be said to be those forming dykes and sills.
3. Volcanic rocks which are those poured out on the surface as lava flows.

On the border line between the igneous and ordinary sedimentary rocks are the *tuffs* formed of fragments varying very greatly in size which owe their origin to the explosive action of volcanoes.

Fine grained lavas and tuffs are particularly subject to the weathering action of frost and much of the finest mountain scenery in the Lake District and North Wales is partly due to this fact.

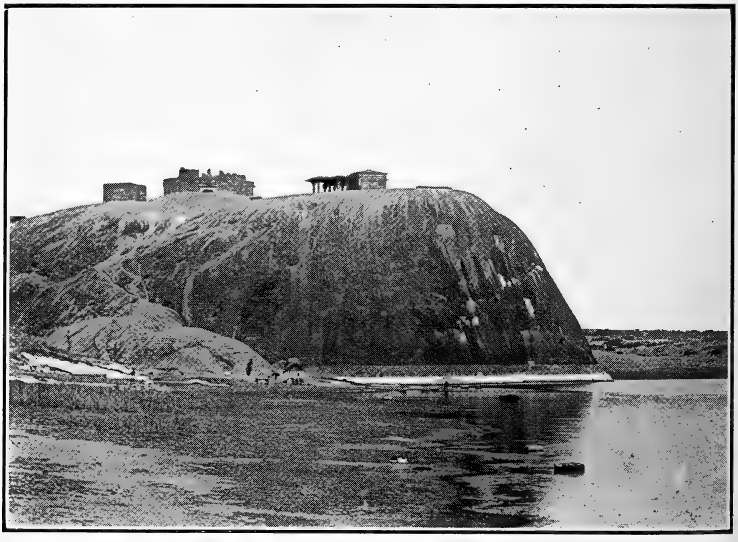
While as regards their mineralogical composition the varieties of igneous rocks are almost endless, from the scenic point of view very few need be considered, and these may be classified as follows:—

A.—BEINN NA CAILLICH, ONE OF THE RED HILLS OF SKYE.
Shows the smooth outline frequently characteristic of hills formed of granitic rocks.

B.—SGURR NAN GILLEAN, SKYE.
Shows the rugged outline of the gabbro mountains.

Plate VII.

A.—"LE GRAND SARCOUI" CLERMONT, AUVERGNE.
Shows the rounded outline characteristic of the trachyte puys. The hill on the right (Les Goules) has a crater and is composed of tuff.



B.—HILL AT WARANGAL, NEAR SECUNDERABAD, INDIA.
The smooth rounded outline is due to exfoliation.

Plate VIII.

	ACID.	BASIC.
PLUTONIC	granite	gabbro
VOLCANIC AND MINOR INTRUSIVE	rhyolite and trachyte	basalt

In is an interesting fact that as regards abundance and hence importance from the scenic aspect, the acid plutonic rocks—the granites and the basic volcanic and minor intrusive rocks—the basalts are vastly the most important.

Acid rocks when occurring as plutonic masses of moderate size frequently, but by no means always, tend to form hills with smooth rounded outlines. This is typically shown in the case of the Red Hills of Skye (Pl. VII., A), the outlines of which contrast strongly with those of the neighbouring gabbro mountains (Pl. VII., B). The same feature is shown by some of the Galloway granite masses, such as the Cairnsmore of Fleet.

Acid lavas cool relatively quickly and hence do not flow far before consolidation. The Grand Sarcoui (Pl. VIII., A), one of the trachyte hills of the Puy de Dome district in Auvergne, is believed to owe its peculiar form, which resembles that of an inverted basin, to the viscosity of the material of which it is composed. The trachyte seems to have been squeezed out of a vent occupying the position of what is now the centre of the hill and to have spread out for only a short distance, the last mass of lava to be ejected consolidating in the crater and closing it up.

The rounded form of many granite surfaces in countries with a high daily range of temperature depends on exfoliation. During the day time, the surface layers being very much heated, tend to detach themselves from the layers beneath and to bulge outwards. This tendency to detachment is further accentuated when rapid cooling by radiation takes place after sunset, and eventually flakes and slabs separate off from the main mass or *exfoliate*. To this process the rounded domes of the Yosemite valley, California, and of the Matopos Hills in Rhodesia are due. Similar features are well known in India (Pl. VIII., B), S.W. Africa, Australia, and many other parts of the world.

Allusion may here be made to the peculiar *inselberg* type of landscape which, though not confined to granitic rocks, is specially characteristic of them. It is marked by the occurrence of precipitous smooth-sided hills, often conical in form, rising suddenly from the plain and often towering above it for a thousand feet or more. Such heights are found in many parts of the tropics, such as Mozambique, Tanganyika territory, Northern Nigeria (Pl. IX., A) South West Africa, Northern Ceylon. They seem generally but not universally to be associated with an arid climate. Those of Mozambique present an astonishing spectacle when viewed from a steamer passing along the coast and the peaks near Rio de Janeiro must, to judge from photographs, be almost equally impressive.

There is no general agreement as to the exact method of origin of inselberge, and it is probable that they may have arisen in more than one way. In arid regions many of them may be of the nature of residual hills, *i.e.*, ones which, from being composed of harder rocks than the rest or from some other cause, have survived the general levelling by erosion. Dr J. D. Falconer, who attributes them to alternating periods of static weathering and of river erosion, writes as follows[1]:—

"A plane surface of granite and gneiss subjected to long continued weathering at base level would be decomposed to unequal depths, mainly according to the composition and texture of the various rocks. When elevation and erosion ensued the weathered crust would be removed and an irregular surface would be produced, from which the more resistent rocks would project." Exfoliation plays an important part in producing the smooth rounded outlines.

The minor features which give such a characteristic appearance to many granite areas, such as Dartmoor and the Cornish granite masses, are due to weathering along the powerful vertical and horizontal joints which traverse the rocks. The tors which cap so many of the hills in these regions vary in appearance according to whether the vertical or horizontal joints are the more developed. When the vertical joints

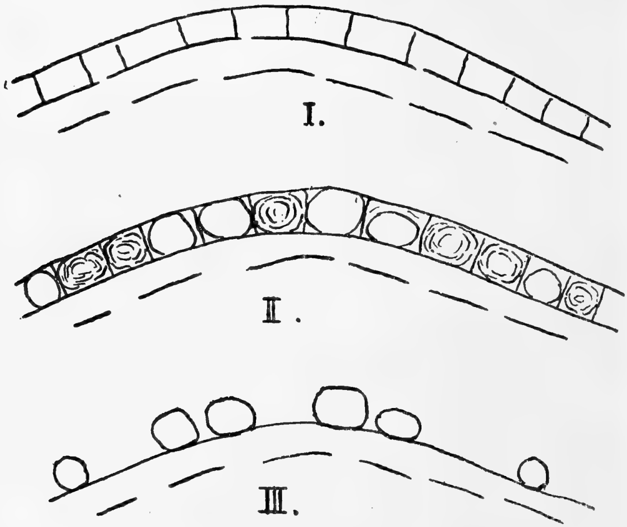
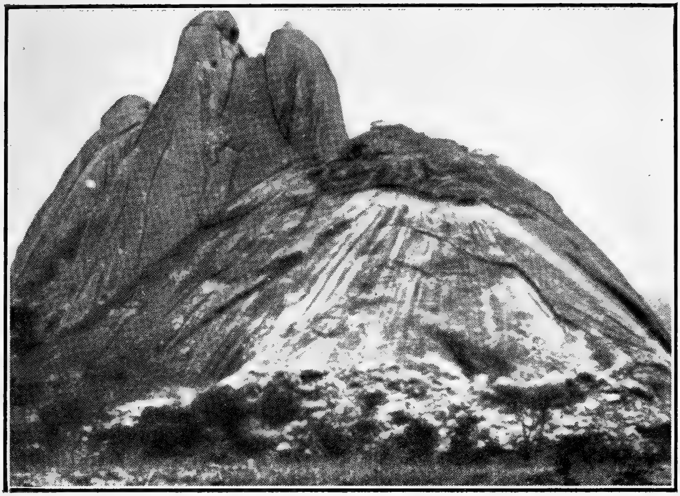


DIAGRAM SHOWING THE PROBABLE MODE OF ORIGIN OF THE MATOPOS GRANITE "BOULDERS."

1. Rounded surface of rock probably due to exfoliation and showing two sets of joint-planes, one concentric with the surface, the other at right angles.
2. Weathering along the joint-planes at right angles to the surface has isolated a series of more or less rectangular blocks, some of which, though weathering at the corners, are proving relatively resistent, while others are rapidly crumbling away.
3. Present conditions where many of the blocks have completely disappeared owing to weathering.

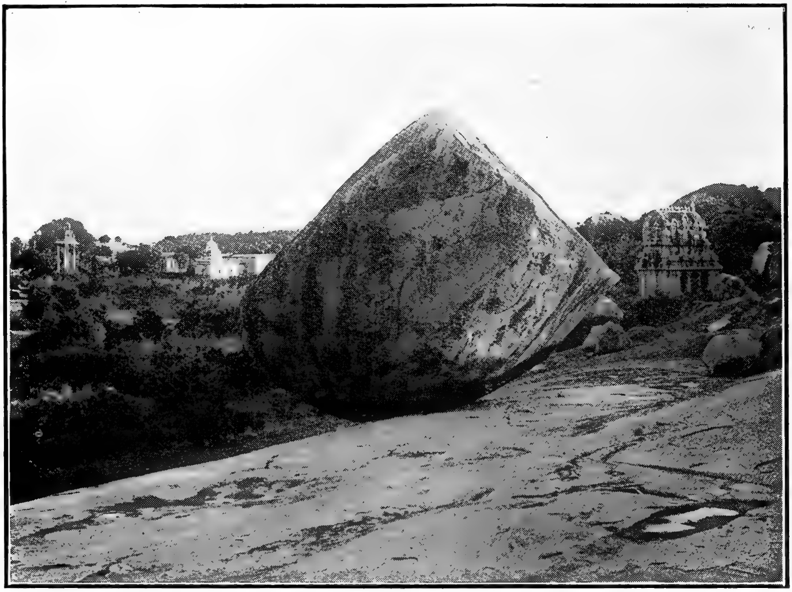
[1] The Geology and Geography of Northern Nigeria (1911), p. 246.



A.—INSELBERG IN THE KILBA HILLS, NORTHERN NIGERIA.
(Photographed by the late A. Longbottom.)
Shows the production of a smooth outline by exfoliation.

B.—ROUGH TOR, BODMIN MOOR, CORNWALL.
Granite weathering along predominantly horizontal joint-planes.

Plate IX.



A.—THE SEVEN PAGODAS, NEAR MADRAS.
A loggan-stone resting on an exfoliated surface of granite.

B.—RHODES' TOMB, MATOPOS, SOUTHERN RHODESIA.

Plate X. Granite " boulders," compare diagram p. 210.

are the more prominent, pillar-like masses such as the well-known Dartmoor rock called Bowerman's Nose may result. When the horizontal joints are specially powerful, features such as those illustrated in the photograph of Rough Tor (Pl. IX., B) may arise. When both vertical and horizontal joints are powerful and regular, weathering may gradually round off the corners till portions may become completely detached from the rest as in the case of the logganstones of Cornwall. Similar features in many other parts of the world are due to prolonged weathering along joints. The rounded surfaces due to exfoliation and the logganstone-like masses produced by weathering along joints may bear a curiously close resemblance to ice-transported boulders resting on a glaciated surface (Pl. X., A). This is well seen in the neighbourhood of Rhodes' tomb, Matopos (Pl. X., B), and the diagram on p. 210, shows how these features may have arisen.

Granites may, however, weather in forms very different from those hitherto described, thus on many mountain summits in the Alps and elsewhere, if traversed by close-set joints granites weather through frost action, into a jagged series of crests and pinnacles. This method of weathering is not perhaps a very general feature among British granites, but is well seen in that of Goatfell, Arran, and in the gabbro of the Coolins, Skye (Pl. VII., B).

In many parts of the world, but particularly in Corsica, the granite may be most fantastically weathered into irregular hollows. A noted example is the "Tête du Chien" at Piana. While the most remarkable instances are probably those at La Calanche, Piana, at no great height above the sea, other examples almost equally remarkable occur in many parts of the island up to heights of 5000 feet or more. Very similar examples from Port Victor, near Adelaide, are thought to be in some way dependent on their proximity to the sea.

Although numerous large intrusive masses of basic rock are found, it would probably be correct to say that its most common and characteristic method of occurrence is as lava flows or in the form of relatively small dykes and sills.

Dykes vary much in durability and power of resistance to the forces of erosion. When of a durable type, or when intruded in rock which can be easily weathered, they tend to stand out above the general level as ribs of rock (Pl. XI., A). This is particularly noticeable in the dykes penetrating the little-consolidated material of many modern volcanic cones. Frequently, however, a dyke is less resistent than the surrounding rock and by weathering gives rise to a trench or gully (Pl. XI., B), or, when occurring on a large scale, to a deep ravine or chasm as in the Coolins of Skye or at Mickledore, between Scafell and Scafell Pike.

The well-known Sgurr of Eigg (Pl. XIII., A), probably the most remarkable and impressive feature in the islands off the west coast of Scotland, owes its outstanding appearance to the removal by erosion of the less resistent rock with which it was originally associated. First described as a lava flow, more recent opinion (not shared by all authorities), is that it is an intrusive mass.

More important scenically than dykes are the horizontally-disposed masses of basic rock, the lava flows and sills. These vary much in their powers of resistance to the weathering agents. Some are dense, compact rocks, others include numerous steam cavities and are readily weathered. When, as is frequently the case, these two types alternate, a very characteristic terraced form of landscape results, the hard bands giving rise to lines of crag and cliff over which the streams tumble in cascades, the softer bands forming grassy slopes. This type of landscape is typically seen in the Tertiary volcanic regions of the western islands of Scotland, especially in Skye, Mull, Eigg, and Canna (Pl. XII., A). In all these areas the lavas are quite as important as the sills.

In other regions, such as the Karroo in S. Africa, there are no lavas but the sills are very numerous, and are the cause of many hundreds of flat-topped hills (*tafelberge*) (Pl. XII., B). Identical basalt-capped hills are characteristic of Auvergne, *e.g.*, Carlat, the Coiron and Gergovia. Prolonged erosion of such a plateau may reduce it to a conical hill (*spitzkop*) (Pl. XII., B) still capped by a remnant of the basaltic sheet.

A feature which produces a marked scenic effect is the columnar jointing so well seen at the Island of Staffa, the Giant's Causeway, and countless other localities. Such columnar jointing, though most characteristic of basalts, may occur in almost all kinds of lava and in intrusive rocks as well. In many cases while the lower part of such a basaltic mass shows regular columnar jointing, the upper part may be far more closely and irregularly jointed. The contrast between the two parts is equally well marked in undoubted lava flows such as those which poured into the valley of the Ardèche at Jaujac in Auvergne and in Scottish examples which are frequently regarded as sills, a famous example being that of the Isle of Staffa. It is generally stated that the difference depends on rate of cooling, the columnar structure being assumed in the more deep seated part of the mass where the cooling was slow and the irregular jointing in the superficial parts where the cooling was more rapid, the sharp break between the two being due to each mass having cooled from the surface inwards.

A minor feature characteristic of many basic lavas and sills is their tendency to spheroidal weathering. Bonney described spheroidal structure as a result of strain set up by contraction usually during cooling in fine-grained igneous rocks, especially basalts. The strain tends to produce concentric lines of fracture and along these weathering takes place, causing successive shells to flake off.

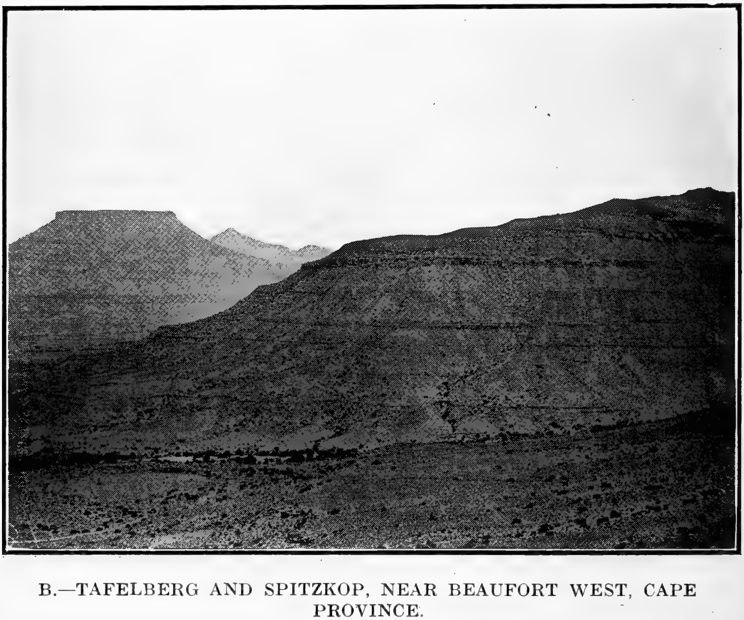
Allusion may also be made to the peculiar pillow-like surface assumed by certain lavas (spilites). Very perfect examples are seen in the Precambrian rocks of Canada and Anglesey, the Ordovician of Ayrshire and Co. Mayo and the Devonian of Cornwall. This structure has been proved in the case of a lava in one of the Samoan islands to be due to rapid cooling in the sea and is generally believed to indicate a submarine flow.

A volcanic neck may be composed of an igneous rock, or a tuff, or of the two types combined. While a volcanic neck or vent may be worn

A.—BASALT DYKE, NEAR KILDONAN, ARRAN.
Stands out prominently from the less resistent rock into which it was intruded.

B.—GULLY DUE TO WEATHERING ALONG BASALT DYKE IN GRANITE.
Plate XI. W. end of Mull, Inner Hebrides.

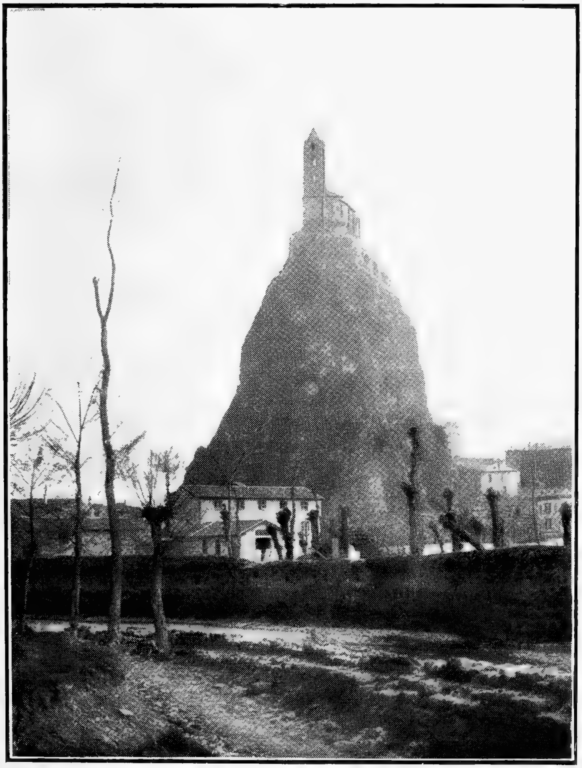
A.—BASALT TERRACES, CANNA, INNER HEBRIDES.
(Photographed by the late G. W. Palmer.)
Illustrates the plateau-basalt type of scenery.



B.—TAFELBERG AND SPITZKOP, NEAR BEAUFORT WEST, CAPE PROVINCE.

Plate XII. (Photographed by Dr A. W. Rogers.)

A.—THE SGURR OF EIGG, INNER HEBRIDES, FROM THE N.E.
The pitchstone ridge extends away to the right of the Sgurr; basalt cliffs in the foreground.



B.—THE ROCHER MICHEL, LE PUY, AUVERGNE.
A volcanic neck.

Plate XIII.

down by erosion flush with the surface of the ground as in the case of the Kimberley diamond pipes, it far more often forms a prominent hill. Small examples of such necks are admirably seen on the shores of Fife from St Andrews to Burntisland. Other examples are found in the Edinburgh district and elsewhere in the lowlands of Scotland, and include such well-known hills as Arthur's Seat, Edinburgh Castle rock, North Berwick Law, and the Binn of Burntisland. A particularly remarkable example is afforded by the Rocher Michel, Le Puy, Auvergne (Pl. XIII., B). Magnificent examples occur in Arizona.

Sincere thanks are tendered to Dr J. D. Falconer and Dr A. W. Roger for permission to reproduce Pl. IX., A and Pl. XII., B.

The Botany of Bristol.[1]

By J. W. White, M.Sc., F.L.S.

THE city boundaries have spread so far afield and its suburbs enlarge so rapidly that, as time passes, we realise more and more the wisdom of those who chose the large area of the *Bristol Coal-fields and Associated strata*, defined by the geological map of Mr Sanders, as a suitable district for natural history investigations. For it is an extensive tract of country, equal in size to many English counties, and will provide room enough for naturalists to work over in generations yet to come. And to such students it must be an undeniable advantage to carry on their field work within limits that are substantially natural instead of within an entirely arbitrary line drawn around the city as a centre. We speak of the Bristol district, therefore, as bounded on the west by the Severn Sea and the Bristol Channel; on the south by the river Brue which falls into the mouth of the Parrett just below Burnham; on the north as including the towns of Berkeley and Dursley; and extending east to the cities of Bath and Wells. Portions of North Somersetshire and of West Gloucestershire make up this area, and are separated, save for a short distance, by the river Avon, which, passing through Bath and Bristol, joins the Severn at Avonmouth.

The want of a published Flora embracing the whole of the district whose botany is here described, with its wide diversity of hill and dale, wood, river and marsh, and its great variety of geological formations, had long been felt by local botanists, and was fairly well met in the eighties of last century by the publication in the "Proceedings of the Bristol Naturalists' Society" of the *Flora of the Bristol Coal-field*. With its Supplements this compilation treated, concisely and with fair accuracy, of about 1020 flowering plants and vascular cryptogams, excluding varieties, aliens and casuals. It was replaced in 1912 by a far more comprehensive work—*The Flora of Bristol*—by the same author. In this book 1178 species are adjudged to be permanent units in the district. In addition, records are given of 255 varieties and 282 aliens and casuals. These are big figures, but as will be presently mentioned they have been made larger still by later discoveries. All those enquirers who may desire to become more closely acquainted with our plants in their respective habitats can be confidently referred to that Flora. The *History of Bristol Botany* therein contained shows clearly that not only is the modern city of Bristol particularly interesting to botanists on account of the richness of her flora, but that abundant evidence exists that the natural advantages of the district were as fully known in past centuries as they are to-day. That this good repute was established even before the invention of printing is indicated in an expression used by one of the earliest botanical travellers, who speaks of

[1] Written for the Bristol meeting of the British Association, September 1930, but not published.

wending his way to " the famous St Vincent's Rocks." We find, indeed, that the primitive British herbalists, with successive writers of eminence in later years, and scientific men from other lands on their visits to this country—in fact, every botanist of note from the foundation of the British Flora by William Turner down to the present time—all made a pilgrimage to Bristol, attracted by the fame of her scenic loveliness and the rarity of her limestone plants. It should be remembered that these visitors of the sixteenth and seventeenth centuries lived in times when no one thought of travelling for pleasure; when roads were few and perilous; when food and lodging for man and beast must have been scarce simply because there was so small a demand for either outside the towns; and when every lengthy excursion was beset with risk and discomfort of which the modern tourist knows little or nothing. But those learned men who ventured far into the remote West in pursuit of knowledge at first hand were not disappointed when they reached our city. An air of cheerful satisfaction pervades the records and letters that survive. With Lobelius they could say that Bristol was " urbs peramœna " a place of pleasant remembrances. The time-stained pages of old herbals, accordingly, contain many mentions of our plants with localised records and descriptions. Although our Rocks and Downs at the present time no longer wear the clothing that met the eyes of Turner, Parkinson, or Gerard, and the " millions of Hart's Tongues about Bristol in ye Lands and Roads all over," noted by Plukenet about 1690, have been extirpated, yet one can say with good content that all the more important species known of old are still with us though it may be in seriously lessened quantity.

It happens fortunately that our rarer local plants are generally confined to precipitous rocks with adjacent stony slopes and broken ground, unfit for cultivation or for building. Our swamps and water courses, too, as a rule are safe from disturbance. And many important habitats are in localities which, like Brandon Hill, the Observatory Hill, and Clifton and Durdham Downs, are now devoted as open spaces for the use of the citizens for ever. The Avon Gorge with its unrivalled charm is in no danger; all quarrying on the Clifton side has happily come to an end; and a splendid riverside road to Avonmouth, lately completed, must by its fencing aid Nature's effort to restore the displaced rupestral vegetation. Upon St Vincent's Rocks and the Downs, in the Gorge itself, in Leigh Woods and the Frome valley, the stranger who visits Bristol in search of plants can, while rambling amid delightful scenery and with little exertion, make acquaintance with many of the greater rarities.

The following account aims at conveying to the visiting botanist and readers unfamiliar with the country a view in broad outline of the topography and surface conditions of the district, together with a mention —without unwanted detail—of the noteworthy plants that occur. As should be expected, the geology and vegetation, here as elsewhere, vary together. Of this fact, the contrast between the flora of the relatively acid coal measures with that of the alkaline limestone soils is a striking example.

The city of Bristol lies in a basin at the confluence of the rivers Avon and Frome, the latter a small tributary from the north-east which flows through the picturesque Glen Frome, and is not to be confounded with the larger stream passing by the town of that name. Around the city arise hills that are more or less broad table-lands or plateaux. The steep acclivities on the north and west are mainly masses of carboniferous limestone. To the south the swelling slopes of Knowle and Totterdown extend towards the Dundry range, which rises to 769 feet near the village and bounds the horizon for a considerable sweep. On the east a wide expanse of coal-measures containing many pits extends from the river Frome to the low cliffs that contain the Avon at Brislington and Conham. The influence of the tide is shut off near this spot, and the Avon, being locked, becomes a canal. Beyond Bath, however, the canal leaves the river to join the Kennet and Thames system and thus formed, before the development of railways, one of the more important links of inland navigation between Bristol and the metropolis. Towards Bath the riverside scenery and botany are somewhat commonplace, although along the towpath and on the Somerset bank in this direction have been found *Saponaria*, *Moenchia*, *Epilobium Lamyi*, *Sambucus Ebulus*, *Rubus Borreri*, *R. raduloides*, *R. infecundus*, *Sedum Fabaria*, Tansy and several Mints. *Potamogeton Drucei* is abundant in the river near Bath, having travelled possibly through the canals from the Thames and Loddon, where it was first observed. The smaller and much synonymed *P. Friesii* may be seen near Kelston and Saltford locks. On the Bath oolite are several species that do not occur elsewhere in the district, *viz.*, *Polygala calcarea*, *Thesium humifusum*, *Orchis ustulata* and *Euphorbia pilosa*. Returning now through the city and Hotwells we reach the terraces of Clifton and the bare mass of St Vincent's Rocks. Here, not many years ago, the attractive spikes of *Veronica hybrida* could be gathered without risk, and the same might be said of *Geranium sanguineum*, *G. columbinum* and *Sedum rupestre* (*minus*). But these have all retreated to less accessible ledges of the cliff to keep company with tiny colonies of *Allium sphaerocephalum* and *Scilla autumnalis*. Towards the Suspension Bridge the cliff face in May bears a delightful crop of yellow Wall-flowers; and hereabout, too, can be seen, but not touched, Orpine, Snapdragon, and a beautiful white-flowered sport of the Greater Knapweed. Above, nestling in the turf of the ancient camp, are *Trifolium scabrum*, *T. subterraneum*, *Trigonella*, and *Cerastium tetrandrum*, while *C. semidecandrum* is often to be found sheltered under the path-side seats. All five are similarly associated near the paths on Brandon Hill. The Alexanders, Parsley, and Fennel, so prominent on the cliff-edge and elsewhere about the Observatory Hill, are probably the remains of bygone cultivation and may be derived from a herb garden used by the hermit who, tradition says, at one time inhabited the Giant's Hole. Alexanders is one of the oldest English and French plant-names, and for many centuries the herb was much esteemed as a green vegetable. But it has so long been superseded by more excellent food-stuffs that its very name is in danger of being forgotten, and by a confusion of ideas ill-informed persons have demanded its extirpation from the Rocks as " a rampant growth of Wild Celery." A broad ledge along the face of the cliff by which the hermit reached his lair has been quarried away and exported to the West Indies as ballast for old time sugar ships. And with that ledge may have gone *Lactuca virosa* and one or two other good things that were authentically recorded in past days. The alien garlics, *Allium roseum*, *A. carinatum* and *A. siculum*, precariously established on the rocks, were planted years ago by some " victim of a false enthusiasm." A few yards to the north we look down abruptly to a broad glade and green valley that mark a great dislocation and distortion of the strata known as the " Great Fault." Here for a short distance Millstone Grit, shales and conglomerate come to the surface, and the flora changes surprisingly. Calcifuge species such as *Ornithopus perpusillus* and *Sagina ciliata* at once appear, and the wealth of Rubi (a group remarkably shy of limestone) within the space of a few yards is extraordinary. The Downs have entirely altered in character during the last few decades. The golden gorse-covered and heathy commons dear to our fathers have completely vanished under the trampling feet of growing crowds; and wide stretches of bare turf no longer show signs of the characteristic vegetation with which they once abounded. Even furze is now banished to the edge of the cliffs where a protecting fence gives it security. At the present day *Aquilegia*, *Spiraea Filipendula*, *Hippocrepis*, Bee Orchis, *Carex pulicaris*, *C. pilulifera*, *C. panicea*, *C. digitata*, *Avena pratensis*, *A. pubescens*, *Gastridium* and *Bromus madritensis* must be looked for on ledges, banks and bushy spots for which the golfer and footballer have no use. Here and there on rocky slopes and screes overlooking the Avon the Bristol Rock Cress (*Arabis stricta*) is sparsely scattered in early Spring, together with *Hutchinsia*, *Cerastium pumilum*, *Trinia glauca* and *Carex humilis*, the latter chiefly on the turfy edges of old excavations and depressions of the ground. After flowering the sedge blends its foliage with the grasses and entirely justifies its specific name. *Potentilla verna* is far more conspicuous and plentiful, and indeed is frequent on exposed limestone throughout the district. Towards the Sneyd Park boundary, where limestone again comes to an end and the turf is much less worn, *Carduus acaulis* with its caulescent variety, some Hare-bells and at least four species of *Rubus* are in evidence. In Cook's Folly Wood abundant Foxgloves mark the transition to Old Red Sandstone. In its tidal course to the Severn below Bristol the Avon reaches an extensive tract of alluvial flats drained by numerous intersecting ditches mainly brackish, and inhabited by the customary estuarial halophytic vegetation. On the way its banks and land near by yield *Trifolium squamosum*, *Lathyrus Nissolia*, *Petroselinum segetum*, *Tragopogon porrifolius*, *Allium oleraceum*, *Carex divisa*, *Alopecurus bulbosus*, *Sclerochloa maritima* and *Triticum pungens*. *Asparagus* and *Chenopodium urbicum* occur sporadically. Other principal sources of drainage in the district are the Frome, the Chew, the Yeo, and the Axe. The Frome drains a region that comprises most of the Coal Measures to the north-east of Bristol. Rising in the Sodbury Hills it takes a picturesque course by way of Frampton Cotterell and Frenchay, providing us en route with *Corydalis claviculata* and *Carex vesicaria*, passes as a moat under the city's ancient walls, and falls into the Floating Harbour at St Augustine's. The flexuous valley of the brisk little stream presents some charming bits of rural scenery, the most lovely being on its lowest reach where it passes through the domain of Oldbury Court to Glen Frome, under Stapleton. Through this Sandstone area the river has cut deeply a narrow channel, our sole station for *Campanula latifolia* and *Asplenium lanceolatum*, and an unfailing source of *Cardamine impatiens* with *Geranium rotundifolium*. Aconite grows on a shady bank by the water associated with a rare hybrid Comfrey (*Symphytum lilacinum* Buckn.).

The Chew runs through a rich pasture valley between Dundry and the Mendips by way of Chew Magna, Stanton Drew and Pensford. It reinforces the Avon at Keynsham. A long list of good plants can be noted from the Chew Valley, particularly from that section between Stanton Drew and Compton Dando. This tract affords:—*Helleborus viridis*, *Stellaria umbrosa*, *Vicia bithynica*, *Lathyrus Nissolia*, *Rubus fissus*, *R. sulcatus*, *Epilobium roseum*, *Senecio sarracenicus* in profusion, *Inula Helenium*, *Mentha longifolia*, *M. piperita*, *M. rubra*, *M. paludosa*, *Daphne Laureola*, *Juncus compressus*, *Calamagrostis Epigeios*, *Carex acuta* and *C. strigosa*. In a meadow and lane at Woollard Snowdrops are plentiful; and on the riverside near Chew Magna *Symphytum* hybrids form a handsome group of many tints. The head waters of the Axe are underground in Mendip, and flow forth from caves at Wookey Hole and Cheddar, whence toll is taken by the Bristol Water Company. In its course to the Channel at Brean Down the angler is perhaps more interested than the botanist. Near Congresbury there drains into the Yeo a spring-head choked with *Ceratophyllum submersum*. The tidal estuary of this small river can be reached from Woodspring Priory.

Besides the Dundry range there are in the vicinity of Bristol some isolated hills of lower altitude. But the chief elevations are on Mendip a few miles to the south-east, and among the southern spurs of the Cotswolds which come down into the north-eastern portion of the district. These latter afford some enjoyable rambles from stations on the L.M.S. Railway, being either wooded and furnishing an abundance of belladonna, lily of the valley, Solomon's seal and good orchids; or open and grassy, decked with patches of *Hippocrepis*, *Trifolium medium*, *Galium erectum*, *Campanula glomerata*, *Verbascum nigrum* and many roses. Among the Cotswold spurs occur nearly a dozen species not to be found elsewhere about Bristol, including the very rare *Stachys alpina*, *Rubus rudis*, *R. Bucknalli*, *Astragalus danicus* and *Hordeum sylvaticum*. There is an extraordinary colony of *Lilium Martagon* at Hillsley; *Papaver somniferum* is prevalent above Wotton-under-Edge, and the only aboriginal Box woods in Britain are situate near Alderley and Boxwell. The Mendip Hills are, for the most part, huge masses of Mountain Limestone with cores of Old Red Sandstone, rocky and precipitous in places, but presenting usually rough pasture and rugged slopes. The summits have been planed down by denudation to broad levels varying from 800 ft. to the top of Black Down, a wide tract of open moor and heath that rises to an altitude of over 1100 ft. Upon the limestone the soil is shallow, and the underlying rock so permeable that in spite of heavy annual rainfalls no water remains long on the surface of that formation. But wherever sandstone or igneous rock becomes exposed drainage ceases, peat forms, and associations of acidific plants point to stagnant moisture. Consequently we find high up on Mendip several characteristic paludal species, for example, *Viola palustris*, *Peplis Portula*, *Vaccinium Oxycoccos*, *Andromeda polifolia*, *Scutellaria minor*, *Pedicularis palustris*, *Littorella lacustris*, *Eriophorum vaginatum*, *E. latifolium* and *Scirpus pauciflorus*. Noteworthy ericetal, pascual and glareal plants associated with these hills are *Helleborus foetidus*, *Thlaspi occitanicum*, *Arenaria Gerardi*, *Silene maritima*, *Vicia Orobus*, *Carex binervis*, *C. montana*, *Lycopodium clavatum*, *L. Selago*, *Botrychium Lunaria* and *Lastrea Oreopteris*. The Musk Orchis is very local, and *Antennaria dioica*, as usual, occurs in one tiny patch. Cheddar deserves to be treated separately on account of the great natural phenomena there exhibited, and the exceptional richness and peculiarity of its flora. The grandeur of its cliffs and caverns attracts swarms of visitors who come nowadays by charabanc and motor rather than by train, and throng the Gorge throughout the summer months. Every practicable acclivity or scree is climbed and scrambled over, and every attractive flower is plucked. In this way unintentioned but irremediable mischief is being done. There were days, well remembered, before the advent of this mechanised invasion, when a botanist could see or even handle all the local treasures without leaving the roadside. In future he will have to extend his ramble when searching for the Pink, the Welsh Poppy, *Saxifraga hypnoides* and some of the special Cheddar hawkweeds—*Hieracium lima* and *H. stenolepis* in particular. On the lower screes, where they have become partially fixed by sufficient soil, *Cochlearia officinalis*, *Sedum rupestre* (*majus*) and *Phegopteris Robertiana* are still plentiful, while *Thalictrum minus*, *Cardamine impatiens*, *Prunella laciniata*, *Ophrys apifera*, *Epipactis leptochila* and *Polygonatum officinale* occur more sparingly. Such trees as Yew, Ash, and Whitebeam with some allied forms of *Sorbus* flourish on precipitous crags where only a trifling amount of soil can have accumulated.

Below the zone of undulating moor, rough pasture, heath and old grey rock, there are stretches of aboriginal copse-wood sheltering many sylvestral species. *Lithospermum purpureo-caeruleum* makes its home on the sunny border of such woods. The lovely hue of its petals, its porcelain fruit and remarkable mode of growth—the barren shoots arch over and root at their tips—give this plant a high place in our estimation apart from its rarity. Not far away, in a similar situation but lower still, lies the most important station in the Kingdom for *Carex depauperata*. This sedge does not increase or spread by rooting but appears to maintain itself from seed. By the roadside near Axbridge in some seasons *Fumaria capreolata* and *Crepis biennis* are quite conspicuous. *Sedum Telephium*, *Centranthus ruber* and several Mulleins are permanent ornaments of the Cheddar Valley line towards Winscombe.

The Mendips and the Cotswolds each overlook a great alluvial plain, stretching away westward to the Severn and the Bristol Channel. Reclaimed from the sea at some distant date, these extensive tracts are now fertile pasture, rich in aquatic and paludal species that find congenial stations in the frequent marshes, pools and sluggish drains. Along the Channel shore numerous tidal inlets locally termed " Pills " shelter a number of such species as demand a saline soil or atmosphere, but shun the exposure of the open coast. Examples are *Cochlearia anglica*, *Bupleurum tenuissimum*, *Aster Tripolium* in both forms, *Artemisia maritima* and *Atriplex* spp. To the southward the line of mud-banks and saltings is varied by low cliffs, bays and headlands, ending at length in broad sand dunes that continue to the mouth of the Parrett. The coast flora has a special interest. In the bays we find *Rosa spinosissima*, *Onopordon*, *Chenopodium Vulvaria*, *Atriplex laciniata*, *Blysmus compressus*, *Equisetum hyemale* and *E. variegatum*. On the headlands and hills adjoining grow *Cochlearia danica*, *Viola calcarea*, *Helianthemum polifolium*, *Erodium moschatum*, *Pyrus torminalis*, *Aster Linosyris*, *Artemisia Absinthium*, *Limonium binervosum* and *Koeleria vallesiana*—a grass unknown elsewhere in Britain. Prominent among the sandhills are *Viola macrantha*, *Oenothera odorata*, *Cynoglossum officinale*, *Iris foetidissima*, *Salix rubra*, *S. repens*, *Populus alba*, *P. canescens*, *Ammophila arenaria* and *Agropyron junceum*. In damp hollows amid the dunes *Epipactis palustris*, *Juncus maritimus* and *Scirpus Holoschoenus* hold on well, but *Elymus arenarius* occurs uncertainly. Within an enclosure surrounding a derelict dwelling in this vicinity a luxuriant colony of *Himantoglossum hircinum* was discovered in 1923. This splendid orchid may have existed there for a considerable time. Its origin is a mystery.

Below Highbridge begins the peat moor area, a flat tract of old lakeland generally some feet below sea level. A railway to Glastonbury and Wells runs across its surface and the main drainage is effected by the river Brue controlled by sluice-gates at its tidal mouth. This is the " Turf Moor " described by Mr Thos. Clark in his *Catalogue of the Rarer Plants*, 1856; and a most fascinating region to the naturalist. The vegetation is abundant and possesses special characteristics. The rhines and hollows left by the turf-cutters support rich and important plant associations and provide a host of aquatics, with marsh and bog species, often of decided rarity. The good plants are by no means evenly distributed to the extent that might perhaps be expected where the soil and general conditions are throughout so much alike The following species seem to have their own restricted area:—*Ranunculus Lingua*, *Thalictrum riparium*, *Helosciadium inundatum*, *Lathyrus palustris*, *Andromeda*, *Menyanthes*, *Utricularia neglecta*, *U. minor*, *Pinguicula vulgaris*, *P. lusitanica*, *Polygonum minus*, *Sparganium minimum*, *Juncus diffusus*, *Cladium Mariscus*, *Schoenus nigricans*, *Carex teretiuscula*, *C. filiformis*, *C. evoluta* and *Osmunda regalis*; while others such as *Peucedanum palustre*, *Sium latifolium*, *Wahlenbergia*, *Rumex* *maritimus*, *R. limosus*, and *Juncus obtusiflorus* are more widely spread. I have no recent record for *Cicuta*, *Oxycoccus* or *Rynchospora fusca*; but as more than a hundred years went by between recorded observations of several other scarce species we hope that all may be yet in existence. Another deposit of black peat occurs for a mile or two in the Gordano valley between Portbury and East Clevedon, where it has been dug for fuel within my recollection. It is now coarse pasture attached to farms on the adjacent hills, but the water courses continue to yield *Cyperus fuscus*, *Cladium*, *Scirpus cernuus* and many *Charophyta*.

A peculiar and distinctive feature of the Bristol flora is the number of rare species that are mostly known in one spot only in this large area, and are often restricted to the compass of a few square feet. A few important additions have been discovered since 1912, *e.g.*, *Wolffia*; *Ranunculus ophioglossifolius* in our West Gloucester division, of which particulars are given in *Journ. Bot.*, August 1926; *Pyrus Deseglisei*, *Centunculus minimus* in Leigh Woods and on the wet clay of Syston Common; *Limosella aquatica* near Warmley; *Typha angustifolia* and the colonist *Anthoxanthum aristatum*.

Enough has been written to make it clear that the neighbourhood of Bristol possesses a widely varying configuration and furnishes nearly every kind of locality desirable for botanical research. But what of the future? What will be the outlook when next a local botanist essays this task? The indications are depressing. There has been no more eventful period in the history of this country than the years that have elapsed since the last visit of the British Association, and while the greater part of the sketch of Bristol Botany prepared in 1898 remains unimpaired to-day, and has been made use of on the present occasion, the botanical features of the district have suffered much in the interval. Rural areas throughout the country have changed enormously during the last few decades, and are still changing with rapidity to meet the needs of mechanical transport and the demands of builders. It is an age of demolition, reconstruction and disfigurement, distressing to all lovers of the countryside. Far out in the country petrol pumps and signboards defile the landscape. And, unhappily, one can foresee no limit to extension of the trouble. New roads are being driven through pleasant pasture lands; old roads are widened and straightened; miles of grassy wastes and hedgerows have disappeared; and woods, cut down for war-time timber, are replanted, not with oak or fir, but with war-time huts and fowl pens. If families and houses grow smaller as time goes on they are covering more ground. Bungalows and tiny dwellings, often detestably ugly, are being sprinkled widely around our expanding city. These are the things that mar the joy of an old naturalist who remembers the kindly, placid face of the rural England of his youth, and finds it now distorted, scarred and pimply! Such operations inevitably destroy multitudes of wild flowers, and may even endanger plant species. And although possibly we may gain by introduction from gardens, docks and dumping grounds more species than we lose, in no wise can they take the same place in our regard and estimation.

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TABLE OF CONTENTS.

FOURTH SERIES, VOL. VII., PART IV., 1931.

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*	Baker, B. A., F.G.S.	1 Clyde Park, Redland
S	Baker, H. C.	Glen Farm, Abbot's Leigh, Som.
	Balfour-Browne, F., M.A., F.E.S.	Winscombe Court, Som.
	Barke, H. F., F.I.C.	34 Park Row, Bristol
S	Barke, Mrs	34 Park Row, Bristol
*	Bartlett, Chas., F.C.A.	8 Woodhill, Portishead
*	Baxter, T. V. T., M.A., B.Sc.	25 Clyde Road, Redland, Bristol
	Beacham, G. H.	18 Raglan Road, Bishopston
S	Beer, Miss E. M., B.Sc.	15 Selworthy Road, Knowle
S	Bell, Mrs A. G.	25 St Michael's Park, Bristol
S	Berry, K. C.	120 City Road, Bristol
S	Bidgood, Miss M. E.	47 Granby Hill, Clifton
	Bishop, H. C.	43 Elton Road, Bishopston
S	Blathwayt, Rev. F. L.	Dyrham Rectory, Chippenham
†	Boley, A. E.	508 Stapleton Road, Bristol
	Boley, Mrs	508 Stapleton Road, Bristol
	Bowen, Miss M., B.Sc.	13 Whatley Road, Clifton
S	Bowland, J.	12 Berkeley Road, Bishopston
A	Brebner, Mrs G.	22 Victoria Walk, Cotham, Bristol
	Bush, Mrs R. E. J.	56 Coldharbour Road, Bristol
S	Cadmore, Miss E.	Merlinhaven Lodge, Wotton-under-Edge
S	Capel, Miss	66 Claremont Road, Bishopston
S	Carlson, R. G.	93 Pembroke Road, Clifton
	Carter, Miss F.	14 Charlotte Street, Park Street, Bristol
	Cay, Arthur	Lyndhurst, Leigh Woods, Bristol
	Chamberlain, W.	157 Whiteladies Road, Clifton
S	Chidzey, Mrs C.	2 Windsor Terrace, Clifton
S	Churchill, Miss E.	121 Somerville Road, Bishopston
	City Librarian	Central Library, Bristol
S	Cleave, R. C.	5 Henleaze Road, Bristol
S	Cleeve, R. E.	80 Beauley Road, Southville
S	Clement, Miss L. E.	8 Windsor Road, St Andrew's Park
S	Clough, J. W. S.	Bourton House, Flax Bourton
S	Clough, Mrs	Bourton House, Flax Bourton
S	Clough, Dr N.	30 Henleaze Avenue, Bristol
S	Clough, Miss A. M.	30 Henleaze Avenue, Bristol
*	Cook, Sir Ernest, D.Sc.	40 Alma Road, Clifton
*	Cook, W. R. I., B.Sc., Ph.D.	The University, Bristol
S	Coombs, F. C., Jun.	3 Pembroke Road, Clifton
*	Cott, H. B., M.A., F.R.P.S., F.Z.S.	The Elms, Stoke Bishop
	Cottle, A. W.	17 Blenheim Road, Durdham Park
S	Cotton, Miss V.	52 Sandy Park Road, Brislington
S	Daniels, F. L., F.G.S.,	Stringer's Court, Rodborough, Stroud
*	Darbishire, Prof. O. V., Ph.D.	The University, Bristol
S	Darbishire, Mrs	8 Henleaze Gardens, Westbury-on-Trym

†	Darell, D., F.G.S.	Hillfield House, near Dartmouth
S	Davies, W. H., B.Sc.	Colston School, Stapleton
	Davies, T. H.	Down House, Stoke Bishop, Bristol
S	Daws, Miss H.	109 Forest Road, Fishponds
	Dunscombe, Miss	72 Pembroke Road, Clifton
S	Ellis, F.	59 Berkeley Road, Bishopston
	Evans, I. W.	46 Horfield Road, St Michael's, Bristol
	Evens, F. W.	Stretton, Manor Road, Fishponds
	Edmonds, H. O.	33 Wellington Park, Clifton
	Fitzjames, R. H.	17 St Martin's Road, Knowle, Bristol
*	Flemming, A. L., M.B., Ch.B.	48 Pembroke Road, Clifton
	Ford, Roger	Hartfield, Cotham Park, Bristol
	Fox, Mrs	Brislington House, near Bristol
*	Gait, R. P.	51 Howard Road, Westbury Park
S	Gass, Miss I.	7 Ravenswood Road, Redland
	Gibbons, H. J.	8 Nugent Hill, Bristol
	Glasspool, F. F., B.Sc., F.C.S.	6 Southfield Road, Cotham, Bristol
S	Godden, Miss	56 St John's Road, Clifton
	Goodall, Rev. Canon R. W.	19 Elmdale Road, Tyndall's Park, Bristol
S	Gorham, Major A.	Avonside, Limpley Stoke, Som.
A	Goulding, Thomas	6 Nelson Street, Bristol
S	Grignon, Miss	41 Filton Avenue, Horfield
†	Gummer, Horace (deceased)	Herbert Lodge, Cotham Park, Bristol
S	Haigh, F. C.	Alderley, Shipley Road, Westbury
S	Haigh, S.	Alderley, Shipley Road, Westbury
S	Hamilton, L. J. R. S.	385 Stapleton Road, Bristol
S	Harding, G. Dermott	10 Royal York Crescent, Clifton
S	Harding, Miss J. Dermott	10 Royal York Crescent, Clifton
S	Harrison, G. P.	Springfort Cottage, Stoke Bishop
S	Hawkins, L. A.	Cowslip Green, Wrington, Som.
S	Helliar, F. J. A.	85 Broad Walk, Knowle Park
*	Hellyar, R. H.	18 Redland Grove, Bristol
S	Heslam, Miss K. D.	36 Carnarvon Road, Redland
	Hiley, Miss M. D.	116 Portway, Bristol
S	Hiley, Miss W. F.	116 Portway, Bristol
S	Hill, R. M., J.P., B.A.	Dilton Ley, Limpley Stoke, Som.
S	Hockin, Miss G.	20 Fremantle Square, Cotham
	Hodgson, C. J.	5 Cotham Terrace, Bristol
	Horder, Miss M. G.	81 Redcliff Street, Bristol
S	Hudson, F. G.	The Elms, Stinchcombe, Dursley
S	Hudson, Miss	4 Belgrave Place, Clifton Park
	Humphries, Lady	Eastfield Lodge, Westbury-on-Trym
S	Hurst, G. W. S.	34 Upper Belgrave Road, Clifton
S	Hurst, Mrs	34 Upper Belgrave Road, Clifton
S	Hutchinson, Miss M. I.	57 Oakfield Road, Clifton
S	Hutton, Miss H. M., F.G.S.	The Manor, Dursley
	Ivens, H. P.	18 Alexandra Road, Clifton, Bristol
S	Jarvis, Rev. George	Hambrook, Bristol
	Jeffcoat, Rev. R., M.A.	5 Berkeley Square, Clifton
	Jenkins, F. G., M.B., Ch.B.	51 Redcliff Hill, Bristol
S	Jenkins, Mrs J. C.	10 Napier Road, Redland
S	Jervis, W. W., M.Sc., F.G.S.	The University, Bristol
S	Jones, Miss D. Dunlam	5 Oakfield Road, Clifton
S	Jones, F. G., F.G.S.	8 Clifton Vale, Clifton
S	Jowett, Dr A., F.G.S.	Downside, West Town, Som.

	Kearns, H. G. H., B.Sc., F.E.S.	Ashton Research Station
S	Keeler, R. H.	76 Berkeley Road, Bishopston
S	Kellaway, G. A.	125 Howard Road, Westbury Park
S	Kelly, Miss N. K.	11 Normanton Road, Clifton
	Knight, H. H., M.A.	The Lodge, All Saints' Villas, Cheltenham
	Knowlson, Mrs	9 Downfield Road, Clifton
S	Kromler, A.	45 Summerleaze, Fishponds
	Latham, Miss E. M.	84 Stackpool Road, Southville
S	Leach, A. C.	11 Percival Road, Clifton
S	Lee, Mrs F. R.	St Heliers, Larkhall Place, Bath
S	Lucas, H. J., F.C.I.	14 Walcot Parade, Bath
S	Luxford, R.	15 Russell Grove, Westbury Park
	Macdonald, D.	Fosse Cottage, Nailsea, Som.
	Macpherson, Miss B. B.	4 Belgrave Place, Clifton Park
S	Madkins, W. E., B.A., F.R.G.S.	Fairfield Secondary School, Bristol
	Mappin, S. W.	100 Pembroke Road, Clifton
	Marsden, A., F.I.C.	161 Bishop's Road, Bishopston
S	Marsden, Mrs	161 Bishop's Road, Bishopston
S	Marshall, Miss D.	54 St John's Road, Clifton
S	Martineau, P. E.	Hillside, Cleveland Walk, Bath
S	Mathews, P. M.	Wharfedale House, Pulteney Road, Bath
*	Matthews, L. H., M.A.	The Orchard, Portishead
S	Maxwell, H. W.	10A Downfield Road, Clifton
S	Maxwell, Mrs	10A Downfield Road, Clifton
	McMurtrie, G. E. J.	Eastfield House, Westbury-on-Trym
S	Merryweather, Miss D.	11 St John's Road, Clifton
	Miller, M.	7 All Saints' Road, Clifton
S	Mizen, H.	98 Coronation Road, Bristol
S	Mogg, G.	483 Fishponds Road, Bristol
A	Morley, Miss A.	17 The Avenue, Clifton
S	Morrison, Miss A.	8 Richmond Hill, Clifton
	Nierenstein, M., Ph.D.	30 Cavendish Road, Bristol
S	Nettle, Miss E. C.	3 Beaufort Road, Kingswood, Bristol
	Norgrove, J. W.	22 Alma Road, Clifton
	Nuell, F. H.	63 Springfield Road, Cotham
S	Onn, H. A.	Broad Moor, Station Road, Nailsea
S	Osmond, D. A.	Agri. Station, Long Ashton
S	Parker, F.	150 Filton Road, Horfield
S	Parkhouse, Miss O.	St Crantock, Wotton-under-Edge
	Peach, A. H.	5 Hanbury Road, Clifton
*	Pearman, J. V., F.E.S.	32 Cornwallis Crescent, Clifton
S	Penruddocke, J. H. H.	Ensleigh, Limpley Stoke, Som.
	Pepperell, R.	9 Rayleigh Road, Coombe Dingle
S	Pepperell, Mrs	9 Rayleigh Road, Coombe Dingle
S	Perry, Miss M. P.	6 Chantry Road, Clifton
S	Pole, Mrs A. H.	60 Charlton Road, Keynsham
	Powell, J. J., M.D.	2 Gloucester Road, Bishopston
S	Pratt, Miss D., C.S.M.M.G.	1 Hughenden Road, Clifton
S	Preddy, Mrs K.	The Grange, Stapleton
*	Rafter, J., M.A.	228 Shirehampton Road, Bristol
	Reed, F. N.	15 Stackpool Road, Southville
	Reed, W. N.	18 Stackpool Road, Southville
*	Reynolds, S. H., Sc.D., F.G.S.	13 All Saints' Road, Clifton
	Richards, G.	10 Mortimer Road, Clifton
	Richardson, Frank	15 Percival Road, Clifton

S	Rockett, F. A., M.A., F.R.G.S.	Colston School, Stapleton
*	Roper, Miss I. M., F.L.S.	4 Woodfield Road, Redland, Bristol
	Rudge, Miss D. M.	17 Wellington Park, Bristol
	Rudge, Miss E. L.	17 Wellington Park, Bristol
	Rutter, Miss E. M.	Cambridge House School, St John's Rd., Clifton
A	Salmond, P. W.	20 Tyndall's Park Road, Clifton
S	Salmond, Mrs	20 Tyndall's Park Road, Clifton
	Sampson, Miss D.	5 Hatherley Gardens, Crouch End, N.8
*	Sandwith, Mrs	26 Canynge Square, Clifton
S	Savory, J. H.	Windyridge, Abbots Leigh, Som.
S	Searle, G. C.	Long Ashton Research Station
	Selley, A.	116 Coronation Road, Bristol
	Shaw, Miss T.	12c Kingsdown Parade, Bristol
S	Sheppick, P. R.	The University, Bristol
S	Shield, E. H.	78 Sefton Park Road, Bishopston
S	Shrimpton, D. F.	172 Brynland Avenue, Bishopston
	Skene, Macgregor, D.Sc., F.L.S.	The University, Bristol
	Smith, Stanley, M.A., D.Sc., F.G.S.	The University, Bristol
A	Smith, Mrs W.	17 Vyvyan Terrace, Clifton
S	Stevens, F. H.	9 Osborne Villas, St Michael's, Bristol
S	Stone R.	75 Clevedon Road, Weston-s.-Mare
S	Storey, R. G.	8 Oxford Chambers, St Stephen's Street, Bristol
	Sully, H. T.	Elmside, Stoke Bishop, Bristol
S	Sully, Mrs	Elmside, Stoke Bishop, Bristol
S	Sutton, H. C.	Stoneleigh, Cotham Park, Bristol
S	Tarring, J.	3 Narrow Wine Street, Bristol
	Taunton, W. C.	36 Egerton Road, Bishopston
S	Taylor, W. R., M.A.	12 Pembroke Vale, Clifton
*	Tetley, H., B.Sc.	Ferncliffe Cottage, Leigh Woods
S	Thomas, Miss D. M. L.	79 Somerville Road, Bishopston
S	Thomas, J. I.	79 Somerville Road, Bishopston
S	Thomas, R.	131 Cumberland Road, Bristol
*	Thompson, H. S., A.L.S.	11 Buckingham Place, Clifton
	Thompson, Miss J. G., O.B.E., B.Sc.	Foxstones, Westbury Hill, Bristol
S	Thornton, P. T.	5 Goldney Avenue, Clifton
S	Tily, W. J.	6 Crofton Avenue, Horfield
S	Tomkins, Miss M.	62 Ashley Road, Bristol
	Tuckett, C.	St Just, Chew Magna, Som.
*	Tuckett, R. C.	5 Beaufort Buildings, Clifton
	Turner, H. W., M.A. (Oxon), F.G.S.	The University, Bristol
*	Tutcher, J. W., M.Sc.	57 Berkeley Road, Bishopston
S	Tyrrell, E. B., B.A.	5 Addicott Road, Weston-s.-Mare
	Vassall, H.	Cldbury Court, Fishponds
	Vaughan, Mrs	42 Fernbank Road, Redland, Bristol
S	Venning, Miss	31 Beauchamp Road, Bishopston
S	Vick, C. R.	29 Zetland Road, Bristol
S	Vizard, Miss E. M.	25 Logan Road, Bishopston
	Waight, Miss M.	14 Osborne Avenue, Ashley Down
	Walker, L. E.	5 Crowndale Road, Knowle, Bristol
	Walker, R.	5 Crowndale Road, Knowle, Bristol
*	Wallis, F. S., D.Sc., Ph.D., F.G.S.	90 Coldharbour Road, Bristol
S	Walsh, W. G.	6 Alma Vale Road, Clifton
	Walton, T. C. H. (deceased)	Compton Bishop, Som.
	Wann, Miss I.	35 Burleigh Road, St Andrew's Park
S	Waters, A. B.	Newhaven, Walton, Clevedon
S	Waters, A. C.	Newhaven, Walton, Clevedon

S	**Waters, Mrs**	Newhaven, Walton, Clevedon
	Webb, H. Vicars	58 Belmont Road, St Andrews, Bristol
•	White, E. Barton, M.D., F.E.S.	Mental Hospital, Fishponds, Bristol
	White, Mrs E. B.	Mental Hospital, Fishponds, Bristol
•	White, Jas. W., M.Sc., F.L.S.	18 Woodland Road, Clifton
	White, Mrs J. W.	18 Woodland Road, Clifton
•	Wickes, W. H.	84 St Michael's Hill, Bristol
S	Willcox, E. P.	Stoke Hill Cottage, Stoke Bishop
S	Willcox, F. R.	Stoke Hill Cottage, Stoke Bishop
S	Willis, D. C.	360 Fishponds Road, Bristol
†	Wills, W. Melville	Bracken Hill, Leigh Woods, Bristol
S	Woolcott, J. W.	Bryars, Filton
	Woolley, W. H.	2 Nugent Hill, Bristol
S	Woollon, P. C. A.	30 St Paul's Road, Clifton
S	Woolls, Miss	5 Hamilton Road, Easton, Bristol
S	Wynne-Edwards, V. C., B.A.	McGill University, Montreal, Canada

Honorary Members.

Henry J. Charbonnier, Rose Cottage Bungalow, Olveston, Gloucestershire (dec'd.).

Prof. C. Lloyd-Morgan, LL.D., F.R.S., F.G.S., 79 Pevensey Road, St Leonards-on-Sea.

R. M. Prideaux, F.E.S., Brastead Chart, near Sevenoaks, Kent.

W. G. Scott, Cardiff.

Prof. H. S. Hele Shaw, M.I.C.E., LL.D., F.R.S., 64 Victoria Street, Westminster, S.W.1.

Prof. W. J. Sollas, M.A., LL.D., F.R.S., F.R.S.E., F.G.S., University Museum, Oxford.

Prof. Sydney Young, D.Sc., F.R.S., Trinity College, Dublin.

REPORT OF COUNCIL,

TO DECEMBER 31st,

1931.

FOR the second year in succession a new President had to be found to carry on the reins of government. The Society is to be congratulated in the fact that Mr J. W. Tutcher, M.Sc., was willing to succeed Dr A. L. Flemming, whose professional duties prevented him from remaining in office for another year. Mr Tutcher has a wide reputation as a geologist, and the activity of the Geological Section owes much to his enthusiasm and whole-hearted interest in the subject.

Council has decided to suspend for a time the entrance fee of 5s to see if it produces a good effect on the membership. During the year only six Ordinary Members have been elected, whereas over twenty have joined the sections at a very low subscription and no entrance fee. The advantages of the well-stocked Library and the " Proceedings " with original papers on Natural History do not apparently appeal to the citizens. The sections, however, are doing excellent work, and greater co-operation on their part might be of material help to the Society as a whole.

The Annual Dinner in February attracted a record number of members and friends. Mr J. E. Barton, headmaster of the Bristol Grammar School, was the guest of the evening, and in proposing " Prosperity to the Society " gave an inspiring address on the advantages to be gained by direct contact with Nature rather than by work in the Laboratory.

The Open Meeting again took place in October, and was well attended by members and the general public. Prof. C. J. Patten, of Sheffield University, fascinated his audience by an account of his researches in Bird-migration at Irish Light-stations.

The Sections were not slow to take advantage of the opportunity to show examples of their studies at the Annual Exhibition night. An excellent series of bird photographs, microscopic slides of plant sections, geological specimens, and local lepidoptera were on view, and demonstrated the good work being carried on.

The summer has not been very favourable for outdoor meetings, but over fifty members attended the Summer Excursion in June, and were rewarded with ideal weather conditions. The arrangements were again in the capable hands of the Officers of the Field Section, who covered new ground by exploring Frocester Hill, one of the highest points of the Cotteswold escarpment.

The Executive Committee of the S.W. Naturalists' Union applied to its affiliated Societies to nominate one of its members to the post of General Secretary of the Union. The only nomination received was from this Society, with the result that Miss Roper has taken over the secretarial duties. All members are associates of the Union, and are, therefore, entitled to attend the Annual Congress without extra payment. It is hoped as many as possible will accept the invitation of the Plymouth Scientific Societies to meet in that city during Whitsun week.

The Society as usual has participated in the doings of kindred Societies. The Hon. Secretary attended as delegate the Conference of Corresponding Societies held during the Centenary meeting of the British Association in London. The President, Sir Arthur Smith Woodward, F.R.S., in an able address, pointed out the importance of Geology as a subject for local societies, whose members might be amateurs with only a limited amount of leisure for research. They could give help by watching, in their own neighbourhood, work on excavations and in quarries.

The Hon. Secretary was also a representative at the National Conference for the Preservation of Rural England, held at Bath for three days in October. The Earl of Crawford and Balcarres, F.R.S., presided over a representative gathering of nearly 120 delegates of Natural history and Antiquarian organisations desirous to safeguard the beauties of the countryside from disfigurement by uncontrolled development.

The Society was honoured by an invitation to a conversazione in December given by the Cardiff Naturalists' Society in the magnificent buildings of the National Museum of Wales. A new wing has been lately added for the display of a series of old Welsh rooms, and these, together with the splendid botanical and zoological galleries, were much appreciated by 600 guests. Our Society proved to be the only one of the many corresponding Societies who had accepted the invitation and sent a representative.

In March the Society lost by death two of its oldest and staunchest supporters. Mr H. J. Charbonnier was elected a member at the end of 1863, a year after the foundation of the Society, and always maintained a great interest in its activities. He was a true lover of Nature, and willing at all times to encourage young people to appreciate and study bird life. He was also an authority on local Diptera and Mammals, and had contributed several papers to the "Proceedings." For many years he was sub-Librarian, and shortly before his death he presented a portion of his natural history books to the Library. On leaving Bristol in 1914 to retire into the country, Council made him an honorary member as a slight recognition of his services over such a long period. Mr Horace Gummer was in his 80th year. He had been a member for over 30 years, had served on Council, and had been a Vice-President. Of a retiring disposition, he will be best remembered by his generous gifts of money to the book-binding fund, whereby a large number of volumes were made more available to the members. In the closing days of the year Mr T. C. H. Walton passed away at Compton Bishop after a short illness. He served for many years on Council before leaving Bristol, and always took part in the doings of the Society.

The "Proceedings" for 1930 were published early in the year, and distributed to the British and Foreign Societies with whom exchanges are effected. The volume was of more than passing interest on account of the excellent photographs which illustrated two of the papers, and thanks are given to Prof. S. H. Reynolds and Mr H. B. Cott for defraying the cost of the blocks and to Mr J. W. White for a donation towards the printing of his paper on Bristol botany.

IDA M. ROPER, *Hon. Secretary.*

The Hon. Treasurer in Account with The Bristol Naturalists' Society.

GENERAL ACCOUNT FOR THE YEAR 1931.

Dr.	£	s.	d.	*Cr.*	£	s.	d.
To Members' Subscriptions :—				By Subscriptions to Societies :—			
Ordinary, ...	42	5	6	Ray, ...	1	1	0
Associate, ...	1	5	0	Zoological Record, ...	2	10	0
Arrears, ...	2	0	0	S.W. Naturalists' Union, ...	0	11	0
In advance, ...	1	15	0	,, Cost of *Proceedings*, 1930, ...	42	3	6
,, Entrance Fees, ...	1	10	0	,, Printing, Postage, etc., ...	7	14	9
,, Field Section Capitation Fee, ...	4	7	0	,, Lecture Expenses, ...	3	1	4
,, Donations to Publishing Fund, ...	13	0	0	,, Rent and Fire Insurance, ...	1	11	0
,, Sale of Publications, ...	3	15	9	,, Dinner Expenses, ...	18	11	0
,, Sale of Dinner Tickets, ...	19	16	0	,, Bookbinding ...	12	6	0
,, Interest on Deposit, ...	3	4	0	,, Cash in hand :—			
,, Balance forward :—				General Account, ...	132	2	5
General Account, ...	124	12	0				
Bookbinding Fund, ...	4	1	9				
	£221	12	0		£221	12	0

December 31st, 1931.

Audited and found correct.

ERNEST H. COOK,
CHARLES BARTLETT, F.C.A., } *Auditors.*

LIBRARIAN'S REPORT

FOR THE YEAR 1931.

THE Library has had an uneventful year, but there are pleasing signs that it is being made more use of by newly elected members. Not only are more books taken out for home reading, but the current literature from exchange Societies, always displayed on the Library table, is being consulted by regular visitors.

The Director of the Museum has kindly granted the use of the strong room attached to the Library, and this additional shelving will soon be occupied by the large stock of unbound publications, which under existing circumstances cannot be easily consulted.

The book binding fund is exhausted except for a few pounds which is reserved for the binding of the series of monthly periodicals presented by the Sections. Donations of money will therefore be most acceptable to start again a bookbinding fund to which the late Mr Horace Gummer was such a generous donor.

Prof. S. H. Reynolds has kindly undertaken the task of cutting up the long series of the Palaeontographical Society and arranging them into completed monographs. Council has voted a sum of £15 towards the cost of re-binding the fifty-one volumes, and it is hoped they will be completed early next year. Unfortunately the series lacks the first fifteen volumes.

Our " Proceedings " are slowly finding a place on the shelves of Continental libraries. The Royal University Library of Upsala had lately acquired a long series of our volumes dating from the first issue, and applied to us for fourteen volumes to bring the series up-to-date. We were able to supply the missing volumes with one exception. In return we have received from the University of Upsala six volumes of the Bulletin of the Geological Institution, 1925-30, with the suggestion that the two Societies should exchange all future issues. Council has agreed to this and we have already received their current publication.

A firm of publishers and booksellers in Tokio, Japan, has applied for a specimen copy of our " Proceedings " for an exhibition of foreign periodicals and magazines to be held in the city during October. The " Proceedings " for 1930 have been sent.

The following books have been added to the Library and cordial thanks are given to the donors :—

" British Birds," Vol. 26, from the Ornithological Section.
" Entomological Monthly Magazine " and " The Entomologist," 1931, from the Entomological Section.
Fenton, C. L. " Studies of Evolution in the genus Spirifer," 1931, from the Wagner Free Institute of Science, Philadelphia.
" Field Club Flora of the Lothians," 1927, presented by Mr Ivor W. Evans.
" Geological Magazine," 1931, and " Palaeontographical Society," Vol. lxxxiii, from the Geological Section.
Gurney, R. " British Freshwater Copepoda," Vol. i., 1931.
Patten, C. J. " The Story of the Birds," 1928, presented by Miss Roper.
Raven, C. E. " In Praise of Birds," 1925, presented by Miss A. Morley.
Thomson, A. L. " Problems of Bird Migration," 1926, presented by Dr A. L. Flemming.

IDA M. ROPER, *Hon. Librarian.*

BOTANICAL SECTION,

1931.

THE Section has now completed six years and a review of its activities during the past year is very favourable. The number of resignations has been balanced by an equal number of new members. The younger members who have joined recently have shown great keenness in collecting and preserving specimens and at the same time have extended their studies into the other branches of Botany. Although we do not wish to stress unduly the utilitarian aspect of the Section, we would like to point out that the governing bodies of some professions recommended entrants to start a herbarium of official plants at least, and in this the Section can offer unique opportunities.

The meetings have been well attended and as in previous years have consisted of informal discussions on botanical specimens. Examples of fasciation have again been abundant; an Asparagus was so unusual that it was forwarded to the Museum. The exhibits brought by members during the year, while not producing anything exceptional, have been both varied and plentiful and have ranged from Algae to the Flowering Plants.

In the autumn some of the Section volunteered to send botanical objects to the Museum, and arrangements were made for each one to exhibit for one week. During the winter months when flowers are scarce, Lichens, Fungi, and Ferns have been shown.

At the Exhibition in November, the Section was represented; the exhibits included pressed flowers and prepared microscope slides.

Miss Roper has continued to occupy the chair.

F. F. GLASSPOOL, *Hon. Secretary and Treasurer.*

ORNITHOLOGICAL SECTION,

1931.

THE number of members has increased during the year and now stands at 33. Five meetings have been held at which the attendance has been well up to the average.

An original paper was given by Mr F. R. Willcox on the " Dawn-chorus " following observations made at Stoke Bishop during February and March, and he also gave a good account of birds seen during a recent holiday in Wales. This was illustrated by photographs taken by Mr C. Tuckett.

Mr J. H. Savory's account of "Bird-life on Texel," with excellent slides, and Mr W. C. Taunton's paper on " Birds on Lundy Island " both contained much of interest.

The Section has been represented at both meetings of the Ornithological Section of the Somerset Natural History Society, of which it is a member.

H. TETLEY, *Hon. Secretary and Treasurer.*

ENTOMOLOGICAL SECTION,

1931.

UNLIKE some other branches of natural history, entomology to be enjoyed as a hobby demands practical experience and does not greatly appeal to those whose interest is only academical, hence, having regard to the general decline of enthusiasm for intellectual recreation, it is not surprising that there have been no accessions to our membership during the year. On the other hand we have suffered no losses. Although the total of 16 ordinary and 2 honorary members is smaller than that of a few years ago, it is adequate to maintain the presentation of two entomological journals to the Society's Library and to provide a sufficient revenue to meet ordinary expenses out of the present small subscription. The average attendance of nine at the meetings compares well on a percentage basis with that of other groups.

It was again found that difficulties of transport, accommodation, tastes, and time, made the arrangement of a general field excursion impracticable.

An important project debated during the year was the proposed scheme for the re-introduction in favourable local areas of the Butterfly, *Papilio machaon*, which is reputed to have occurred many years ago near Bristol. In this experiment the Entomological Section of the Somerset A. & N.H. Society will co-operate.

Meetings have continued to be held for the most part at Clifton, but on two occasions advantage was taken of special invitations. In March Mr and Mrs Audcent entertained the Section at their house. Mr Audcent showed members his large and rapidly growing collection of Diptera and explained his methods of cataloguing, labelling, preservation and examination. For the May meeting members were the guests of Dr and Mrs Barton White at Fishponds. A dissertation by Dr Barton White on Insect Pigmentation was illumined by special exhibits (including many rare varieties of *Arctia caja*), and the host's extensive collection of Lepidoptera was on view. For their hospitality on these two occasions our hosts are warmly thanked.

Various members have contributed papers of great interest providing topics for lively discussion. The chief proceedings are summarised in the following list.

January 13—Paper—Varieties of Common Moths, Mr A. H. Peach.
February 10—Paper—Melanism, Mr J. W. Norgrove.
March 10—Demonstration—Diptera, Mr H. Audcent.
May 12—Paper—Insect Pigmentation, Dr E. Barton White.
October 13—Exhibition—Captures of the Year.
November 10—Papers—(1) Pyrethrum Insecticides, Mr H. G. H. Kearns; (2) Collecting Diptera in S. France, Mr H. Audcent.
December 8—Paper—Migrants, Mr C. Bartlett.

Exhibits have in the main been related to the matters under consideration at the meetings, and nearly all the attending members have contributed so that the subjects could be illustrated as comprehensively as possible.

Among the notable captures of the year have been the following :—

Plusia ni Hubn., Brockenhurst, 21st June 1931, Dr E. Barton White.
Leucania unipuncta Haw., S. Cornwall, 10th September 1931, Mr C. Bartlett; 16th September 1931, Dr Barton White.
Tetromia gabrieli Weise (Coleoptera, Longicornia), New Forest, ex Fir, June 1931, Mr C. Bartlett.

Specimens have also been shown of :—

Deilephila livornica Esp., Paignton, May 1931, Mr A. H. Peach; S. Cornwall, 26th April 1931, Mr Bartlett.

Sphinx pinastri L., from Dorset (ova, preserved larvae, and imago), Mr Bartlett.

Lycaena adonis, ♂, a black specimen (due to reversal of scales upon the wing), Folkestone, Mr Bartlett.

Callimorpha hera, a bred series exhibiting variability in inheritance of parental characteristics (parent taken in Dorset), Mrs Barton White.

J. V. PEARMAN, *Hon. Secretary and Treasurer.*

FIELD SECTION,

1931.

BORN in 1920, yet not acquiring a parent until 1927, your Section can report a year of progress and continued usefulness. The nett membership has increased—it now stands at 103—and the average attendance at field meetings has reached the high level of 35. Mere statistics, however, can deceive and may be so devised to prove any argument, but the continued progress of the Section is more clearly shown by the enthusiasm of its members and in the fact that during the past session all meetings have had a definite and inter-related aim. As explained in the programme the localities for each meeting were so arranged that during the summer, all the chief types of natural history groupings in the Bristol District were visited.

In May, Mr G. E. J. McMurtrie selected Radstock as a typical Coal Measure country. On this occasion, as on all the general field meetings, fine weather favoured the members. The Geologists found much of interest on the coal tips, and the Botanists were fortunate in encountering many types of trees, all displaying a radiance which was enhanced by the late spring.

The Annual Field Meeting of the parent Society was again held under the auspices of the Section, and according to recent custom your President and Secretary (Dr F. S. Wallis and Miss M. D. Hiley) were responsible for the arrangements. The chief object was the examination of the scenery, rocks, fauna and flora of the Inferior Oolite of the Cotteswold Hills and the Section was fortunate in securing the help of several local gentlemen. The Rector (Rev. A. W. Van Den Bergh, A.K.C.) proved invaluable, and Messrs C. Granville Clutterbuck, F.E.S., and J. W. Haines, both members of the Cotteswold Naturalists' Field Club, further added to the enjoyment of the district. The Rev. H. J. Riddelsdell, although unable to attend, supplied useful botanical notes. The Cephalopod Bed was of interest to the geologists. Botanists were rewarded with several Orchids. Entomologists made many captures, and heard of other far more thrilling finds, whilst all were intrigued by Hetty Pegler's Tump, and entranced by the near and distant views, the beauty of which was increased by the fine summer weather.

In July the Section were fortunate in obtaining permission from Mr W. Melville Wills to inspect his estate nurseries under the guidance of Mr H. C. Baker, and thus examine the faunal and floral associations of Carboniferous Limestone and Old Red Sandstone country. Members were interested in the improvements effected at Abbots Pool, and the trout ponds at Markham Brook.

In September Mr Ivor Evans arranged a field meeting to Filton and North Woods—an area which excellently displayed the Liassic type of country. Many fossils were collected and specimens of the uncommon Grey Poplar were noted.

The success which attended the October meeting in 1930 suggested the holding of a fifth meeting in 1931, and accordingly an area of recent river alluvium at Portishead claimed attention. Dr Rose Bracher demonstrated the various zones of vegetation on the salt-marshes and showed how their distribution was dependent on the frequency of submergence by the tides and the rate and efficiency of drainage. Mr and Mrs H. F. Barke were responsible for the general arrangements.

At the Annual Meeting Dr F. S. Wallis was elected President, Mr G. H. Beacham became Vice-President, and Miss M. D. Hiley and Miss T. Shaw were re-elected Honorary Secretary and Treasurer respectively. The retiring President, Mr H. F. Barke, gave an address on the P/H values of soils and stressed the importance of such data to the botanist and market gardener as each species of plant only grows in a soil whose P/H value lies within narrow limits.

A meeting was held in the spring for the purpose of giving leaders an opportunity of explaining the aims and objects of the field meeting for which they were responsible. The enthusiasm shown justified this new departure and the keenness of members throughout the session proved the value of the enlarged explanatory notes in the programme.

Your Section was again fortunate in securing the able services of Mr H. Vicars Webb, and he has contributed the following notes :—

April 22nd. An evening ramble round Flax Bourton district. A party of 10. A number of nests of resident species found, and the entire absence of migrants due to the wintry conditions was noted.

May 6th. A party of fifteen visited Long Ashton Park. Kind permission was given to go through " the drives." The conditions were not conducive to bird songs; both migrants and resident species only made feeble attempts. The new leafage of the magnificent Oaks, Beeches and other trees was much enjoyed.

May 16th. The fixture to Brean Down was abandoned owing to a soaking day.

May 30th. A successful excursion to the Shapwick peat moors near the Polden Hills by a party of seven. The Vicar of Shapwick met the train and joined the party for a couple of hours. The Loxton Woods are a famous beauty spot on the Poldens. Songsters were here in good voice. Large numbers of Swallows, House Martins and Swifts were seen during the day. Weather dull, but fine.

June 6th. A large party of 25 members visited Blaise Castle Woods. Warblers and other bird-life seen or heard very favourably. Woods in all the full glory of June foliage.

September 19th. An extra excursion arranged for on this date when six members accompanied the leader to the beautiful park of Earl Temple at Newton St. Loe. The chief object was for the purpose of enjoying the charming arboreal character of the district.

This year Mr Ivor W. Evans has kindly taken charge of the Botanical meetings, and he reports as follows :—

April 15th. Brislington and Hanham. Number present 15. Meeting at the Brislington Tram Terminus the party proceeded by way of Brislington Church to the fields near Lower Keynsham. Most trees were in early bud and afforded interest. The principal trees and plants observed were Elm, Yew, Willow, Hazel, and Red Campion, Lady's Smock, Stitchwort.

May 20th. Left Bank of the Avon. Number present 24. Meeting at the Ferry the party took the left bank of the Avon, passed the Quarries to the Woods opposite Sea Mills, which were entered. By kind permission of the landowner of Leigh Court Mental Hospital the party was enabled to continue through the Woods and climb the slope to the main Portishead Road. Mr Beacham found the Sweet Mountain Fern. Among trees and plants observed were Aspen, White Beam, Beech, Water Dropwort, Stork's-bill, Lady Fern, Wild Celery, etc

June 13th. Pucklechurch and Wick. Number present 12. From Pucklechurch the party walked in the direction of Wick Rocks, and the season being well advanced the Botanists were rewarded. Spindle Tree, Hawthorn, Field Maple, Dogwood and Mallow, Hedge Woundwort, Pendulous Sedge, Orpine, etc., were found and examined.

July 25th. Ponsford to Keynsham. Number present 14. The route to Keynsham was taken via Publow, Woollard, Compton Dando, and Chewton Keynsham. Plants noted were Soapwort, White form of Ivy-leaved Toadflax, Broad-leaved Ragwort, Creeping Soft Grass.

M. DORIS HILEY, *Hon. Secretary.*

GEOLOGICAL SECTION,

1931.

THE year has been uneventful but successful and the consolidation of the informal discussion class may be cited as the outstanding feature. Started under the leadership of the Vice-President (Mr J. W. Tutcher, M.Sc.) somewhat hesitatingly, a few years ago, it has become an important part of the Section's activities, fulfils a definite need and enables members to meet in a congenial atmosphere.

At the Annual General Meeting held in January the officers were re-elected and the following ladies and gentlemen formed the Committee—Mesdames Barke, Marsden and Vaughan and Messrs H. F. Barke and G. A. Kellaway. Afterwards members adjourned to the Geological Museum of the University where the exhibits—many of which had been specially prepared for the Bristol Meeting of the British Association—were explained.

At both the February and October meetings members were interested in the results of careful mapping by Mr G. A. Kellaway. At the first of these, the Lias in the neighbourhood of Henleaze, Horfield and Southmead was shown to include all zones from *langportensis* to *turneri*. Attention was also drawn to the thinness of the White Lias and the marked effect of the Avonian rocks on the overlying strata. These points were demonstrated when the lecturer conducted a Field Meeting in July. Prof. Reynolds pointed out interesting features in the Avonian rocks on this occasion, and Mr and Mrs Barke entertained the members at their house. At the October meeting Mr Kellaway described the Avonian rocks in a recent cutting on the Gloucester by-pass road. Excellent exposures of K_m, α and K_I were recorded and both the Palate Bed and Bryozoa Bed were seen. He also described an exposure of the Charmouthian clays from Broadway Lane, near Welton, and showed how the section links up with the better known one at Clandown.

At the March meeting Mr J. W. Tutcher, M.Sc., gave the Section the benefit of his prolonged and extensive researches on the Liassic rocks of Dundry Hill. He enumerated details of all the beds—as far as the scanty evidence will allow—and said that they are not evenly distributed over the whole area and that at several places partial erosion has removed certain beds causing non-sequences.

At the November meeting the President (Prof. S. H. Reynolds, M.A., Sc.D.) gave a paper on the Tertiary volcanic regions of Western Scotland and N.E. Ireland. Skye and Eigg were dealt with in detail; Rum, Canna, Muck, Arran and N.E. Ireland were described and Ardnamurchan was selected as the most accessible place for viewing Tertiary igneous rocks.

The April Field Meeting, led by Mr Barke, was arranged to enable members to inspect the excavations made for the Keynsham sewerage works. Owing to the wealth of fossils Mr Tutcher was able to demonstrate the evolutionary sequence from *Coroniceras* to *Agassiceras*. Another April Field Meeting, under the leadership of Major A. Gorham, gave members the opportunity of inspecting the upper and lower junctions of the Midford Sands at Limpley Stoke. Members were impressed by the detailed nature of the researches and indebted to both Mr Penruddocke and the leader for hospitality.

Owing to the co-incidence of several disturbing factors, the usual charabanc Field Meeting was cancelled and members, under the leadership of Mr and Mrs Barke, used the normal 'bus service. The Central Mendips proved an excellent area both from the scenic and fossil standpoints.

The average attendance at winter meetings reached the high level of 32, whilst 16 was the average number for the Field Meetings.

The year closed with a membership of 60 and a satisfactory credit balance.

F. S. WALLIS, *Hon. Secretary and Treasurer.*

Account of the Annual and General Meetings.

THE 68th ANNUAL MEETING.

January 15th, 1931.

Mr J. W. Tutcher, M.Sc., was elected President, and Mr H. F. Barke a Vice-President, with minor alterations in Council. The retiring President, Dr A. L. Flemming, gave the Annual Address for his only year of office, 1930, entitled " The Migration of Birds." (See p. 172).

THE 552nd GENERAL MEETING.

February 5th, 1931.

THE 4th ANNUAL DINNER.

The President, Mr J. W. Tutcher, M.Sc., presided over a record attendance of upwards of 70 members and friends, and an enjoyable evening was spent.

Mr J. E. Barton, headmaster of the Bristol Grammar School, was the guest of the evening, and, in proposing " The Society," referred to his early studies in natural history. He felt an immense loss was suffered by many reared under the conditions of town life and over organised education in which they had no contact with Nature. The teaching of science in our schools was made far too abstract, and it was assumed that every boy was going to devote his life to some form of scientific research. The naturalist took the other aspect of science, and endeavoured to keep alive the instincts of unity with the soil from which he sprang. Shakespeare, Wordsworth, Isaak Walton, Maeterlinck, and others showed in their writings how to share their lives with Nature, and Thomas Hardy could portray in one line the feeling of a spring morning in a country lane when he wrote—" The sparrow dips in his wheel-rut bath."

The world still needed those who kept in touch with the great natural facts of life as they emerged from the hands of the Creator, and that was the work this Society was doing under the leadership of a President who had a wide, if not international, reputation.

An excellent programme of music and recitations was contributed by Mrs James Rafter, Mrs Jeffreys, Miss McMurtrie, Messrs J. W. Norgrove, M. Miller, and I. W. Evans.

THE 553rd GENERAL MEETING.

March 5th, 1931.

" Dinosaurs," by Prof. S. H. Reynolds, M.A., Sc.D., F.G.S.

Dinosaurs (= terrible lizards) are a group of extinct land reptiles which during the Triassic, Jurassic, and Cretaceous geological periods occurred in great numbers and variety, and were almost world-wide in their distribution. The only living members of the species are the crocodiles and turtles and the Halterea, a fin-backed lizard. While the smallest Dinosaurs were scarcely bigger than a squirrel, the largest were perhaps equal in size to the largest whale.

The earliest known British Dinosaurs were found in a quarry, now built over, on the borders of Durdham Downs, and their bones are preserved in the Bristol Museum. They were carnivorous reptiles with a long neck and tail, and walked on their hind legs only as does a bird; this bipedal gait gave rise to the footprints in the Keuper Sandstone, showing the reptile running in a narrow way like a bird. Some of the later members of this group of dinosaurs were the most formidable predaceous animals the world has ever seen.

The carnivorous dinosaurs, which were all bipeds, did not reach such a size as the herbivorous quadrupedal forms, the largest of which may have been some 80 or more feet long. Only isolated bones of these huge creatures have been found in England, but the complete skeletons found in America are familiar to many people from the reproduction presented by Mr Andrew Carnegie to the Natural History Museum at South Kensington. The latest dinosaurs just prior to the extinction of the group assumed many strange forms such as horned, helmeted, and duck-billed types. The only museum in Europe where an exhibit of dinosaurs can be seen comparable to those of several of the American museums is that of Brussels, which contains over a dozen skeletons of a particular kind discovered when excavating for coal.

The origin of these reptiles is unknown, but it is supposed that their home was in Central Asia. The American Expedition to the Gobi Desert a few years ago found many skeletons and also some dinosaur eggs. From Asia they made their way all over the world, through Arabia and Egypt to South Africa and through Alaska to North and South America. They did not have a long life geologically, and they disappeared entirely at the end of the Cretaceous period. At that time there were tremendous earth movements in which the Alps, Caucasus, Himalayas, and other mountains were formed, and it is assumed that these reptiles were unable to adapt themselves to a new mode of life, and so died out.

THE 554TH GENERAL MEETING.

March 26th, 1931.

I.—"Notes Concerning an Interesting Underground Deposit," by Arthur Marsden, F.I.C., M.I.Chem.E., M.Inst.Gas E.

The deposit was discovered some time ago on the outside of an underground foul-gas main, and was of particular interest because it consisted essentially of calcium acetate, in masses of greyish-white, silky crystals, resembling some forms of native asbestos. The source of the calcium was the virgin marl in which the main was buried, and the acids apparently had a bacterial origin, there being calcium butyrate present, while the degree of activity was due to the hot main acting as an incubator.

The work done in endeavouring to trace the source and transformation of the material was described, and illustrated by analyses and other data. Of particular interest were certain strata lines in the deposit which were shown to have occurred when the main was cold. The peculiar odour of the deposit is due to calcium butyrate, and it was suggested that the sour odour often noticed during street excavations and ascribed to " sour gas " is actually due to the presence of small amounts of fatty acids due to bacterial action. The remarks were illustrated by numerous specimens, photographs, and lantern slides.

II.—" Graft Hybrids," by Macgregor Skene, D.Sc., F.L.S.
Printed on p. 279.

THE SUMMER EXCURSION.

June 20th, 1931.

Frocester Hill, Cotteswolds, was selected for the Summer Excursion under the leadership of Dr F. S. Wallis and Miss M. D. Hiley, the President and Secretary of the Field Section. Leaving Bristol via Stapleton and Winterbourne and proceeding to Cromhall, a short halt was made at Slickstones Quarry for an explanation of the general scenic features of the route. A long climb on to the Cotteswold escarpment brought the party to Nympsfield. Here the Rector met it and pointed out the main features of the 12th century church, which stands on one of the highest habitable spots on the hills.

After tea in the open the drive was continued to Frocester Hill where two local gentlemen, Mr J. W. Haines and Mr C. Granville Clutterbuck, F.E.S., gave short talks on the botany and entomology and assisted the members in the field. The geologists examined the rocks in the large Frocester quarry and in some near by, but smaller, exposures. They were able to trace the far-famed Cephalopoda bed along the hillside, and many fossils were collected. The influence of the rocks on the scenery was easily traced, and the splendid isolated Cam Long Down was noted. Entomologists, though not successful in finding the large blue (*Lycaena arion*), made captures of much interest.

The botanists were rewarded with the Pyramid, Bee and Spotted Orchids, Sainfoin, Horsehoe Vetch and other plants which flourish on these oolitic slopes. Before starting on the homeward journey a visit was made to Hetty Pegler's Tump. The stones which formed the chambers are still standing in their original position, and members were very interested in this best-preserved old burial place which exists in the county. The view from the top of Frocester Hill was very inspiring. The Severn valley and Forest of Dean in middle distance, with the Wrekin in far distance, presented a panorama long to be remembered.

THE 555TH GENERAL MEETING.

October 15th, 1931.

" Researches in Bird Migration at Irish Light-stations," by Prof. C. J. Patten, M.A., M.D., Sc.D., University of Sheffield.

Early observers had strange ideas to account for the seasonal coming and going of birds. Ancient ideas were of transmutation into other forms, and Swallows were said to be submerged in ponds during the winter. Papers were read to the Royal Society about the hibernation of birds, and Gilbert White toyed with this theory at one time but rejected it later. Observers had stated that Corncrakes wintered in Ireland but it was found that the birds noted were Water Rails.

Practically all birds in the British Isles migrate either long or short distances; temperature of locality and food supply are the controlling factors. The birds of the Tropics do not migrate as their food supply is constant.

In migration physiological conditions must be taken into account, the body temperature is 110 F., the heart beats fast, the appetite is immense and all functional activities are rapid. The bird has to move about and look for food and its endurance on the wing is marvellous; the food supply is all important. The struggle for existence causes birds to leave their breeding places in high latitudes and find feeding areas elsewhere, as in the darkness of the Arctic winter they would not be able to see their food.

As far as can be found out, birds have no sense of direction as if so, a sense organ would be found on dissection, but their vision is wonderful and they may have some memory of land forms. In migrating the flock hugs the coast line or follows the course of big rivers flowing north and south, avoiding the mountains, and it may be the roar of the breakers and waters is also a guide. The birds call to one another and this has helped in the development of their cries.

The spring migration is direct and swift to get to the breeding grounds, which are determined by temperature, but the autumn migration is leisurely, a sort of gipsy life without looking for any given point and wandering about until some good feeding area is discovered.

The Irish Light-stations are excellent points to observe the migration as the British Isles are on one of the main lines; in fact they are an important junction, some birds of passage going west to Ireland and some north-east to Scandinavia. Tuskar Light-station is on an island on the south-east coast of Ireland and Prof. Patten gave a vivid description of his stay there. The lighthouse has a balcony with horizontal rails which serve as perches for birds, and the lantern was within reach of a person standing on the balcony. The island was fairly level and half a mile in extent, which allows resting room for birds on flight and a collecting ground for wounded and exhausted ones.

Descriptions of the arrival of birds in bad weather were given. On foggy, wet or windy weather the birds must shelter and rest, or if bad weather continues, will die of famine and exhaustion. Weather conditions have a great bearing on migration; fine, clear and still weather is required for flight.

During his stay Prof. Patten was able to collect data as to speed of migration, which averaged 25 to 35 miles per hour, and the method of flight in which relay after relay would pass in order as though there was some directing disciplinary movement.

A list was made of Irish birds and many odd incidents noted, such as the arrival of a Carolina Corncrake which had flown the Atlantic, and of a Golden Crested Wren on the back of an Owl.

Original photographs and close portraiture were shown on the screen, many of the slides coloured by the lecturer.

THE 556TH GENERAL MEETING.

November 5th, 1931.

Exhibits of Natural History by the Members.

The exhibits laid out by the Botanical Section included one by Miss Roper showing relationship of present day Horsetails to those of the Carboniferous age; parasitic fungi rare throughout the world belonging to the Plasmodiophorales by Dr W. R. Ivimey Cook; living Coniferae by Mrs A. G. Bell; herbarium specimens of some of the numerous flowering plants growing on the red sandstone railway bank at Brislington station by Mr H. S. Thompson; and rare grasses by Mr I. W. Evans; micro-slides of plant sections and seeds by Messrs Shrimpton and Munsen. Entomology was represented by Dr E. Barton White's collection of *Arctia caja* illustrating variation in colour due to temperature and moisture, and four races of *Callimorpha dominula*; and Mr H. G. H. Kearns' examples of economic control of insect pests and worms. Geological exhibits included a fossil fish and restorations of fossil vertebrates (Camerascope) shown by Prof. S. H. Reynolds; ammonites from the Jurassic by Mr G. A. Kellaway; and a series illustrating the evolution of fossil Trigoniae by Mr J. W. Tutcher.

In the Ornithological Section Messrs L. A. Hawkins and J. H. Savory exhibited a number of photographic life studies of local birds; Mr W. C. Taunton eggs of Guillemots with photographs of the nests and haunts of the birds taken by himself during a visit to Lundy Island; and Mr H. Tetley, specimens illustrating the similarity of birds in different parts of the world. Another exhibit of interest was that of Neolithic flint implements found locally by Mr A. Selley.

Coffee was served during the evening.

THE 557TH GENERAL MEETING.

December 3rd, 1931.

" Some Early Alchemists," by M. Nierenstein, Ph.D., D.Sc.

The approach to the history of chemistry is through the alchemical philosophers and not through the ancient industrialists. Egypt, Assyria and the other ancient nations had highly developed chemical industries, but they were merely empirical; there was no theory behind their work. One has only to read such works as that of Dr Campbell Thompson on Assyrian Chemistry or Eber's Egyptian papyrus to convince oneself that their knowledge was empirical and utilitarian. To quote Cornelius Agrippa, one of the early philosophers of the 16th century: " The chemist is either a soap-boiler or a philosopher." It is these philosophers who laid the foundation for our present-day chemistry.

Alchemical philosophy is a Greek produce and the outcome of the teaching of Thales, Democrites, Plato, Aristotle and others. As these philosophers taught that matter is made up from elements (Fire, Water, Earth, Air and Ether) and since chemistry is concerned with the knowledge of matter, it was reasonable to expect in the light of Greek philosophy, that by introducing or abstracting one of the elements into or from a given form of matter, new matter might be produced. Thus, for example, it was argued that a form of matter entirely consisting of earth (ore) would, by introducing the element fire (smelting), give a new form of matter (metal). This new form of matter (metal) would therefore consist of the two elements, Fire+Earth.

The economic conditions of Greece, who had been the leading financier of the world before the Peloponnesian War, about 400 B.C., led to the application of these theories to the production of wealth, namely, gold. The Greek "Owl," which had corresponded to the £ as far as international commerce went, had gone off the gold standard, so to speak, and attempts were therefore made to produce wealth artificially. These attempts, the beginning of alchemy, in 450 A.D., coincided with the lowest ebb of Western finance, when the total wealth of £358,000,000, which is estimated to have been the value of Roman coinage in 14 A.D., had gone down to £87,000,000. Alchemical philosophers looked to synthetic gold for salvation. We, who are at the present time similarly situated, are therefore in the best position to approach the early chemists in a right perspective. The alchemists have generally been put to ridicule. They have erred, but they were true philosophers searching after the truth, and it is in this light that the two alchemical philosophers, Zsosimos, the founder of alchemical thought in 450 A.D., and Albertus Magnus, the sage of the Middle Ages, are best appreciated.

Zsosimos, of whom personally nothing is known, left three works:—

(a) A Book describing chemical manipulations.
(b) A Book on the theory of chemistry.
(c) A series of philosophical letters to Theosobia.

His experiments, of which one may be quoted, led him to the conclusion that silver can be produced from earth. He found, namely, that the yellow earthy-looking mercuric oxide by heating (introduction of the element Fire) gave the *silver-like* mercury. This well-known chemical process: $Hg_2O=Hg_2+O$, gave him mercury, which looks like silver, and an "inflammable heat," as he called it, that is, oxygen. Zsosimos thus discovered oxygen 1300 years before Priestley. This single experiment, one of many by Zsosimos, may serve as an illustration of his way of reasoning. It is evident that he was an Aristotelian philosopher to the core.

To understand Albertus Magnus (1193-1286), one has to realise that the 800 years which separated him from Zsosimos also meant the destruction of Greek civilisation, and its contamination with Eastern thought. Greek reasoning had been submerged into the Oriental dogmatism. Aristotle had become either a Dogma or a Demon, and his teaching, dragged through the Syriac, Persian, Arabic and Hebrew, had reappeared in a Latin version in Europe. It was therefore to be expected that a thinker such as Albertus Magnus would revert to the original Greek source. Albertus found the world he lived in, poor, exhausted and looking to the discovery of America for salvation.

Two outstanding factors may be mentioned in Albertus's researches on chemical lines. (1) He showed that gold is insoluble in nitric acid, and the so-called synthetic gold does not obey this law—it dissolves in nitric acid (Note the term law introduced by Albertus Magnus!). From this he concluded that either synthetic gold is no gold at all, or that there are two kinds of gold, natural gold which obeys this law of Nature, and artificial gold which does not obey it. (2) That metals differ in their "love" for acids. Thus, copper is soluble in nitric acid, whereas gold is insoluble. By putting forward this observation Albertus Magnus laid the foundation of Chemistry: he established the theory of affinity.

PRESIDENTIAL ADDRESS, 1931.

The Divining Rod.

By J. W. Tutcher, M.Sc.

FROM very early times it has been claimed that certain persons have a special faculty for discovering, usually by means of an instrument termed a Divining Rod, many different things such as gold, coal, oil, and hidden treasure; but the divining rod has been more frequently used in locating subterranean water than for any other purpose. This operation is termed dowsing and the operator is known as a dowser.

The dowser claims the power to indicate the presence of underground water by means of the uncontrolled movements of a twig, usually a forked hazel twig, one branch of which is held in each hand, he often claims also that the violence of the movement enables him to estimate the depth at which water will be found and whether the supply will be large or small. The ability of the dowser to find water in this way is disputed by many, and geologists especially are usually sceptical of his claim to success by this means.

Replying to a request that the question of water divining should be investigated the United States geological survey said, "It is difficult to see how for practical purposes the entire matter could be more thoroughly discredited, witching for water, oil or other minerals would be a misuse of public funds." The Principal of the Melbourne Technical School sums the matter up by saying, "On the whole I have no confidence in the divining rod or its professed ability to discover either water or minerals," and the Principal of Sydney College remarks, "I know of no scientific men who have any faith in this method of finding water." The views adverse to the claims of the water diviner held by Professor Gregory, Professor Sollas and other distinguished geologists in our own country are well known. It must be admitted that a critical examination of many alleged successes by dowsers justifies scepticism, but when the art of the diviner has been divested of the numerous absurdities and superstitions which accompany it there appears to remain an unexplained residuum, there is apparently in the end a problem to be solved.

There are, of course, rogues in most professions, but it may be taken for granted that the majority of those persons who claim the possession of this faculty for finding water by aid of the twig are honest folk who would not consciously deceive. Many of the older citizens will remember William Scott Lawrence, who practised the art of dowsing from a very early age to the end of his long life. For some years in his later days Lawrence was a near neighbour of mine, and no one who knew this benevolent white-haired old gentleman could suspect him of being anything but sincere in his belief that he possessed the faculty to find water by means of the hazel wand; he held testimonials to his success in this direction from many local gentlemen and commercial firms. An example of the dowser's success for which I can personally testify occurred recently. Mr Mullins, of Bath, a diviner of considerable repute, was engaged to locate a suitable spot for a well at a Somerdale factory site. At the point selected Mullins stated that water would be reached at a depth of about 30 feet. The well was sunk and water obtained within a foot or two of this estimate. In fairness it must be stated that in my opinion no geologist would have predicted with certainty the finding of water at that spot and at that depth, but he would probably assume that if water did occur it would also be obtained at any other point in the immediate neighbourhood.

Some years ago Professor Sollas undertook to test a water diviner on behalf of the Psychical Society. The test took place in a field near Weston-super-Mare. The dowser was requested to indicate two positions, in one of which water would be found whilst the other would be dry. He willingly undertook to do this and in the positions selected by him two wells were sunk. Professor Sollas predicted from geological considerations that water would be found in both wells or in neither of them, and that prediction proved to be correct; water occurred in about equal quantities in both wells. In this case the dowser rightly indicated where water would be found but was wrong in his prediction where it would not be found, although his method for indicating these positions was the same in both cases.

Another local experiment of more recent date arose from a challenge by a diviner to the late Professor Wertheimer, who, in a lecture to the Bristol branch of the Institute of Chemistry, expressed an opinion adverse to the dowser's claims. The experiment was conducted on an estate at Almondsbury. The dowser traced out a line in the field where his rod gave indications of water; pegs were placed on either side of this line marking the area within which the rod indicated. He then went over the ground on either side of the two lines of pegs and ascertained that his rod gave no indication of the presence of water there. He was then blindfolded and led about the field in such a way that he crossed the area marked by the two lines of pegs nine times; his rod gave indications twice when crossing the area and seven times when outside the area, that is in parts of the field where the rod had not previously indicated.

Records of similar successes and failures might be multiplied almost indefinitely. The authors of a recent book on the subject, Sir William Barrett, F.R.S., and Mr T. Besterman, who are sympathetic to the diviner, give detailed reports of many cases, some of them strikingly favourable, others, when critically examined, not so convincing, and failures are candidly admitted. It may be that the very general acceptance of the diviner's powers by the public is due to uncritical journalistic accounts of their operations. An instance of this kind is reported by Mr Beeby Thompson, a well known and very competent geologist and physicist of Northampton. In his statement Mr Beeby Thompson says, "The finding of water by a local diviner near Towcester station was announced in the local papers under such headings as 'A Towcester Wonder' and 'Extraordinary Feat at Towcester.' The water found came from a rock known as marlstone, a bed underlying the whole of Towcester and a considerable district around, into which a number of wells had already been made, including the nearby Towcester Water Works. Particulars of these wells and the rocks passed through had already been published in a memoir of the geological survey for which I and Mr H. B. Woodward were jointly responsible. To select and succeed on one spot when 10,000 others were available all around so far as water was concerned is no success at all, but a virtual failure; the real test for a diviner here would be for him to find a spot where there was no water." On another occasion Beeby Thompson says, "Of 36 dowsing records I have from various places 20 were complete failures, 8 were virtual failures, and 8 are classed as successes in the absence of definite knowledge as to whether they should be classed as virtual failures or not." These statistics are, of course, too limited to have a general application, but 80% of failures in one experience is a startling proportion. The geologist may sometimes fail to correctly determine the probability of finding water at any particular spot; he relies upon a knowledge of the structure and distribution of the underlying strata and unknown irregularities in the distribution of the beds may invalidate his expectations, but I believe that reliable statistics, if they could be obtained, would show a much smaller percentage of geological than of dowsing failures. Dowsers generally deny having any knowledge of geology and claim to disdain its use. The professional dowser may not have had a regular geological training but it is hardly conceivable that, by virtue of their profession, they have failed to acquire a considerable amount of information on water-bearing strata and its distribution, and also on the average water level as revealed by wells in a district with which he is acquainted. If the diviners wand does all that he claims for it no mistakes should occur. The twig is an inanimate thing that should not vary in its response to the same physical cause, yet all authorities admit that the operator is sometimes deceived by its behaviour.

It has already been stated that there is no reason to doubt the honesty of the majority of water diviners; investigation should be directed towards finding an explanation which will cover both successes and failures. Endeavouring to reduce the problem to its lowest terms we find that some of the most successful diviners use no rod; its behaviour in the hands of those who affect it varies considerably, in some cases the wand turns upward in other cases it turns down. The diviner Professor Sollas tested stated that when he walked forwards the rod turned down, but when he walked backwards it turned up; in German hands it generally turns up, used by a Frenchman it turns down. This is difficult to understand unless in addition to the other virtues claimed for it the rod has a sense of nationality. Nearly all professional dowsers assert that the operation is accompanied by peculiar and unpleasant sensations which some describe as like the tingling of an electric shock, others as shivering or trembling and others again as an unpleasant sensation in the epigastric region suggestive of *mal de mer*, with all there is more or less a convulsive spasm. These unpleasant sensations are experienced whether the dowser is right or wrong in his conviction that water is present; when the dowser is off duty these disturbances are not felt even in the presence of water.

Notwithstanding the protestations of the dowser to the contrary the legitimate inference from what has been stated is that it is not water as such which determines either the erratic movements of the wand or the physiological discomfort of the operator. That some emotional disturbance induces subconscious muscular action is endorsed by the evidence of several medical men who have watched the movements of the operator at the critical moment. It is common knowledge that some persons are curiously affected in circumstances that make no similar impression upon others. Shakespeare refers to such cases in "The Merchant of Venice," and it was recently reported that during the war a Sergeant Major, an individual not usually credited with nerves, preferred to risk his life in no-man's-land than remain in the trenches with a cat. Such antipathies are difficult to understand and the causes that affect the diviner are equally obscure. Barrett and Besterman apply the term cryptesthesia (hidden perception) to the divining faculty but admit that the nature of cryptesthesia is unknown. This suggests that the solution of the problem lies with the psychologist. Corpuscular emanations, electricity and magnetism and mechanical vibrations have also been advanced in explanation. Mr Beeby Thompson has recorded a demonstration in which he took part at the Caxton Hall, London. The experiments were conducted in circumstances that left no room for trickery. A number of coats, hats, and newspapers were placed upon chairs arranged around the room; under two of the garments specimens of radium were hidden. The two diviners employed were called into the room separately, neither of them being informed what was hidden, but each in turn was affected by and correctly indicated the position of the hidden radium. The best test, however, was an accidental one. Each diviner detected something against one of the windows. As the radium had never been hidden there an inquisitive visitor wanted to know why the diviners were affected. There was a coat at this point and on enquiry it was found that it was in a pocket of this coat the radium had been brought to the meeting. These experiments suggest that it is not water only, or, that it is not water per se that influences the diviner, but that certain persons are specially responsive to radiations not yet determined, and that the motions of the divining rod are merely the outward expression of an emotional disturbance resulting in subconscious muscular action.

Investigations into the constitution of matter and the nature of radiation have been, and still are, occupying the attention of physicists. Many conceptions formerly held upon this subject have already been much modified, and it is possible a solution of the mystery attached to the use of the divining rod will be found in that direction.

Note on the Squamules of Cladonia ochrochlora Flk. var. ceratodes Flk.

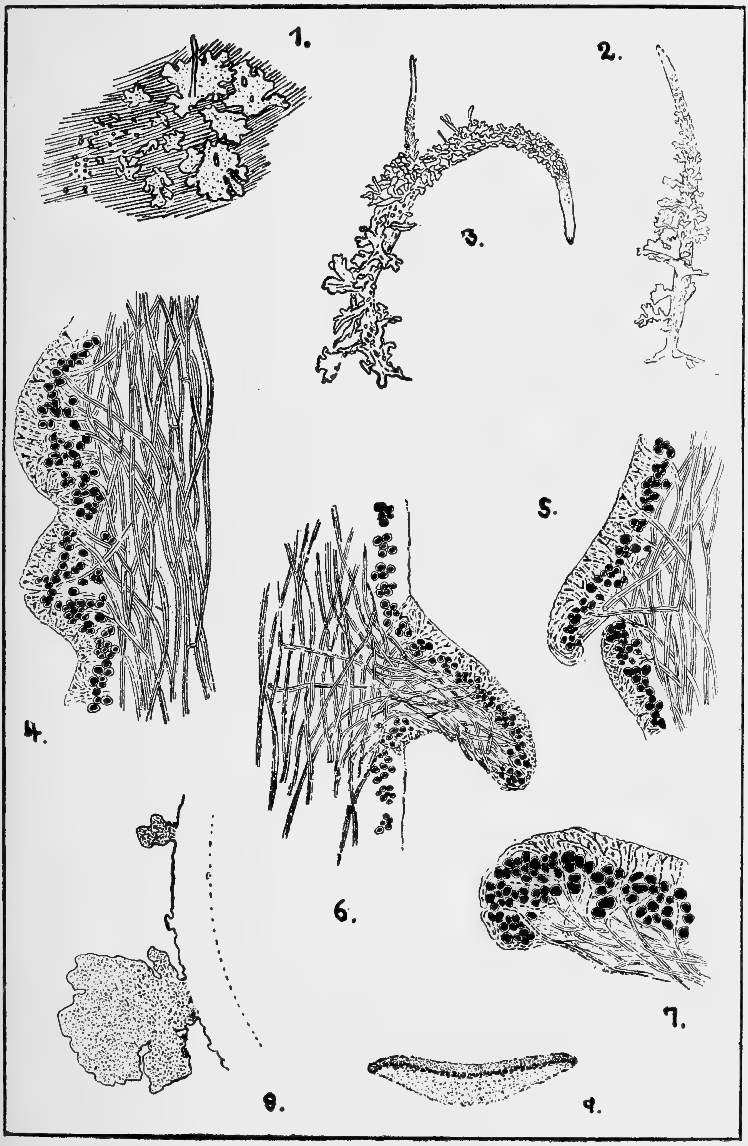
By E. Nellie Sawyer.

THE object of the investigation recorded in this paper was to make observations on the origin and structure of the horizontal squamules found on the upright podetia of a species of *Cladonia*, one of the fruticulose lichens. The material was collected in the Leigh Woods, near Bristol, and belonged to the species *Cladonia ochrochlora* Flk., var. *ceratodes* Flk. (Smith, 1918, p. 434). The specimens were kindly identified by Dr H. Sandstede, of Zwischenahn, Oldenburg, to whom the authoress wishes to express her best thanks. The investigation was carried out in the Botany Department of the University of Bristol at the suggestion and under the guidance of Professor Darbishire, to whom also thanks are due. The Colston Research Society has made a grant towards the cost of the publication of this paper, which is hereby gratefully acknowledged.

Fresh material was used for direct observations or fixed in weak Flemming for sectioning with the microtome. Sections were mounted in Glycerine jelly to which a trace of Gentian violet had been added.

Cladonia ochrochlora grows round the base of tree boles and on stumps of old trees. It is often associated with moss on the soil in the immediate neighbourhood of a tree. It is also sometimes found in patches on slightly sloping banks. The height on the tree trunks to which it grows is usually limited to the lower two or three feet. Occasionally it is found growing higher up, as, for example, in the case of a mountain ash. It occurred here in the horizontal fissures of the bark which form a suitable rough substratum for the growth and development of soredia, the vegetative reproductive organs of this lichen.

The podetia of *Cladonia ochrochlora* are narrow tubular structures, 1 to 2 cm. in height, and often tapering to a point where apothecia and spermogonia are borne (Figs. 1 to 3). The surface of the podetium is smooth and of a greenish-grey colour, becoming white and pulverulent towards the apex. Squamules, superficially resembling leaves, may be borne on the podetia chiefly at the lower ends. They stand out at right angles to the upright podetium and are placed more or less horizontally. This is the normal form of the podetium, but it is found to vary very much. It may be swollen at the base, branched and it may bear several secondary podetia. In the latter case the primary podetium often bends down and may finally come to lie along the ground, secondary podetia growing up from it (Fig. 3). Squamules may be few in number and isolated on the podetium or they may be crowded together. They are always more abundant on the side of the podetium which faces the light. Abnormal forms occur chiefly in exposed situations on tree trunks. When growing on the ground in association with moss plants the podetia are generally upright and possess only a small number of squamules.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The primary flat thallus on which the upright podetia arise is squamulose and generally short lived. By its decay at an early stage the upright podetia become separated. They may then appear to be attached directly to the substratum.

Secondary podetia may also be developed on primary podetia, either directly or indirectly, from the podetial squamules. The latter has been observed to occur when the primary podetium has assumed a horizontal position thereby placing the podetial squamules in a position similar to that of the squamules found on the primary thallus. Under these conditions, too, podetia develop. I have not observed their occurrence on squamules of the upright podetia.

The central cavity of the upright podetium occupies a large proportion of the whole (Figs. 12 and 13). Measurements show that in the mature podetium the diameter of this cavity may occupy three to four-fifths of the whole diameter. The latter varies from 0.6 to 1 mm. Outside the hollow central cavity is a ring of tissue, consisting of hyphae running longitudinally, tightly packed, branching, and showing numerous fusions between the hyphae. The hyphae have thick walls and small lumina. This band of tissue forms a strong support for the whole podetium, on the principle of the hollow cylinder of an upright organ. Further out the hyphae become less tightly packed and either bend upwards or send branches outwards. The free ends of these hyphae are branched and hooked, especially nearer the tips of the podetia, and give the latter the whitish pulverulent appearance. Soredia, possibly of foreign origin, are often entangled in these hyphae. Further down from the tip the soredia become more frequent, the hyphae seem to be growing actively, and surrounding the soredia which thus come to form an integral part of the podetium.

A longitudinal section of the lower part of a podetium would show the three zones of tissues (Fig. 12). The innermost zone consists of a ring of tightly packed, longitudinal hyphae, which become looser towards the outside. This zone varies in thickness from 150 to 200 μ. It surrounds the central cavity. Outside this ring is the layer of groups of gonidia, belonging to the alga Cystococcus, the whole layer being about 25 μ deep. Between the gonidia are intergonidial hyphae. The outermost cortex is formed of the swollen ends of the hyphae which have run out from the gonidial layer. There are no interhyphal air spaces and the cortex presents a smooth appearance. The width of the cortex varies from 15 to 25 μ. In some cases the gonidia are less closely grouped together. The cortex then has a more irregular surface though its continuity is not interrupted. The podetium as a whole assumes a slightly warty appearance. There are also protuberances in the cortex which appear to be due to an excessive accumulation of gonidia at certain points. It is from these points and these protuberances that the squamules arise.

From longitudinal sections of podetia which bear squamules it would appear that the first stage in the development of a squamule is the appearance of a crack in a protuberance on the surface of a podetium (Fig. 4). This crack may occur in the centre of a protuberance or near its base. The inner cause of the crack is not evident. The upper portion of the protuberance soon grows out and ultimately gives rise to a squamule (Figs. 5 to 7). The hyphae immediately behind the gonidia form a protection for the gonidia, which commence to divide actively. The hyphae keep pace in growth with the gonidia and also grow up between them, giving rise to the usual cortical layer above. This is continuous with that of the podetium. Meanwhile the hyphae near the centre of the podetium take some part in the formation of the squamule. It was observed that some of these hyphae run horizontally from the podetium into the squamule, and others obliquely. The latter appear to come from above and below the level of the squamule, which means that some hyphae have sent branches downwards (Figs. 10 and 11). These oblique hyphae often cross over to the opposite side of the squamule as they enter, thus giving it mechanical strength.

The general course of the hyphae in the medulla of the squamule thus formed is longitudinal. The lower surface, however, has no cortex. It consists merely of free and loosely interwoven hyphae. The squamule appears green above and white below (Fig. 9). In shape it is at first flattened and round, but it soon becomes more or less deeply lobed owing to unequal horizontal growth (Fig. 8). The regions of most active growth are recognisable by an accumulation of gonidia within them. A longitudinal section through one of these growing points shows that the growing apex is blunt and curved downwards (Fig. 7). Measurements show that the depth of the cortical and gonidial layers is fairly constant in different squamules. The cortical layer is about 30 μ and the gonidial layer about 25 μ deep. The medullary layer varies from 60 to 150 μ in depth.

Gonidia are often present at the base of the squamule near its junction with the podetium. The origin of these gonidia can be traced. The crack appearing on the podetium divides the podetium into two parts. The upper part develops into a squamule whilst the lower part remains undeveloped forming a sheath at the base of the squamule (Fig. 6). If the crack occurs near the base of a protuberance this basal sheath is not present. Occasionally soredia may be observed clinging to the loose hyphae at the base of the squamules which apparently takes no steps to grow round these soredia. The squamules usually attain a length of about 4 mm. When podetia grow in close proximity to one another, it is not a rare occurrence to find two neighbouring podetia joined together by a squamule. On contact with a neighbouring podetium the squamule, an actively growing organ, becomes so united that it is impossible to distinguish to which podetium the squamule originally belonged. The development of the gonidial layer and the squamules on the surface of the podetium is correlated with the gradual disappearance of the primary squamulose thallus.

The occurrence of soredia on the surface of the podetium is linked up with the problem of the origin of the gonidial layer (Fig. 13). On this subject there is considerable difference of opinion. Wainio claims to have proved that the gonidia are carried up from the primary thallus by the primordial hyphae and increase of these cells follows by normal cell-division. (Smith, 1921, p. 144, and Wainio, 1897, p. 32.) The growth of the gonidia keeps pace with that of the podetial hyphae. He does not explain specifically the origin of the soredia. Presumably they are formed by the isolation of groups of gonidia which are then surrounded by hyphae. Krabbe's views as regards the origin of the gonidia is diametrically opposed to that of Wainio. According to Krabbe's observations the podetial gonidia have their origin in the foreign soredia which arrive on the podetium from an external source (Krabbe, 1891, p. 115). The free growing ends of the hyphae form a suitable alighting ground for these soredia. By further growth of these hyphae the foreign soredia become an integral portion of the podetium. Observations by the authoress seem to support the latter view. The external hyphae on the podetium with their free ends, branching, hooked and curved as they are, seem to form a most suitable landing place for the soredia (Fig. 14). The hyphae, after the arrival of the soredia on their free tips, seem to be stimulated to active growth. They surround the foreign soredia, their ends become swollen and ultimately form the typical cortex of the podetium. The "warty" appearance presented by some podetia would be due to the accumulation of gonidia derived from a group of such foreign soredia.

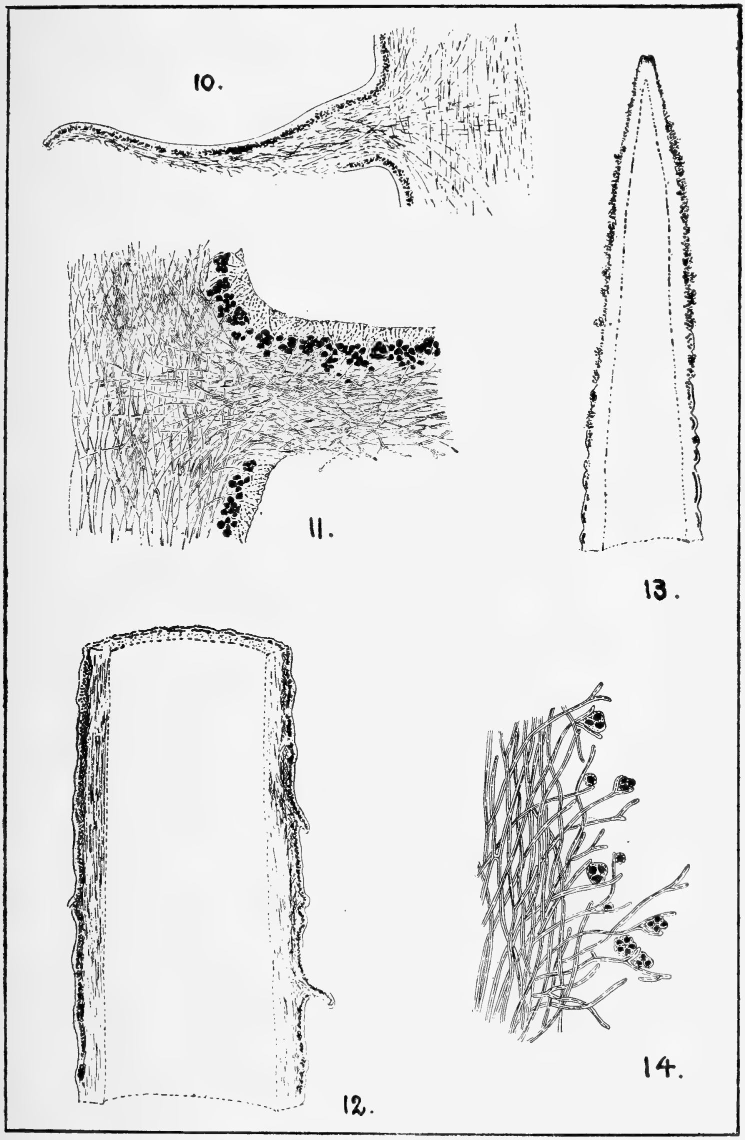
The clothing of the podetium with gonidial tissue enables it to take on an assimilative function, the assimilative function being further increased by the development of squamules. The relation of squamule to podetium suggests that of the leaf of a flowering plant to its stem. The structure of a squamule is also roughly comparable with that of a leaf, the upper cortex covering and protecting the gonidia. These are arranged in a definite layer just below, and near to, the upper surface. They thus obtain a good supply of light for photosynthesis. Below the gonidia run the longitudinal hyphae, some of which are connected with the hyphae of the interior of the podetium. They are connected with the supply of water. The lack of a cortex on the lower side of the squamule permits of the necessary exchange of gases for purposes of assimilation and respiration. There is, of course, no close comparison between squamule and leaf as regards their origin. But it is interesting to note that both have an exogeneous origin.

From the information gained by this investigation on *Cladonia ochrochlora*, the following conclusions may be drawn:—

1. The primordium of the squamule consists of a protuberance from the external layers of the podetium containing an accumulation of gonidia.

2. In these protuberances cracks have been observed, the upper edges of which seem to develop excessively, the lower portion growing more slowly.

3. The outward horizontal growth of this part results in the protrusion of hyphae from the interior of the podetium, covered by gonidia layer and cortex which is continuous with the general cortex of the podetium.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4. The resulting horizontal structure represents the fully developed squamule and closely resembles the squamulose primary thallus on which the primary podetia arise. The lower undeveloped part forms a basal sheath.

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DESCRIPTIONS OF FIGURES ON PLATES.

PLATE I.

Figure 1.—Primary thallus and developing podetium.—× 4.

Figure 2.—Typical podetium bearing squamules.—× 2.

Figure 3.—Podetium bearing squamules and secondary podetium.—× 2.

Figure 4.—Early stage in the development of a squamule, showing the crack in the protuberance.—× 180.

Figure 5.—Later stage in the development of a squamule.—× 130.

Figure 6.—Later stage still, exhibiting the basal sheath.—× 130.

Figure 7.—Growing point of a squamule.—× 200.

Figure 8.—Surface view of a squamule in a transverse section of a squamule.—× 20.

Figure 9.—Transverse section of a mature squamule.—× 20.

PLATE II.

Figure 10.—Longitudinal section of a mature squamule.—× 20.

Figure 11.—Longitudinal section through point of attachment of a mature squamule.—× 180.

Figure 12.—Longitudinal section of lower portion of podetium.—× 20.

Figure 13.—Longitudinal section of apical portion of podetium, showing the presence of " foreign " soredia.—× 20.

Figure 14.—Longitudinal section of podetium near the apex, showing the arrival and capture of " foreign " soredia.—× 200.

On the Occurrence of a Blattoid Hind-wing in the Bristol Coal Measures.

By Herbert Bolton, D.Sc., F.R.S.E., F.G.S.

THE rarity of fossil insect remains in the British Coal Measures, and their relation to insect development during the Upper Carboniferous Period, renders them of more than passing interest, whilst they may prove as in the case of the Welsh and Pas de Calais coalfields, of great value in the determination of horizons.

During Dr Crookall's researches upon the fossil flora of the Bristol coalfield he discovered the fossil wing which forms the subject of this note, and presented it to the writer. It is the third specimen recorded from this area.

The first wing fragment discovered was obtained from shale lying in the Tyning waste heap at Radstock colliery, and passed into the possession of the Sedgwick Museum at Cambridge.

The horizon of the shale could not be discovered, as at that time the Tyning waste heap was receiving material from five collieries.

The wing-fragment proved to be that of a dragonfly closely allied to the giant dragonflies made known by Brongiart from the Stephanian of Commentry, Central France. It was first placed in the same genus *Meganeura*, but has since been transferred to a new genus, *Boltonites*, by Handlirch (Revision der Paläozoischen Insekten, Vienna. 1919, p. 61, fig. 71).

The second discovery was of two small wing fragments, one partly superposed upon the other. These were found in shale at 637 feet below the Bedminster Great Vein and 137 feet above the Ashton Great Vein. The wing fragments were referred to Scudder's genus, *Genentomum*, as *G. subacutum*.

The blattoid hind wing discovered by Dr Crookall was found in shale at the Coalpit Heath colliery, and thus adds a third locality at which fossil insects may be found in the Bristol coalfield. The wing lies upon the slicken-sided surface of a hard greyish black shale containing small ironstone nodules. Unfortunately the wing has become distorted and polished by the slicken-siding. It has a length of 19.5 millimetres and a width of 8 mm. The front or costal margin is straight, the vein forming a raised edge to the wing. It is followed by the subcosta, a delicate vein with a number of widely spaced oblique branches. The radius vein and radial sector are difficult to trace throughout their length, the radius appearing to be feebly forked, and giving off the radial sector in the wing base. It gives off three parallel outer branches.

The median vein seems to rise from a common stem with the radius, the intervening area being occupied by the three outer branches of the median, the first forking twice into three twigs. The area occupied by this vein is small.

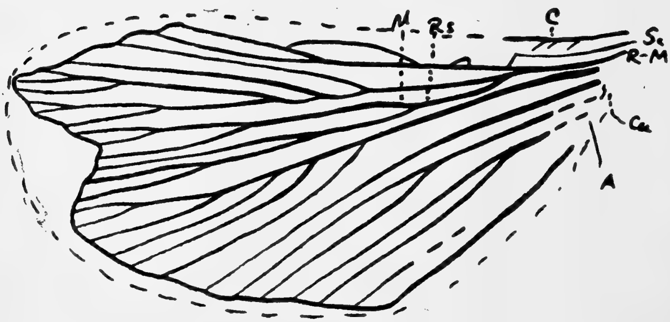
The cubitus is a strong straight vein with three inner branches, and it ends in a long fork. The area of the anal veins has suffered most by distortion. The full course of the veins cannot be traced. The anal furrow is well marked, the first anal vein running parallel to it and dividing into two in the middle of its length. Marginal portions of three other anal veins are distinguishable and portion of a forked vein in the centre of the area. A small portion of the hinder wing margin is present.

Very little is known of the blattoid hind wings. Almost invariably, when found alone, they are imperfect, and when found in association with the forewings and body of the insect, only the apical margins are exposed.

Prof. P. Pruvost has recorded and figured a number of blattoid hind wings from the Pas de Calais Coal Measures, but has only been able to determine their relationship when found in association with the blattoid remains. Those he has so determined he has referred to the Archimylacrid and Hemimylacridian groups.

A comparison of the Coalpit Heath wing with Pruvost's figures seems to indicate that it is Hemimylacridian in type. It may therefore belong to some species of Phylomylacris or Soomylacris, both of which genera have been recorded from the Forest of Dean and South Wales coalfields. Its systematic position can only be expressed as Hemimylacridia, gen. and sp. indet. Horizon: Coalpit Heath Colliery, near Bristol.

The specimen and its counterpart have been added to the Bristol Museum collections (Reg. No. Cb. 2098).



Waterfalls.

By S. H. Reynolds, M.A., Sc.D.
Professor of Geology in the University of Bristol.

WATERFALLS and cascades which form perhaps the most attractive feature of river scenery are characteristic of regions of immature topography and are, geologically speaking, temporary phenomena in the landscape. Long though they may last, they cannot persist indefinitely, but sooner or later, as the rivers cut back and grade their beds, they must disappear.

They may be due to a considerable variety of causes, the chief of which are the following:—

1. The occurrence of a hard stratum resting on a soft one.
2. The occurrence of a hard mass of rock such as an igneous intrusion in the course of a stream.
3. The overdeepening of a main valley.
4. The bringing in contact by means of a fault of two rocks of different degrees of hardness.
5. The occurrence of planes of weakness in rocks along which erosion can proceed with special rapidity.
6. The obstruction of a stream in some way, as by a lava flow or landslip.
7. Local upheaval of part of the earth's crust.

1. Waterfalls due to the occurrence of a hard stratum resting on a soft one. This is undoubtedly the commonest cause of waterfalls, in fact it is stated by the American geologist Shaler that probably three-quarters of all the larger waterfalls in the world are due to this cause. Niagara is the classical example, and Shaler states that within a hundred miles of Niagara there are at least a hundred small waterfalls of this type. Such waterfalls are the chief ones in which a precipitous fall occurs, in a large proportion of cases *cascade* is a more appropriate term than *waterfall*, implying that the water descends over a steep irregular slope rather than over a vertical cliff.

It some cases, as probably in that of Niagara, the fall originated through the water in the first instance finding its way over a line of escarpment. In other cases it has arisen through the undercutting by the stream at the point where the hard band rests on the soft (Fig. I., 1), so that the production of waterfall and escarpment proceeded simultaneously. In either case the undercutting causes the hard upper stratum to overhang, so that slices periodically give way, are broken up and carried away down the stream. Hence the waterfall continually recedes and a ravine is produced extending from the original position of the fall to its subsequent or present position. Lines of joint are important in this connection, frequently determining the direction of the ravine and being largely responsible for its precipitous sides.

The Niagara river falls 330 feet in its course of thirty miles between Lake Erie and Lake Ontario (Fig. II.). When leaving Lake Erie it is nearly a mile wide and during the first fifteen miles of its course, though

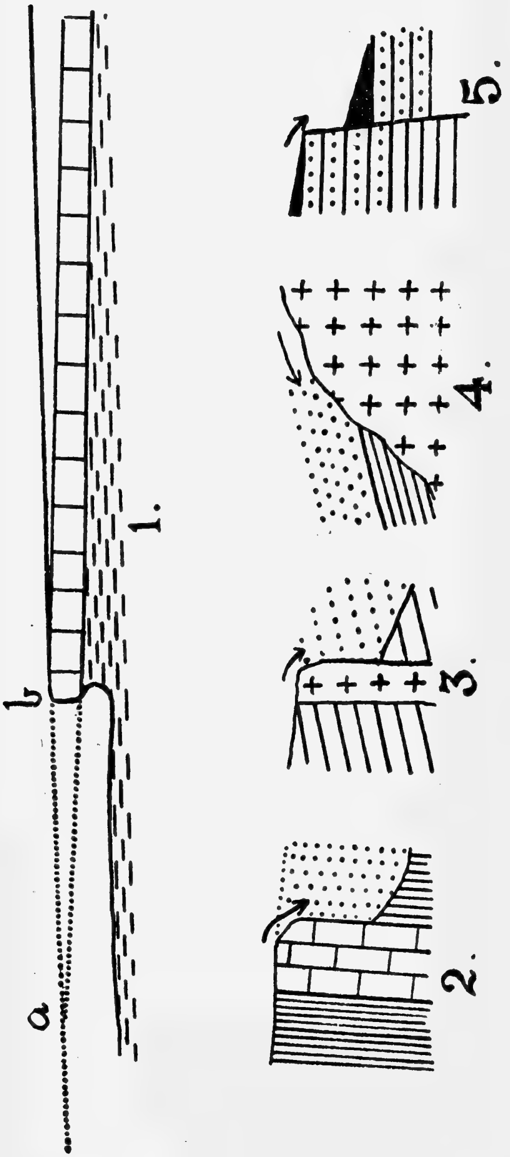


Fig. I.—TYPES OF WATERFALLS.

(Parts removed by erosion shown by dots.)

1. Waterfall of the Niagara type due to the occurrence of a hard band resting on a soft band. (a) Indicates the position when the cutting back commenced, (b) the present position of the fall.
2. Waterfall due to a hard band interbedded with soft, the whole series being highly inclined. The waterfall is over the hard band.
3. In this case a dyke cuts across the strata and forms the hard band over which the fall takes place.
4. In this case the fall is over the edge of a plutonic mass such as granite.
5. In this case a fault brings soft rock (black) against hard rock (dotted) and the fall is over the fault plane.

A.—THE HORSESHOE FALL, NIAGARA.
(August 1924.)

B.—THE LOWER FALL OF THE YELLOWSTONE.
(September 1924.)

Plate I.

A.—THORNTON FORCE, NEAR INGLETON.
(August 1919.)

B.—NEAR THE OUTFLOW OF THE NILE FROM LAKE VICTORIA WITH THE RIPON FALLS IN THE DISTANCE.
(March 1925.)

Plate II.

flowing smoothly and rapidly, it descends only fifteen feet. On approaching the Falls, however, it forms rapids, plunging over a succession of limestone ledges and descending fifty feet in a mile. The Falls, which are 165 feet high, are divided into two by a wooded island—Goat

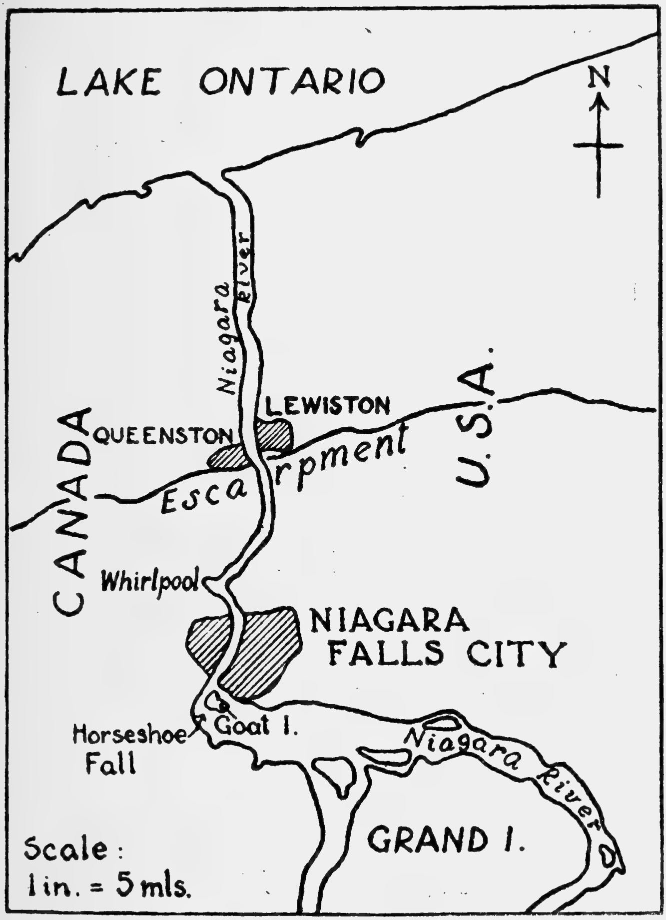


Fig. II.—SKETCH MAP OF THE NIAGARA AREA.
(Based on a map in the Times Atlas.)

Island. The major Fall, the Horseshoe or Canadian Fall (Pl. I. A) is nearly in the direct course of the river and is about 600 yards wide, while the minor or American Fall enters somewhat laterally and is about 200 yards wide. The Horseshoe Fall owes its peculiar form to the intersection of two lines of joint. From below the Fall the river, with a depth of 200 to 300 feet, rushes through a gorge only 200 to 400 yards wide, this contrasting strongly with the width of the river above the Fall. About half-way along the gorge is the Whirlpool, where, at a bend in its course the channel widens and the outflowing water is forced to pass under the inflowing, to escape along a course nearly at right angles to that by which it entered. The gorge ends with the escarpment at Queenston and Lewiston, distant six miles from Lake Ontario.

The Falls have receded seven miles from the present position of the escarpment, and as the cutting back of the escarpment must also have been slowly proceeding the total recession of the Falls must be more than seven miles. The rate of recession has been carefully studied. A Commission reported in 1890 that since 1742, when the Falls were first surveyed, the Horseshoe Fall has receded 104 feet. Some observers have considered the average annual recession to be three feet, but Lyell concluded that an average of one foot would be more probable and estimated that 35,000 years would be required for the excavation of the whole gorge. Spencer estimated the time required at about 30,000 years. It is clear, however, that the rate of retreat is not uniform and it is far more rapid at the Horseshoe than at the American Fall.

Owing to the slight dip of the strata upstream, the hard layer as the Falls retreat will gradually come nearer to the river bed and the Falls will become lower and lower. Should cutting back proceed to a point at which the hard layer reaches the bed of the river the Falls will be converted into rapids.

Several other well-known American waterfalls are due to causes similar to those of Niagara, *e.g.*, the Falls of St Anthony on the Mississippi at Minneapolis. These are said to be cut back three to six feet annually. The Falls of the Yellowstone river (Pl. I., B) are apparently due to the occurrence of specially hard bands of tuff in a series which is in the main soft.

Several of the better known waterfalls in the north of England, such as High Force and Cauldron Snout in Teesdale, Thornton Force near Ingleton (Pl. II., A), and Hardraw Force in Wensleydale have had a similar origin. In the Teesdale examples the hard upper layer is formed by the Great Whin Sill. At High Force, where the fall is about 70 feet, the strata below the Whin are Carboniferous limestone and shale; the gorge below the fall points to its recession. Thornton Force and Hardraw Force are over Carboniferous rocks—hard well-jointed sandstone or limestone overlying soft shale. In countless mountain streams any specially hard band of rock produces a cascade.

2. A second common cause of waterfalls is the occurrence of a more or less vertical mass of hard rock in the bed of a stream. Occasionally this may be due to a hard band of rock interbedded in softer and tilted up into a vertical or nearly vertical position (Fig. I., 2). Far more frequently it is due to a dyke intersecting the strata (Fig. I., 3). In either case the hard band affords a check to the erosion of the softer strata up stream, while down stream from it they may be rapidly worn away. If the hard band is of no great thickness, while the fall will not recede, it will be gradually lowered, and in no very lengthy period of time will disappear. The Ripon Falls and other cascades near the outflow of the Nile from Lake Victoria (Pl. II., B) depend on the resistent character of a series of basic intrusions running across the river.

Somewhat similar are the cascades at the junction of a plutonic rock such as granite and the strata, generally less resistant, into which it has been intruded (Fig. I., 4).

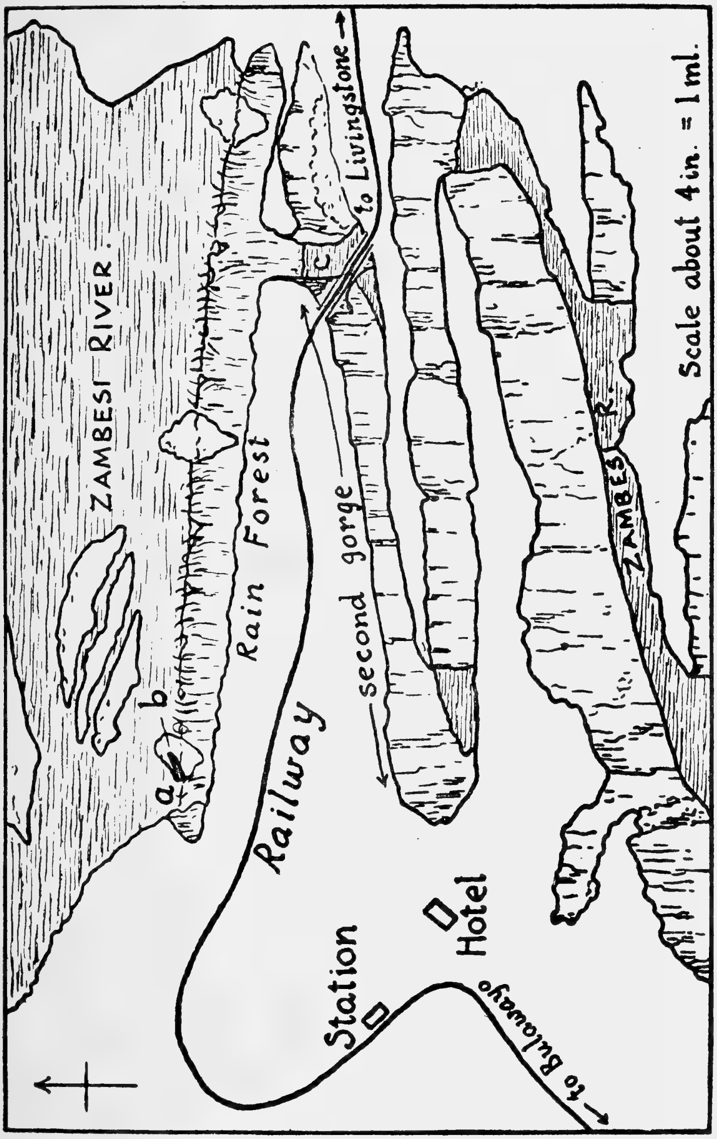


Fig. III.—BIRD'S EYE VIEW OF THE VICTORIA FALLS.
(Based on an illustration in a pamphlet sold at the Falls.)
a. Devil's Cataract or Leaping Water. B. Ravine in Cataract Island
c. Boiling Pot Gorge.

3. A very frequent cause of waterfalls is the overdeepening of the main valleys in glaciated regions. This depends on the fact that the main glacier commonly has greater erosive power than its tributaries, so that when the ice disappears their valleys will open at a higher level than the floor of the main valley into which their streams will tumble in cascades. Numerous examples occur in the Lake District, Scotland, Wales, and many other glaciated mountain regions. Lodore in Borrowdale and the cascade at the Devil's Bridge near Aberystwyth may be quoted as examples. Many Swiss waterfalls are also due to the glacial overdeepening of valleys.

Cascades often descend the faces of the amphitheatre-like terminations of many mountain valleys known as cirques or corries. The largest and most famous cirque in Europe is that of Gavarnie in the French Pyrenees. The slender cascade seen in the photograph (Pl. IV., B), which was taken in September, may be much larger in the spring.

4. A considerable number of waterfalls depend on faulting (Fig. I., 5). In some cases as in that of the Upper Clun-gwyn fall* of the river Mellte in S. Wales, " the stream plunges down the fault plane and continues in the shale gorge below the fall, on the surface of the same sandstone bed over which it flowed before the fall." In this case the soft shale overlying the hard sandstone was brought in contact with it by the fault and the waterfall has arisen by the differential erosion of the two rocks. In other cases an actual fault-scarp may be produced over which the water falls.

5. Waterfalls due to erosion along planes of weakness in the rocks, such as faults and joints, are represented by the most magnificent waterfalls in the world, the Victoria Falls of the Zambesi. They surpass Niagara in grandeur and show some unique features particularly in the wonderful zigzag gorge which extends for many miles below them (Fig. III.). Above the Falls the river, which is over a mile† wide and studded with wooded islands, flows over a plateau of basaltic lava of Upper Trias or Rhaetic age. At the Falls (Pl. III., A) it plunges into a chasm equal in length to the river's width and varying in width from about 35 to 80 yards with a drop at its highest point of nearly 400 feet. The exit from the chasm or First Gorge is by a channel, the Boiling Pot gorge, only about 100 feet wide. First discovered by Livingstone and originally attributed to earthquakes, the chasm at the Falls and its continuation the zigzag gorge (Pl. III., B) are now known to be due to erosion along planes of weakness in the rocks—faults and joints.

Although the Falls have not receded since their first discovery in 1855, the long gorge below them is clearly the result of recession, which,

Note.—Two photographs of waterfalls due to a hard band of rock overlying softer strata are included in the series published by the British Association Geological Photographs Committee.

The illustrations of the present paper are from the writer's photographs.

*Photograph reproduced in the series published by the British Association Geological Photographs Committee.

†The dimensions quoted are from Molyneux's paper in the *Geographical Journal* for 1905.

A.—VICTORIA FALLS OF THE ZAMBESI, NEAR THE WESTERN END.
(August 1929.)

B.—ZIGZAG BEND OF THE ZAMBESI BETWEEN THE SECOND AND THIRD GORGES.
(February 1925.)

Plate III.

A.—NEAR CATARACT ISLAND, VICTORIA FALLS; MUCH BARE ROCK EXPOSED.
(August 1929.)

B.—THE CIRQUE OF GAVARNIE, WESTERN PYRENEES, WITH SLENDER CASCADE.
(September 1931.)

Plate IV.

while in some respects analogous to that of Niagara, in others affords a strong contrast. The recession of Niagara is continuous, that of the Victoria Falls is intermittent and apparently proceeds in the following manner. Erosion is alternately concentrated on transverse or east and west lines of weakness—faults or shatter-belts and on longitudinal or north and south lines of weakness—joints. Erosion along the east and west lines produced the long succession of gorges, each of which was at one time the scene of a waterfall comparable to the present one, and while they were forming recession was at a standstill. Sooner or later erosion became concentrated on north and south planes of weakness, and when this took place the water became gradually drawn off the long line of fall, and cutting back for a time followed a north and south course till another east and west line of weakness was reached and recession again ceased. At the present time the greatest mass of water is concentrated at the Devil's Cataract or Leaping Water at the extreme western end of the Falls, though in the wet season the water pours over nearly their whole length. In the dry season, however, there are broad tracts of bare rock bordering the islands at the brink of the Falls (Pl. IV., A) and showing how easily, if the cutting back now in progress at the Devil's Cataract was accelerated, all the water could be drawn into it, leaving the main fall dry, thus adding another member to the zigzag ravine, and producing a short connecting gorge similar to that of the Boiling Pot. It is a noteworthy fact that Cataract Island, which forms the inner wall of the Devil's Cataract, is penetrated by a deep ravine (b. in Fig. III.) which runs parallel to the second gorge and may be the commencement of a new transverse gorge analogous to that into which the water now descends.

6. Some waterfalls are due to the sudden formation across a valley of a barrier such as a landslip or lava flow which ponds back the water and produces a lake. A cascade may then form over the barrier or the stream may be completely diverted and forced to re-enter the valley by means of a waterfall at some fresh point. In some cases again part of a river valley was choked with boulder clay during the Glacial period and when after the passing away of glacial conditions the stream re-established itself, it sometimes re-entered its valley by a fall.

Professor Marr mentions that a large number of the minor waterfalls of the Lake District "owe their existence to the recent diversion of their courses by the formation of dams of glacial material which have blocked the old courses of the streams."

Mention may here be made of the waterfall or cascade at Jajce in Bosnia due to the deposition of great masses of calcareous tufa.

7. Local upheaval of part of the earth's crust may be a cause of waterfalls. Thus if a coast line be upheaved a line of cliffs may be produced over which for a time streams may fall as cascades into the sea. Or the upheaval may have the effect of adding a coastal plain at the foot of the line of cliff, in which case the spots where the streams cascade on to the coastal plain will commonly be favourite localities for settlement.

Bristol Insect Fauna.

DIPTERA (Part IV.).

By H. Audcent.

THE families of Diptera dealt with so far belonged to the division Orthorrapha, in which the imago leaves the puparium by a T-shape rent. The succeeding families belong to the division Cyclorrapha, in which the top of the puparium is pushed open like the lid of a box.

The Phoridae, however, occupy an intermediate position as regards the emergence of the fly and other characters.

PHORIDAE.

Small, black, humpbacked flies, usually caught by "sweeping" but often seen on leaves and windows. The frons (forehead) is wide and bears a number of well-developed bristles. Eyes large, usually hairy. Antennae sunk in the face and bearing an apical arista. Legs strong, hind femora compressed and dilated. Venation of wing unique: two thick, dark veins reaching only a short distance along upper margin of wing. The portion of the edge of the wing between base of wing and ending of second dark vein is thickened and bristly. From these dark veins four thin, pale veins run to lower margin of wing. The larvae live in decaying matter; some may be parasites.

Mr J. H. Wood published a series of papers on Phoridae in "E.M.M.," 1906-12, in which he described 146 species.

Mr W. Lundbeck deals with this family in "Diptera Danica," Part VI., 1922. This is a family that has been much neglected.

Aphiochaeta fungivora Wood. S., Taunton (Pa.).
,, *melanocephala* v. Ros. S., Backwell (A.), 30/3/26; Taunton (Pa.); Leigh Woods (H.).
,, *pleuralis* Wood. S., Taunton (Pa.); Shapwick (A.), 26/8/25.
,, *rata* Wood. G., Bristol (J. V. Pearman).
,, *ruficornis* Mg. S., Dunster (A.), 8/16.
Chaetoneurophora thoracica Mg. S., Taunton (Pa.).
Conicera atra Mg. S., Freshford (C.).
,, *similis* Hal. S., Tickenham (A.), 19/7/24.
Dorhniphora abdominalis Fln. G., Hallen (A.), 1/8/29. S., Langport (C.).
,, *concinna* Mg. G. and S., fairly common.
Hypocera incrassata Mg. S., Wells (L.); Kew Stoke (C.); Sharpham (A.), 7/8/23.
Megaselia pulicaria Fln. G., Bristol (A.), 20/11/26; Hallen (A.), 19/9/26. S., St Audries (A.), 25/8/29; Tickenham (A.), 20/7/23; Shapwick (A.).
,, *pygmaea* Ztt. G., Shepperdine (A.), 18/8/24.
,, *rufipes* Mg. G., Wotton-under-Edge (C.); Bristol (A.), 26/8/30. S., Taunton (Pa.).
,, *sulphuripes* Mg. (*lutea* Mg.). S., Shepton Mallet (C.).
Metopina galeata Hal. G., Westbury-on-Trym (A.), 2/21.
Paraspiniphora bergenstammi Mik. S., Taunton (Pa.).
,, *erythronota* Strobl. S., Backwell (A.), 17/7/26; St Audries (A.), 25/8/29.
,, *immaculata* Strobl. (*dorsalis* Beck.). G., Olveston (C.).
,, *maculata* Mg. S., Shepton Mallet (C.); Brockley Combe (Wm.), 26/8/22.

Parastenophora unispinosa Ztt. G., Olveston (A.), 30/7/22.
Phora (*Trineura*) *aterrima* F. G., Olveston (A.), 2/9/23. S., Wells (L.); St Audries (A.), 19/8/29; Tickenham (A.), 25/7/26.
Pseudodacteon formicarum Verr. S., Dundry (A.), 2/21.

BRAULIDAE.

This family contains one genus with one species. It is a small blind, wingless fly which is parasitic on Hive Bees and is known as the Bee Louse. It is found attached to the body of the Bee and especially on the Queen Bee. Its life-history is not well known, and in its structure it resembles a Phorid.

Braula caeca Nitz. G., Shirehampton (A.), 24/9/06; Bristol (C.). S., Shepton Mallet (C.).

DIPTERA CYCLORRAPHA.

I. CLYTHIIDAE (PLATYPEZIDAE).

Small, sluggish flies found on leaves and usually obtained by sweeping evergreen hedges. Male with eyes touching, female with eyes far apart; male usually darker than female. Antenna three jointed, with apical arista; tarsal joints of hind legs dilated. Wings with six straight veins, one cross-vein from third to fourth longitudinal vein, one or two cross-veins between the fourth and fifth longitudinal veins and a sloping cross-vein between the fifth and sixth longitudinal veins. In *Clythia* the fourth longitudinal vein has a short fork, in *Opetia* this fork is long. The larvae are flat and broad, with filaments all along the edge and on the back; they live in fungi. "British Flies," Vol. viii., 1901 (G. H. Verrall), deals with Clythiidae, Dorylaidae and Syrphidae, but this book is almost unobtainable. "Diptera Danica," Part vii., 1927 (W. Lundbeck), deals with Clythiidae and Tachinidae.

Callimyia amoena Mg. (*leptiformis* Fln.). S., Leigh Woods (C. W. Dale).
,, *speciosa* Mg. G., Stone (A.), 28/7/28.
Clythia (*Platypeza*) *atra* Mg. S., Weston-s.-Mare (J.); Sharpham (A.), 17/8/25.
,, ,, *consobrina* Ztt. G., Bristol (Wm.), bred 7/10/22. S., Wells (L.).
,, ,, *fasciata* Mg. S., Chew Magna (H.), 27/8/19.
,, ,, *furcata* Fln. G., Olveston (C.).
,, ,, *infumata* Hal. G., Olveston (A.), 6/21. S., Wells (L.).
,, ,, *inodesta* Ztt. S., Wells (L.).
,, ,, *picta* Mg. S., Wells (L.).
,, ,, *rufa* Mg. S., Wells (L.).
Opetia nigra Mg. S., Backwell (A.), 21/4/27.

II. DORYLAIDAE (PIPUNCULIDAE).

Small, dark flies, with irridescent wings, which hover most gracefully over foliage, seldom over flowers. The head is very large, wider than the thorax, and seems to consist of two huge eyes, which touch in the male and are narrowly separated in the female. In *Verrallia* the eyes extend to the back of the head when viewed sideways, in *Dorylas* they leave a narrow hind border. Antenna is three jointed, last joint either kidney shape or pointed, the arista, which is bare, springs from the upper side of the third joint. The male genitalia are fairly large, unsymmetrical, curving from left to right under the venter. The female genitalia are also fairly large and end in a long ovipositor which is bent in under the venter. The wings are long with six longitudinal veins, the fourth usually bent up towards the third; there are two cross-veins between the third and fourth longitudinal veins (only one cross-vein here in *Chalarus*). The larvae are parasitic on Homoptera (Frog Hoppers, Plant Lice). Literature:—Verrall (*vide ante*) and " Diptera Danica " (W. Lundbeck), Part. vi., 1922.

Chalarus spurius Fln. G. and S., fairly common.
Dorylas (*Pipunculus*) *ater* Mg. (*campestris* Lat.). G., Cranham (Wt.); Wotton-under-Edge (P.); Awkley (A.), 8/9/22; Hallen (A.), 24/9/27. S., Shapwick (A.), 3/9/22; Shepton Mallet (C.).
" " *fuscipes* Ztt. G., Chalford (Wt.); Shepperdine (A.), 5/8/24; Awkley (A.), 8/9/22.
" " *incognitus* Verr. S., Flax Bourton (H.).
" " *nigritulus* Ztt. (*geniculatus* Mg.). G., Clifton (C.); Wotton-under-Edge (P.); Olveston (A.), 30/7/28; Kingsweston (A.), 1/6/22. S., Shepton Mallet (C.); Axbridge (Rd.); Keynsham (A.), 19/7/26; Berrow (A.), 13/7/30.
" " *pulchripes* Thoms. S., St Audries (A.), 1/9/29.
" " *rufipes* Mg. S., Clevedon (A.), 14/5/27.
" " *semimaculatus* Beck. G., Kingsweston (A.), 7/21.
" " *spinipes* Mg. G., Hallen (B.), 30/7/30. S., Sharpham (A.), 22/8/22; Tickenham (A.), 23/6/29.
" " *sylvaticus* Mg. S., Berrow (A.), 19/7/25; Sharpham (A.), 9/8/25.
" " *thomsoni* Beck. (*pratorum* Fln.). G., Hallen (B.), 11/7/29.
" " *unicolor* Ztt. G., Olveston (C.).
" " *zonatus* Ztt. G., Olveston (A.). 30/7/22; Hallen (B.), 11/7/29.
Verrallia aucta Fln. G., Bristol (C.); Hallen (A.), 12/7/24. S., Leigh Woods (C.); Tickenham (A.), 24/6/24.
" *pilosa* Ztt. G., Stroud (W.); Wotton-under-Edge (P.). S., Backwell (A.), 11/7/25; Leigh Woods (Wm.), 21/5/22.
" *setosa* Verr. S., Leigh Woods (A.), 26/5/26.
" *villosa* v. Ros. G., Cranham (Wt.); Hanham (C.). S., Backwell (A.), 6/6/25; Leigh Woods (C.).

III. SYRPHIDAE.

Generally known as Hover Flies because they hover over flowers in the sunshine. May be quite black but more often banded with bright yellow. May be bare or very hairy, some resemble Wasps and Bees. Eyes usually touch in front in the males but are widely separated in the females. Antenna three jointed, arista, bare or plumose, situated on upper surface (sometimes at apex) of the third joint. Male genitalia fairly large, asymmetrical, bent under venter from left to right. Female genitalia small. Wings with six longitudinal veins. The first two may reach edge of wing separately (subcostal cell open) or may unite before reaching the edge (subcostal cell closed). Two cross-veins between the third and fourth longitudinal veins and two between the fourth and fifth. Between the third and fourth longitudinal veins there is always a longitudinal dark stripe (Vena Spuria) which looks like a faint vein. The larvae lead very varied lives; some live in the open on leaves and feed on Plant Lice, others live in damp soil and mud (Rat-tailed Maggots), others in rotten wood, others in living plant tissues, and others act as scavengers in the nests of Wasps, Bees and Ants. Besides Verrall's book (*vide ante*) there is " Diptera Danica," Part v., 1916.

Sub-family CHILOSIINAE.

Either quite black species with a nose-like protuberance on the face, eyes bare or hairy, or species with yellow marks on abdomen, flat face and hairy eyes and face. Subcostal cell open.

Callicera aenea F. S., Dunster (A.), 8/16.

Chilosia albipila Mg. (*flavicornis* F.). G., Painswick (W.); Wotton-under-Edge (P.). S., Ashcot (Wm.), 21/3/27; Blackdown (Wm.), 14/5/27; Shapwick (A.), 21/4/24; Shapwick (Tr.), 3/20.

„ *albitarsis* Mg. (*flavimana* Mg.). G. and S., common.

„ *antiqua* Mg. (*sparsa* Lw.). G., Sheepscombe (St.), 18/6/27. S., Cheddar (C.).

„ *barbata* Lw. G., Olveston (A.), 5/9/22. S., Sharpham (A.), 16/8/23; Shapwick (Wm.), 28/5/31; Chew Magna (A.), 8/5/19.

„ *bergenstammi* Beck. G., Olveston (C.); Kingsweston (A.), 4/9/24; Littledean (A.), 25/5/31; Wotton-under-Edge (P.). S., Wrington (Wm.), 7/5/27; Shapwick (J.), 8/8/19; Withypool (J.), 20/8/22; Banwell (J.), 15/9/22.

„ *chrysocoma* Mg. G., Wotton-under-Edge (P.); Cranham (Wt.); Selsley (Br.).

„ *cyanocephala* Lw. S., Batheaston (Bl.).

„ *fraterna* Mg. G., Bitton (C.); Olveston (C.). S., Batheaston (Bl.); Sharpham (A.), 22/8/22; Shapwick (A.), 1/5/27.

„ *grossa* Fln. G., Painswick (W.); Wotton-under-Edge (P.). S., Shapwick (J.), 3/4/19; Shapwick (Tr.), 3/20.

„ *honesta* Rnd. G., Selsley (Wt.); Cirencester (T.); Wotton-under-Edge (P.). S., Rodney Stoke (A.), 17/4/29.

„ *illustrata* Harr. (*oestracea* Lw.). G., Painswick (W.); Cirencester (T.); Wotton-under-Edge (P.); Oldbury Court (Wm.), 26/6/17. S., Weston-s.-Mare (J.), 12/8/17; Shepton Mallet (C.); Leigh Woods (H.); St Audries (A.), 19/8/29.

„ *impressa* Lw. S., Freshford (C.); Dunster (A.), 8/16; Leigh Woods (Wm.), 8/8/20.

„ *intonsa* Lw. G., Olveston (A.), 30/7/22; Shepperdine (A.), 30/7/24; Kingsweston (Wm.), 16/8/22. S., Freshford (C.); Shapwick (A.), 30/8/24; Tickenham (A.), 24/4/22; St Audries (A.), 23/8/29.

„ *longula* Ztt. G., Bristol (C.); Kingsweston (Wm.), 16/7/22. S., Leigh Woods (H.).

„ *maculata* Fln. G. and S., common on flowers of *Allium ursinum* L.

„ *mutabilis* Fln. S., Portishead (H.); Leigh Woods (H.).

„ *pagana* Mg. (*pulchripes* Lw.). G. and S., fairly common.

„ *praecox* Ztt. (*ruralis* Mg.). G., Selsley (Wt.); Cirencester (T.).

„ *proxima* Ztt. G., Shepperdine (A.), 8/8/24; Forest of Dean (J.), 11/8/23; Blaise Castle (A.), 17/9/21. S., Bleadon (J.), 29/4/21; Winsford (J.), 15/8/22; Tickenham (A.), 20/8/23; Sharpham (A.), 1/5/27.

„ *scutellata* Fln. G., Painswick (W.); Wotton-under-Edge (P.); Olveston (C.); Cirencester (T.). 16/6/22. S., Freshford (C.); Cheddar (C.); Tickenham (A.), 26/6/24.

„ *soror* Ztt. G., Cirencester (T.), 11/7/24; Cranham (Wm.), 13/9/28; Kingsweston (Wm.), 18/7/22. S., Shepton Mallet (C.); Leigh Woods (Wm.), 8/8/20.

„ *variabilis* Pz. G. and S., fairly common.

„ *vernalis* Fln. G. and S., fairly common all the year round.

„ *vulpina* Mg. G., Cirencester (T.), 16/5/22; Kingsweston (A.), 6/5/23; Bristol (Wm.), 8/5/30. S., Ashcot (J.), 28/8/20; Shapwick (J.), 29/6/21; St Audries (A.), 26/8/29.

Chrysogaster chalybeata Mg. S., Dunster (A.), 8/16.

„ *hirtella* Lw. S., Freshford (C.); Bitton (C.); Leigh Woods (H.); Shapwick (A.), 17/6/23; Tickenham (A.), 16/5/25; G., Littledean (A.), 25/5/31.

„ *macquarti* Lw. G., Painswick (W.); Olveston (C.).

„ *solstitialis* Fln. G. and S., common.

Chrysogaster splendens Mg. G., Painswick (W.); Olveston (C.); Awkley (A.), 5/9/23. S., Leigh Woods (H.); Taunton (C.); West Town (Wm.), 21/6/22; Weston-s.-Mare (J.), 3/9/21; Tickenham (A.), 19/7/24.

Cnemodon vitripennis Mg. G., Redland, Bristol (C.); Cirencester (T.), 12/7/23; Olveston (A.), 2/9/23; Shepperdine (A.), 20/8/24. S., Freshford (C.); Sharpham (A.), 27/8/22.

Heringia (*Pipizella*) *heringi* Ztt. (*Penium dubium* Lbk.). S., Leigh Woods (H.); Weston-s.-Mare (J.), 14/5/23.

,, ,, *virens* F. G. and S., fairly common.

Liogaster metallina F. G., Sheepscombe (St.), 18/6/27; Shepperdine (A.), 11/8/24. S., Shepton Mallet (C.); Berrow (A.), 29/9/24; Taunton (A.), 9/6/24.

Orthoneura nobilis Fln. G., Selsley (Wt.); Olveston (C.). S., Taunton (C.); Tickenham (A.), 25/6/26; St Audries (A.), 24/8/29.

Pipiza austriaca Mg. (=*P. lugubris* F. of previous lists). G., Cirencester (T.), 13/6/24; Olveston (C.); Shepperdine (A.), 15/8/24. S., Tickenham (A.), 26/6/24.

,, *bimaculata* Mg. G., Olveston (C.); Kingsweston (A.), 6/5/23. S., Leigh Woods (H.), 3/6/19; Sharpham (A.), 8/8/25.

,, *luteitarsis* Ztt. G., Kingsweston (A.), 17/5/24. S., Weston-s.-Mare (J.), 13/5/21.

,, *noctiluca* L. G. and S., fairly common.

,, ,, var. *fenestrata* L. G., Filton (A.), 22/5/30. S., Banwell (J.), 17/5/21; Weston-s.-Mare (J.), 20/5/20.

Sub-family Spheginae.

Face produced snout-like, body wasp-shaped, hind femora thickened.

Neoascia (*Ascia*) *dispar* Mg. G., Bristol (C.). S., Cheddar (G.); Shapwick (A.), 26/5/23.

,, ,, *floralis* Mg. G., Bristol (C.). S., Weston-s.-Mare (J.); Shapwick (A.), 17/6/23; Dunster (A.), 8/6/24.

,, ,, *geniculata* Mg. G., Littledean (A.), 25/5/31. S., Dunster (A.), 8/6/24; West Town (Wm.), 12/6/27.

,, ,, *podagrica* F. G. and S., common.

Sphegina clunipes Fln. G., Painswick (W.); Sheepscombe (St.), 29/6/24; Colesbourne (T.), 21/6/23; Blaise Castle (Wm.), 8/21. S., Leigh Woods (H.).

Sub-family Brachyopinae.

Face produced snout-like, body without waist, hind femora normal.

Brachyopa bicolor Fln. G. and S., fairly common on flowers of Hawthorn.
Rhingia campestris Mg. G. and S., very common.

Sub-family Bacchinae.

Face not produced, body very slender, tail-end swollen.

Baccha elongata F.
,, *obscuripennis* Mg. G. and S., both common among grass in shady, damp situations.

Sub-family Syrphinae.

Antennae short, hanging down; face not produced; body normal shape, usually with conspicuous yellow markings; first cross-vein between longitudinal veins 3 and 4 is before the middle of the cell on which it rests, subcostal cell open.

Didea fasciata Mcq. S., Minehead (Bl.); Weston-s.-Mare (J.), 13/9/20.
Epistrophe (*Syrphus*) *annulatus* Ztt. G., Stroud (Wt.); Cirencester (T.), 26/6/23. S., Minehead (Bl.).

Epistrophe (*Syrphus*) *auricollis* Mg. G., Painswick (W.); Wotton-under-Edge (P.); Cirencester (T.). S., Shepton Mallet (C.); Freshford (C.); Tickenham (A.), 23/6/29.

,, ,, ,, var. *maculicornis* Ztt. G. and S., common.

,, ,, *balteatus* Deg. G. and S., very common.

,, ,, *bifasciatus* F. G. and S., common.

,, ,, *cinctellus* Ztt. G. and S., common.

,, ,, *cinctus* Fln. G., Cranham (Wt.); Cirencester (T.); Westbury-on-Trym (Wm.), 27/8/22. S., Leigh Woods (A.), 22/5/27.

,, ,, *compositarum* Verr. G., Kingsweston (A.), 6/7/24; Olveston 7/20. S., Cheddar (C.); Leigh Hoods (H.); Shapwick (Wm.), 26/6/21.

,, ,, *diaphanus* Ztt. S., Nailsea (J.), 20/6/22.

,, ,, *euchromus* Kow. S., Banwell (J.), 27/5/21.

,, ,, *grossulariae* Mg. G., Wotton-under-Edge (P.); Forest of Dean (J.); Cirencester (T.), 8/7/24. S., Leigh Woods (H.); Weston-s.-Mare (J.); Batheaston (Bl.); Backwell (A.), 17/7/26.

,, ,, *labiatarum* Verr. G., Olveston (C.); Cirencester (T.); Blaise Castle (A.), 7/21. S., Banwell (J.); Leigh Woods (H.); Tickenham (A.), 25/6/26.

,, ,, *lasiophthalmus* Ztt. G. and S., fairly common.

,, ,, *punctulatus* Verr. G., Stroud (Wt.); Cirencester (T.); Blaise Castle (Wm.), 30/4/27. S., Leigh Woods (H.); Shapwick (A.), 21/4/24; Tickenham (A.), 22/4/22; Brockley (Wm.). 9/5/26.

,, ,, *triangulifer* Ztt. G., Painswick (W.); Stroud (Br.).

,, ,, *umbellatarum* F. G. and S., fairly common.

,, ,, *vittiger* Ztt. G., Kingsweston (A.), 3/5/23.

Ischyrosyrphus glaucius L. G., Olveston (A.), 7/20. S., Cheddar (C.); Leigh Woods (H.).

,, *laternarius* Müll. G., Olveston (C.); Cirencester (T.); Kingsweston (A.), 26/6/31.

Lasiophthicus (*Catabomba*) *pyrastri* L. G. and S., fairly common.

,, ,, ,, var. *unicolor* Curt. G., Kingsweston (A.); Hallen (B.). 30/7/30. S., Sharpham (A.), 6/8/23.

,, ,, *seleneticus* Mg. G., Stroud (Wt.); Hallen (E. R. Goffe), 1/8/29. S., Cannington (Sl.); Clevedon (W.); Weston-s.-Mare (J.), 5/7/20.

Leucozona lucorum L. G. and S., fairly common.

Melangyna quadrimaculata Verr. G., Painswick (W.); Wotton-under-Edge (P.); Kingsweston (A.), 13/3/26. S., Freshford (C.); Brockley (Wm.), 20/3/20.

Melanostoma ambiguum Fln. G., Bristol (C.); Filton (A.), 14/5/22; Olveston (A.), 8/4/23. S., Portishead (H.); Backwell (A.), 18/4/27; Rodney Stoke (A.), 9/4/29.

,, *mellinum* L. G. and S., common.

,, *scalare* F. G. and S., common.

Paragus tibialis Fln. G., Bristol (C.); Ebley (W.); Olveston (A.). S., Kewstoke (Wain.); Nailsea (Wm.), 22/7/22.

Platychirus albimanus F. G. and S., common.

,, *angustatus* Ztt. G., Stroud (Wt.); Wotton-under-Edge (P.). S., Minehead (Bl.); Leigh Woods (A.), 22/6/25.

,, *clypeatus* Mg. G., Painswick (W.); Stroud (Wt.); Cirencester (T.); Olveston (A.), 30/7/22. S., Leigh Woods (H.); Ashcot (A.), 6/5/22.

,, *discimanus* Lw. G., Wotton-under-Edge (P.).

,, *fulviventris* Mcq. G., Wotton-under-Edge (P.); Painswick (W.).

,, *manicatus* Mg. G. and S., common.

,, *peltatus* Mg. G. and S., common.

,, *podagratus* Ztt. G., Sheepscombe (St.), 21/6/25.

Platychirus scambus Staeg. G., Wotton-under-Edge (P.). **S., Berrow (A.), 27/8/30.**
,, *scutatus* Mg. G. and S., common.
,, *tarsalis* Schum. G., Cranham (Wt.), 13/5/94, first British record. S., Weston-s.-Mare (J.), 17/5/22.
Pyrophaena granditarsa Forst. (*ocymi* F.). G. and S., fairly common.
,, *rosarum* F. S., Shapwick (A.), 11/8/23; Porlock (C.); Ashcot (J.), 8/28.
Sphaerophoria flavicauda Ztt. G., Bristol (C., Wm., A.).
,, ,, var. *nitidicollis* Ztt. G., Wotton-under-Edge (P.); Bristol (C.). S., Nailsea (Wm.), 17/7/26.
,, *menthrasti* L. G. and S., common.
,, ,, var. *philanthus* Mg. S., Sharpham (A.), 12/8/23.
,, ,, var. *picta* Mg. G., Painswick (W.). S., Sharpham (A.), 31/7/27.
,, ,, var. *taeniata* Mg. G., Bristol (A.), 7/20.
,, *scripta* L. G. and S., common.
,, ,, var. *dispar* Lw. G., Bristol (A.), 6/20.
,, ,, var. *nigricoxa* Ztt. G., Olveston (A.), 8/20. S., Tickenham (A.), 27/5/22.
,, ,, var. *strigata* Staeg. G., Olveston (A.), 4/6/22; Kingsweston (A.), 6/5/23. S., Leigh Woods (Wm.), 21/7/20.
Syrphus albostriatus Fln. G. and S., fairly common.
,, *annulipes* Ztt. G., Selsley (Wt.), 1894, first British record.
,, *arcuatus* Fln. G., Painswick (C.).
,, *corollae* F. G. and S., very common.
,, *latifasciatus* Mcq. G. and S., fairly common.
,, *luniger* Mg. G. and S., common.
,, *lunulatus* Mg. G., Painswick (W.); Cirencester (T.), 7/6/23; Hallen (B.), 19/6/26. S., Freshford (C.); Cheddar (C.).
,, *nitens* Ztt. G., Stroud (Wt.); Forest of Dean (Y.). S., Portishead (C. Bartlett).
,, *nitidicollis* Mg. G., Wotton-under-Edge (P.); Blaise Castle (Wm.); Dursley (A.), 9/6/25. S., Leigh Woods (H.); Sharpham (A.), 7/8/25.
,, *ribesii* L. G. and S., very common.
,, *torvus* O. S. G. and S., fairly common.
,, *tricinctus* Fln. G. and S., fairly common.
,, *venustus* Mg. G. and S., fairly common.
,, *vitripennis* Mg. G. and S., common.
Xanthandrus comtus Harr. S., Shapwick (A.), 3/9/22.
Xanthogramma citrofasciatum Deg. G., Bristol (C.); Wotton-under-Edge (P.); Kingsweston (Wm.), 20/5/22. S., Nailsea (Wm.), 5/5/21; Ebbor (J.), 22/5/19; Midsomer Norton (H.), 31/5/19.
,, *ornatum* Mg. G. and S., fairly common.

Sub-family Chrysotoxinae.

Antennae longer than head, erect; abdomen with bright yellow stripes.

Chrysotoxum arcuatum L. G., Bristol (C.). S., Cheddar (C.); Wellington (Bl.).
,, *bicinctum* L. G. and S., fairly common.
,, *cautum* Harr. G. and S., uncommon but well distributed
,, *elegans* Lw. G. and S., uncommon but well distributed.
,, *festivum* L. G. and S., fairly common.

Sub-family Microdontinae.

Antennae long, erect; extra cross-vein between third and fourth longitudinal veins; abdomen broader than thorax. Larvae live in Ants' nests.

Microdon mutabilis L. S., Langport (Bl.); Porlock (W. C. Crawley); Castle Neroche (Wm.), 9/6/24.

Sub-family VOLUCELLINAE.

Antennae hanging down, arista plumose; abdomen broad, more or less hairy, hairs forming black, white and red stripes; subcostal cell closed. Larvae live in nests of Humble Bees, Wasps and Hornets.

Volucella bombylans L. G. and S., common.
,, ,, var. *plumata* Deg. G. and S., common.
,, *inflata* F. G., Wotton-under-Edge (P.); Cirencester (T.), 16/6/17; Kingsweston (A.), 6/7/24; Blaise Castle (Wm.), 25/6/22. S., Weston-s.-Mare (J.), 6/6/17.
,, *inanis* L. S., Porlock (C.); Leigh Woods (H.); Dunster (A.), 8/16.
,, *pellucens* F. G. and S., fairly common.

Sub-family ERISTALINAE.

Antennae small, hanging down; subcostal cell closed, third longitudinal vein looped, first cross-vein between third and fourth longitudinal veins resting on middle or beyond middle of cell below it. Larvae live in mud and have a long telescopic tail for breathing purposes.

Eristalinus (*Eristalis*) *sepulchralis* L. G. and S., fairly common.
Eristalis arbustorum L. G. and S., common.
,, *horticola* Deg. G. and S., fairly common.
,, *intricarius* L. G. and S., fairly common.
,, ,, var. *furvus* Verr. S., Shepton Mallet (C.); Weston-s.-Mare (J.); Dunster (A.).
,, *nemorum* L. G. and S., common.
,, *pertinax* Scop. G. and S., very common.
,, *rupium* F. G., Painswick (W.); Wotton-under-Edge (P.).
Eristalomyia (*Eristalis*) *abusivus* Coll. (*lucorum* Auct.). S., Backwell (Wm.), 16/4/27; Berrow (A.), 27/8/30.
,, ,, *tenax* L. G. and S., very common.
Eurinomyia (*Helophilus*) *lineata* F. S., Shapwick (A.), 12/8/23, and (J.), 1/8/19; Banwell (J.), 14/8/22.
,, ,, *lunulata* Mg. S., Shapwick (C. W. Dale), 1892; Ashcot (J.), 28/8/20.
,, ,, *transfuga* L. S., Bitton (C.); Weston-s.-Mare (J.).
Lampetia (*Merodon*) *equestris* F. This is a very variable fly. The following varieties have been recorded :—
Var. *equestris* F. G. and S., fairly common.
Var. *bulborum* Rnd. G., Bristol (B.), 1/6/27; Kingsweston (A.), 26/6/31. S., Leigh Woods (Wm.), 16/5/21.
Var. *bulborum* Rnd. × *equestris* F. S., Wembdon (T.), 3/6/22.
Var. *bulborum* Rnd. × *valida* Mg. S., Wembdon (T.), 27/5/21.
Var. *narcissi* F. S., Tickenham (A.), 8/21; Leigh Woods (Wm.), 25/5/20; Wembdon (T.), 21/5/21.
Var. *narcissi* F. × *equestris* F. S., Wembdon (T.), 31/5/21.
Var. *narcissi* F., sub-var. *ferruginea* Troup. S., Wembdon (T.), 31/5/21.
Var. *narcissi* F. × *transversalis* Mg. S., Wembdon (T.), 31/5/21.
Var. *transversalis* Mg. G., Olveston (A.), 6/18. S., Tickenham (A.), 6/21; Wembdon (T.), 3/6/22.
Var. *valida* Mg. G., Dursley (A.), 9/6/25. S., Cannington (Sl.), 6/26; Tickenham (A.), 6/21.
Lathyrophthalmus (*Eristalis*) *aeneus* Scop. S., Weston-s.-Mare (J.), 25/8/19; Brean Down (J.), 16/9/21.
Mallota cimbiciformis Fln. G., Blaise Castle (Wm.), 25/6/22. S., Weston-s.-Mare (J.).
Myiatropa florea L., var. *nigrotarsata* Schin. G. and S., common.
,, ,, var. *flavofemorata* Strobl. G., Olveston (A.), 1/8/22.

Parhelophilus (*Helophilus*) *frutetorum* F. G., Olveston (C.), 5/7/19. S., Tickenham (A.), 2/6/25.

,, ,, *versicolor* F. G., Wotton-under-Edge (P.); Olveston (C.). S., Shapwick (A.), 16/7/27; Taunton (Wm.), 7/6/24; Bitton (C.).

Tubifera (*Helophilus*) *hybridus* Lw. G., Shepperdine (A.), 9/8/24. S., Shapwick (A.), 20/5/23; Portishead (C. Bartlett); Nailsea (Wm.), 6/25.

,, ,, *pendulus* L. G. and S., common.

,, ,, *trivittatus* F. G., Olveston (C.); Shepperdine (A.), 9/8/24. S., Cheddar (Curtis); Weston-s.-Mare (J.); Shapwick (A.), 3/9/22.

Sub-family Cinxiinae.

Large flies with no loop in third longitudinal vein, subcostal cell open; arista plumose.

Arctophila mussitans F. G., Painswick (W.). S., Batheaston (Bl.); Porlock (C.).

Cinxia (*Sericomyia*) *borealis* Fln. G., Wotton-under-Edge (P.); Rockhampton (A.), 9/8/24. S., Sharpham (A.), 11/7/25; Shapwick (Sl.), 28/6/28.

,, ,, *lappona* L. G., Bristol (Pa.). S., Holford (Miss Penfield); Shapwick (A.), 10/5/23.

Sub-family Milesiinae.

No loop in third longitudinal vein, subcostal cell open; arista bare.

Brachypalpus bimaculatus Mcq. S., Tickenham (A.), 26/6/24.

Eumerus ornatus Mg. G., Olveston (C.); Hallen (A.), 19/6/26; Dursley (Wm.), 17/6/22. S., Freshford (C.).

,, *strigatus* Fln. G., Wotton-under-Edge (P.); Olveston (C.), bred from shallots. S., Weston-s.-Mare (J.), 8/20; Leigh Woods (C.).

Ferdinandea (*Chrysochlamys*) *cupraea* Scop. G. and S., fairly common.

Milesia (*Xylota*) *abiens* Wied. G., Stone (A.), 27/6/28.

,, ,, *florum* F. G., Forest of Dean (J.).

,, ,, *lenta* Mg. G., Selsley (Wt.); Wotton-under-Edge (P.); Kingsweston (A.), 9/6/23; Blaise Castle (Wm.), 25/6/22. S. Minehead (Bl.); Weston-s.-Mare (J.), 1/7/17.

,, ,, *nemorum* F. S., Taunton (Pa.); Dunster (A.), 8/16.

,, ,, *segnis* L. G. and S., common.

,, ,, *sylvarum* L. G., Olveston (C.); Cirencester (T.); Blaise Castle (A.), 6/21. S., Freshford (C.); Leigh Woods (H.); Weston-s.-Mare (J.); Shapwick (A.), 14/8/25.

Penthesilea (*Criorrhina*) *asilica* Fln. G , Olveston (A.), 5/17; Eberton (C.), 29/5/18: Cirencester (T.), 14/6/24; Kingsweston (A.), 6/21. S., Flax Bourton (H.), 28/5/18; Backwell (Wm.), 22/5/20; Leigh Woods (A.), 25/5/29

,, ,, *berberina* F. G., Selsley (Wt.); Wotton-under-Edge (P.); Kingsweston (A.), 9/6/23; Blaise Castle (A.), 28/5/27. S., Banwell (A.), 6/6/25; Ashcot (Wm.), 2/6/23; Weston-s.-Mare (J.); Portishead (C. Bartlett); Shepton Mallet (C.).

,, ,, *floccosa* Mg. G., Selsley (Wt.); Cirencester (T.); Dursley (Wm.), 11/6/22. S., Taunton (Wm.), 7/6/24; Cannington (Sl.), 4/6/26; Weston-s.-Mare (J.); Portishead (C. Bartlett).

,, ,, *oxyacanthae* Mg. G., Painswick (W.); Wotton-under-Edge (P.); Olveston (C.), 6/19; Kingsweston (A.), 9/6/23. S., Weston-s.-Mare (J.); Banwell (J.); 10/6/17; Portishead (C. Bartlett).

,, ,, *ranunculi* Pz. G., Painswick (W.); Wotton-under-Edge (P.); Cirencester (T.). S., Backwell (A.), 15/4/27, (Wm.) 2/4/26, (J.) 2/4/31; Wedmore (Mp.).

Pocota apiformis Schr. S., Leigh Woods (*vide* Verrall), 1841; Weston-s.-Mare (J.).
Syritta pipiens L. G. and S., very common.
Tropidia scita Harr. S., Ashcot (Wm.), 3/6/22.

IV. CONOPIDAE.

Head large, antennae long, projecting, with apical arista; proboscis very long, slender, bent at right angles; abdomen long, thin, swollen at tail-end; wings long, narrow, veins as in Syrphidae but longitudinal veins 3 and 4 almost or quite meeting near apex of wing; female has a projection on fifth sternite (plates on underside of abdomen). Larvae parasitic on Hymenoptera and Orthoptera. Described by E. Séguy in "Encyclopédie Entomologique," Vol. ix. (Mouches Parasites), 1928.

Sub-family Conopinae.

No ocelli, arista quite apical.

Conops cereiformis Mg. S., Leigh Woods (H.).
,, *flavipes* L. S., Dunster (A.), 8/16; Sharpham (A.), 5/8/23; St Audries (A.), 20/8/29.
,, *quadrifasciatus* Deg. G. and S., fairly common.
Physocephala rufipes F. G., Henbury (B.), 3/8/23; Shepperdine (A.), 8/8/24. S., West Lydford (Miss Vincent); Weston-s.-Mare (J.); Sharpham (A.), 3/8/23.

Sub-family Myopinae.

Ocelli present, arista slightly dorsal.

Myopa buccata L. G., Painswick (W.); Wotton-under-Edge (P.); Selsley (Wt.); Cirencester (T.); Olveston (A.). S., Castle Cary (C.); Tickenham (A.), 5/21.
,, *polystigma* Rnd. G., Painswick (W.); Cirencester (T.), 14/5/23.
,, *testacea* L. G., Westerleigh (A.), 22/5/20. S., Tickenham (A.), 10/5/21; Prior Park, Bath (A.), 20/5/29.
Occemyia (*Oncomyia*) *atra* F. G., Painswick (W.).
,, ,, *pusilla* Mg. G., Stroud (Wt.). S., Shepton Mallet (C.).
Sicus ferrugineus L. G. and S., fairly common.

CORRECTIONS TO PARTS I., II., III.

For LIMONIIDAE (LIMNOBIIDAE) read XII. TIPULIDAE, Sub-family Limoniidae.
For XIII. TIPULIDAE read XIII. TIPULIDAE, Sub-family Tipulinae.
For Trichocerinae read Petauristinae.
For Trichocera read Petaurista.
For *Trichocera fuscata* Mg. (*saltator* Harr.) read ***Petaurista saltator*** Harr. (*fuscata* Mg.) Edw.
For Pachyrrhina read Nephrotoma.
For *Pachyrrhina histrio* F. (*lineata* Scop.) read *Nephrotoma flavescens* L. (*histrio* F., *lineata* Scop.).
For *Pachyrrhina crinicauda* Rdl. read *Nephrotoma flavipalpis* Mg.
For *Prionocera* (*Stygeropis*) *pubescens* Lw. read *Prionocera* (*Stygeropis*) *subserricornis* Ztt.
For *Tipula anonyma* Berg. read *Tipula signata* Staeg.
For *Tipula pierrei* Tonn. read *Tipula solstitialis* West.
For *Tipula signata* Staeg. read *Tipula staegeri* Niels.
For *Rhymosia inacrura* Winn. read *Rhymosia macrura* Winn.

ADDITIONS TO PARTS I., II., III.

FUNGIVORIDAE (MYCETOPHILIDAE).

Phronia exigua Ztt. (*rustica* Winn.). G., Hallen (A.), 24/9/29.
Rhymosia macrura Winn. G., Littledean (A.), 25/5/31.

CHIRONOMIDAE.

Chironomus cingulatus Mg. G., Hallen (A.), 24/9/27.
Metriocnemus fuscipes Mg. G., Hallen (A.), 4/3/28.
,, *marcidus* Wlk. G., Littledean (A.), 25/5/31.
Prodiamesa olivacea Mg. G., Littledean (A.), 25/5/31.
Protenthes (*Tanypus*) *punctipennis* Mg. S., Moreton (A.), 15/6/31.

CULICIDAE.

Dixa nubilipennis Curt. G., Littledean (A.), 25/5/31. S., Rodney Stoke (A.), 6/4/29.

TIPULIDAE.

Sub-family Limoniinae.

Cheilotricha imbuta Mg. G., Kingsweston (A.), 26/6/31.
Dicranomyia affinis Schum. G., Dursley (A.), 4/6/30.
Ephelia verralli Bergr. S., Winscombe (J.), teste A. E. Carter.
Erioptera griseipennis Mg. G., Littledean (A.), 25/5/31.
,, *macrophthalma* Lw. G., Littledean (A.), 25/5/31.
Gonomyia lateralis Mcq. S., Tickenham (A.), 11/7/31.
Ilisia areolata Siebke. S., Chew Magna (A.), 30/5/31.
Petaurista (*Trichocera*) *fuscata* Mg. (*major* Edw.). S., Leigh Woods (A.), 21/9/27.

Sub-family Tipulinae.

Prionocera (*Stygeropis*) *turcica* F. S., West Town (Wm.), 2/8/26.
Tipula fulvipennis Deg. (*lutescens* F.). G., Sheepscombe (St.), 7/7/23.
,, *pruinosa* Wied. S., Tickenham (A.), 11/7/31.
,, *pseudovariipennis* Cz. G., Blaise Castle Woods (A.), 15/5/26.

TABANIDAE.

Chrysozona (*Haematopota*) *crassicornis* Wahl. G., Sheepscombe (St.), 21/6/25.
Therioplectes distinguendus Verr. G., Sheepscombe (St.), 21/6/25.
Tabanus maculicornis Ztt. G., Sheepscombe (St.), 21/6/25.

RHAGIONIDAE (LEPTIDAE).

Rhagio (*Leptis*) *notata* Mg. G., Sheepscombe (St.), 29/6/24.

ASILIDAE.

Dioctria baumhaueri Mg. G., Kingsweston (A.), 25/6/31.

EMPIDIDAE.

Drapetis exilis Mg. S., Leigh Woods (A.), 31/9/27.
Leptempis (*Pachymeria*) *grisea* Fln. G., Sheepscombe (St.), 18/6/27.
Tachydromia longicornis Mg. G., Hallen (A.), 24/9/29.

DOLICHOPODIDAE.

Dolichopus picipes Mg. S., Chew Magna (A.), 30/5/31.
Hercostomus chrysozygos Wied. S., Tickenham (A.), 11/7/31.

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Graft Hybrids.

By Macgregor Skene, D.Sc., F.L.S.

THERE is a shrub, to be seen not infrequently in our gardens, with the drooping golden sprays of the laburnum mixed with drooping sprays of a terra-cotta colour, while here and there small tufts of purple flowers appear. If the terra-cotta sprays are examined more closely a still stranger mixture is found. Some of the flowers show streaks of yellow or purple and occasionally one may be found the half of which is obviously pure laburnum while the other half is purple or brick-coloured. This curious plant is Adam's laburnum, *Cytisus Adami.* It arose—or was produced—in 1825 near Paris by a French nurseryman named Adam. He had budded a purple broom, *Cytisus purpureus*, on a laburnum, a common practice, by which the low growing broom may be had as a standard on the laburnum stock. The bud lay dormant for a year and then produced a tuft of shoots, one of which was distinguished by its more erect and stouter growth. This shoot Adam proceeded to propagate and distributed, budded on laburnum stocks, as a new variety of broom. Later on it flowered, and the flowers turned out to be of the terra-cotta shade of our shrub; in this, and in other respects, the plant was clearly intermediate in character between broom and laburnum. The new shrub was recognised as a *graft-hybrid*—an intermediate form produced not by cross-breeding in the usual way but by a vegetative process of grafting. Still later, Adam's laburnum began to behave in a highly peculiar fashion. On one and the same shoot it produced throwbacks to each parent, so that the same bush bore flowers and foliage of laburnum, broom, and intermediate; even, as we have seen, a single flower often consists of strips of all three.

So peculiar a plant naturally drew the attention of scientists, and many botanists have investigated its nature. In the first place it must be noted that its production cannot be due to the stock having so influenced the shoot grafted on it that that shoot has changed its character. Such an influence is ruled out by all the knowledge gained in the millions of grafting operations which have been carried out in horticultural practice. When a fruit tree is grafted or a rose is budded on a stock of another race we do not expect it to take on the characters of that race. Frau Karl Druschki budded on a briar remains Frau Karl Druschki, and a quince grafted on a pear remains a quince. Grafting and budding are practised with two aims; rapid propagation is one, and the provision of a suitable and established root system is the other The stock may influence the scion in such ways as dwarfing and early fruiting, as when apples are grafted on Paradise stock. But such changes are nutritional effects, and do not affect the racial and inherited characters of the scion. It has already been pointed out that Adam described his plant as arising not from the actual bud, but from the tissue beside it; it was a new shoot.

Now we know that the fertilised egg-cell from which an ordinary sexual hybrid arises contains within itself contributions from both parents; and all the cells arising from it, that is the whole body of the hybrid, partake of this dual nature. But the sexual reproductive cells are highly specialised, with the special property of fusing or uniting together, and that such fusion should occur between ordinary vegetative cells lying contiguous in the graft is in the highest degree improbable. Yet, if no fusion of cells has taken place, we must suppose that the graft hybrid consists of cells separately derived from each parent, living together in some strange mixture. It is difficult to imagine how this can be. We must picture two sets of cells belonging to different organisms living together in such perfect mixture and harmony that they produce a uniformly intermediate individual. Furthermore this arrangement must be such that when they do come apart they do so in complete blocks or segments, thus giving rise to the throwbacks to the parent species.

So great did these difficulties appear to some botanists that quite unjustified doubts were thrown on Adam's account, and the suggestion was made that perhaps this was after all a chance sexual hybrid. Unfortunately, the two parents are completely sterile when one is pollinated by the other. And, further, sexual hybrids do not behave in the manner of Adam's laburnum. On the other hand, although many attempts have been made, no one has ever been able to repeat Adam's success; it was the result of a single lucky chance.

Some information might have been obtained from the offspring of the intermediate, but it is practically sterile. The few viable seeds it has produced in the course of its history have all given pure laburnum seedlings, a result that does not appear illuminating. All the specimens which now exist have been derived by propagation from the original shoot.

Although it is much the most familiar example of its kind Adam's laburnum does not stand alone. Indeed, there is another graft hybrid of much greater antiquity. This is the *bizzarria orange*, which was raised in Florence in 1644 by grafting a bitter orange on a citron. The scion shoot died off, and from the point of union a new shoot arose which partook of the nature of both parents. The fruit is particularly striking, for it may be intermediate or consist of segments, variously arranged, of citron and orange. Again it should be noted that it was not the actual shoot used for grafting which assumed the new characters.

More recently graft hybrids have arisen, in France, between the medlar and the hawthorn, the former being frequently grafted on the latter. Several different types of these Crataego-mespili hybrids are known and, though all are intermediate between the two parents, some more closely resembly hawthorn and others medlar. Reputed graft hybrids have also been reported between other fruit trees.

These peculiar plants are rarieties, and those so far described have all had a chance origin. No one has ever succeeded in producing one of them deliberately. It is possible that with a sufficiently large number of trials this might be done. But the odds against are clearly enormous.

For the others, as for Adam's laburnum, origin by sexual crossing seems out of the question, though the orange and citron are inter-fertile. The difficulty of imagining what could be the structure of these plants was very great until twenty-five years ago the problem was attacked from a new angle and finally solved.

It was Prof. Hans Winkler of Tübingen who recognised the conditions which might lead to success in producing graft hybrids at will. It was useless, he saw, to go on experimenting with laburnums, medlars and oranges. A fresh object must be found. Two plants quite distinct in their characters, yet easily grafted together, and preferably inter-sterile, must be chosen. And, what was most important, the plants to be used must be capable of producing buds easily from cut surfaces. It was such a bud, produced where the tissues of the two plants lay together at the point of grafting, that was likely to give an intermediate form. Winkler had a wide knowledge of such properties in plants, gained in previous researches on regeneration, and he chose two species of *Solanum* as the most suitable for his purpose. These were *S. nigrum* (the nightshade) and *S. lycopersicum* (the tomato). Both can be raised in quantity from seed; they can be grafted on each other very easily; and they form masses of buds on cut surfaces.

The method of working is very simple. A tomato plant is decapitated and the stump split. The end of a shoot of nightshade, trimmed to a wedge, is inserted in the slit, and the two are bound together with raffia. All axillary buds of the tomato are rubbed out, as otherwise they would sprout and draw on the supplies of water and salts required by the graft. After about a week union between the two is established and the nightshade is removed by a cut through the graft. This leaves a little wedge of nightshade tissue embedded in the tomato stem. About a fortnight later buds begin to grow on the cut surface. Those arising along the lines where the two plants meet are selected, and, as soon as they are big enough to handle, are cut off, rooted in sand and grown on. A dozen or more such plants may be obtained from a single graft; Prof. Winkler raised hundreds.

In 1907 he obtained a partial success. One of his plants developed a first leaf which was a nightshade; the next two, on the opposite side of the stem, were tomato leaves; the fourth was a nightshade; the ninth and tenth were half nightshade and half tomato. There is no possibility of confusing the leaves of the two plants. That of the nightshade is simple, rather thin, dark green and beset with fine hairs. That of the tomato is compound, coarse in texture, paler in colour and with sparse rough hairs. Here, then, was a plant, obtained after grafting, in which the tissues of the two parents grew in unison side by side. Recalling Homer's " mingled monster of no mortal kind " Prof. Winkler called his plant a " vegetable chimaera " after the monster of the Odyssey.

In the following year his efforts were crowned with complete success. He raised a plant which was actually intermediate between the two parents. The leaves were simple but with very coarse teeth or small lobes, and with the type of hair characteristic of the tomato. The plant flowered and fruited, and flowers and fruits were also intermediate, Later in its growth it gave rise to a shoot of pure nightshade. Its seed was viable and gave pure nightshade seedlings. The parallel with *Cytisus Adami* was complete.

This plant was named *Solanum tubingense.* Later several other intermediate types were obtained, one very close to the tomato, the others more nearly intermediate. *S. Gaertnerianum*, *S. Koelreuterianum*, and *S. proteus* behaved exactly like *S. tubingense*, and they completed the resemblance to the previously known graft hybrids; as with the Crataego-mespili, more than one intermediate had been produced.

But though new graft hybrids could now be produced almost at will—for about one graft in every ten could be counted on to give one or other of these curious plants—and the mode of their origin had thus been established, the problem of their nature remained to be cleared up. A lively controversy sprang up as to whether they were to be regarded as the result of a fusion of vegetative cells, or whether they were composed of an intimate mixture of the tissues of the two parents, were, in fact, a sort of " hyper-chimaera."

New light was thrown on the problem from an unexpected source. An eminent geneticist, Prof. Erwin Baur, happened to be examining the leaves of the common white-edged pelargonium, a plant in the hereditary characters of which he was interested. He found that the white margin was the result of a peculiar arrangement of tissues. Underneath the epiderm, which is always devoid of green colour, there was a layer of cells the chloroplasts of which possessed no chlorophyll, and so were white. At the edge of the leaf the tissues thinned off, till only this layer was left above and below. In reality the whole leaf was covered with a white mantel. Over most of its surface the green inner layers shone through, but at the margin, where only the white tissues were present, the leaf was white. Now anyone who has grown white-edged pelargoniums knows that sometimes they give rise to a pure green shoot and sometimes to one which is pure white. Occasionally shoots striped in green and white occur. Here was a plant which, though not itself a graft hybrid, behaved like one; and it had a structure which might explain that of the hybrids. What if they, too, were composed of a core of tissue belonging to one parent, covered by a skin of the other? How could this be tested for the graft hybrids?

Happily there was a fairly easy and decisive test which could be applied to the tomato-nightshade plants. The dividing nucleus of the tomato has 24 chromosomes and that of the nightshade 76. By counting the chromosomes of dividing cells in suitably prepared sections it is possible to tell to which plant they belong. Such chromosome counts, coupled with anatomical investigations, have established the nature of the hybrids. *S. tubingense* consists of a core of nightshade covered by an epiderm of tomato. As the main bulk of tissue belongs to the nightshade the leaf has very nearly the nightshade form; but the epiderm, being tomato, bears the hairs of that plant. *S. proteus* has a nightshade core with two layers of tomato as a skin. *S. Gaertnerianum* has a core of tomato and a skin of two layers of nightshade, and *S. Koelreuterianum* has a tomato core and a nightshade epiderm. The leaves of this plant closely resemble those of the tomato. The different intermediate forms of flower and fruit are also explained. The reason why different intermediate forms can exist is also clear.

It is easy to see why some branches should revert to one or other of the parents. Any slight accidental injury, or even irregularity of growth, may result in the core breaking out or the skin alone forming a bud. Another peculiarity that is cleared up is the fact that seed of a graft hybrid always gives seedlings of one or the other parent. The sex cells of the flowering plants are derived from the layer of cells below the epiderm, and, as this layer consists of cells of the one parent or the other, pure seedlings must result.

Seeds of *S. tubingense*, as has been said, give nightshade seedlings; so do those of *S. Gaertnerianum*. Seeds of *S. proteus* and *S. Koelreuterianum* give tomatoes.

The *Solanum* graft hybrids are thus chimaeras, though of a rather different type from that of the plant to which this term was first applied. The union of the tissues is much more intimate, and, instead of lying side by side, they lie one within the other. The term " periclinal chimaeras " is used to denote plants of this kind. It is, of course, extremely surprising to find that the tissues of two plants, so distinct from one another, should be able to live in so intimate and orderly a union, and should be able to maintain so wonderful an equilibrium. It is not to be wondered at that restraint should occasionally be lost and that the old Adam should come out.

There remained the question—were the older graft hybrids also periclinal chimaeras? This was answered as the result of anatomical investigations. Indeed it happened that a botanist had already made such investigations about a decade before Winkler's researches, but had just failed to give the proper interpretation to his results. The demonstration is easiest for the flowers of *Cytisus Adami* and for the fruits of the Crataego-mespili. The laburnum owes its colour, as do most yellow and orange flowers, to the presence in its cells of small bodies or plastids which are bright yellow in colour. The purple broom possesses, on the other hand, a purple pigment dissolved in its sap. The flowers of *Cytisus Adami*, as can easily be seen in sections under the microscope, has an epiderm with purple sap and a core with yellow plastids. It is a periclinal chimaera with a core of laburnum and a skin of broom. The Crataego-mespili have a core of hawthorn covered by one or more layers of medlar. In the case of these plants it should be said that some difficulties have arisen in interpreting precisely the arrangement of the tissues. But the essential principle that all graft hybrids are chimaeras is now well established.

As has been indicated, periclinal chimaeras are known which have not originated by grafting. The white-edged pelargonium is the most familiar. Bouvardia is another example. This flower is grown in pink, white and red varieties, and the pink-flowered forms have the peculiarity that, when propagated by root cuttings, they always give red-flowered plants. The explanation is that they are periclinal chimaeras with a white skin over a red core. Now side and adventitious roots always arise from the inside of the plant, pushing their way through the outer tissues. Hence root cuttings will always consist of the core only and so give only red-flowered plants.

Such natural chimaeras must be examples of a special kind of bud sport. Occasionally a single branch of a plant mutates or sports, taking on characters other than those of the type. The fern-leaved beech arose in this way. In pelargonium and bouvardia, instead of a whole bud altering its character, only the skin or the core has changed, with the consequence that a periclinal chimaera has arisen. In their behaviour these natural chimaeras resemble those obtained by grafting.

There is little chance that this method can be used for producing new forms of plants on any extended scale. Few plants possess the necessary qualifications. Other species of Solanum, for instance *S. melongena* (the egg-plant) and *S. tuberosum* (the potato), have been used with success. Between the poplars *Populus canadensis* and *P. trichocarpa* intermediates of chimaeral nature have been obtained. Doubtless, the union of other plants will be attempted; but success will be rare. As curiosities, however, these chimaeras are worthy of our attention, and the quite unexpected power of mutual compatability which has been brought to light is of much interest scientifically. Above all, we have the satisfaction of seeing the solution of a problem which has puzzled botanists and gardeners for now close on three centuries.

The Rhætic and Liassic Rocks of Henleaze and Southmead.

By G. A. Kellaway.

CONTENTS.

I.

IN recent years there has been a great deal of expansion on this side of the city; roads have been driven over the countryside and a large number of houses have been erected.

This, of course, has meant that much excavating has taken place, and this paper is an attempt to embody the most important of the sections which have been exposed. The whole of the material contained here, with one or two exceptions, was obtained from exposures which were purely temporary in their nature. In many cases the trenches which were made for the purpose of laying drains were filled in almost as fast as they had been cut. Often, the only evidence which could be obtained was that from excavated material.

With regard to the area covered by the paper an attempt has been made to simplify the arrangement by dividing it into a northern and a southern portion. The northern portion includes practically all of the district known as Southmead, while the southern portion includes much of Henleaze and a little of Horfield.

It sometimes happened that the outcrops of some of the beds were obscured, or, if exposed at all, then for an insufficient length of time for the exposures to be noted. For this reason some of the boundaries are shown as broken lines, and in these circumstances should not be regarded as definitely fixed. Where such evidence was not available, the approximate boundaries have been determined by means of the contour lines.

Each section in both of the two main areas has been numbered. The number on the description of the section as given in the text tallies with the number of the section or exposure as recorded on the map of the particular area in which that section lies. Sections have to be shown as a line joining two points, and so, in order to simplify the description the following method has been used:—

In any given section the two points (*i.e.*, the extremities) have been marked with a number corresponding with the number on the description in the text, one of the points bears in addition a small letter "a," and the two points are joined by a line, *e.g.*, Section No. 1 will be shown on the map "1——1a." Single exposures (other than sections) bear a single number only.

The mapping of the district on a detailed scale was rendered more difficult by reason of the lack of up-to-date maps. Every possible care was taken with the construction of the maps included, and it is hoped that in the future they will prove to be reasonably accurate.

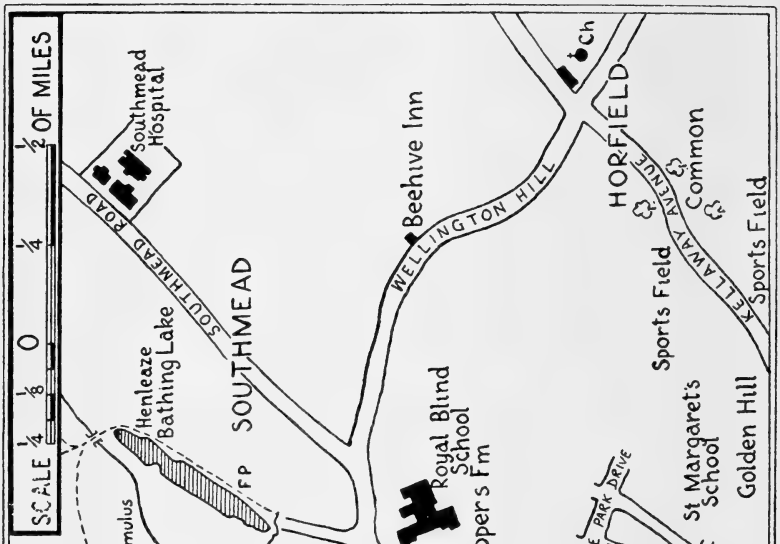
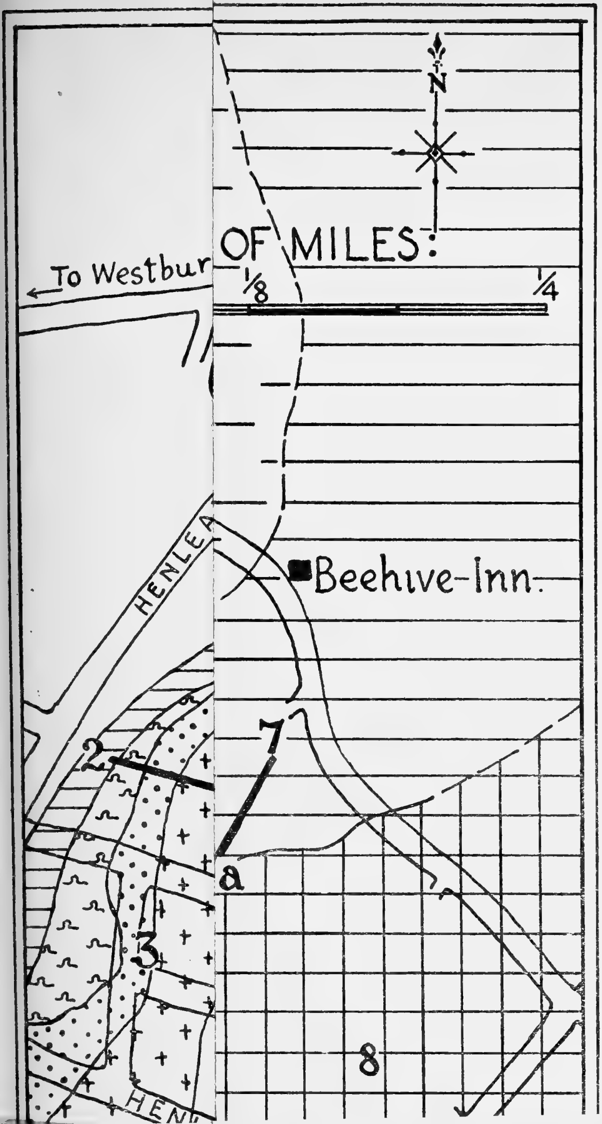


Fig. 1.—General Map of the district, showing its relation to Westbury-on-Trym.

It might also be pointed out that the number of exposures was very great, but that only the more important of them are mapped and described in this paper.

II.

Since the salient features of the landscape are rapidly disappearing under the vast amount of building which is taking place, it may be worth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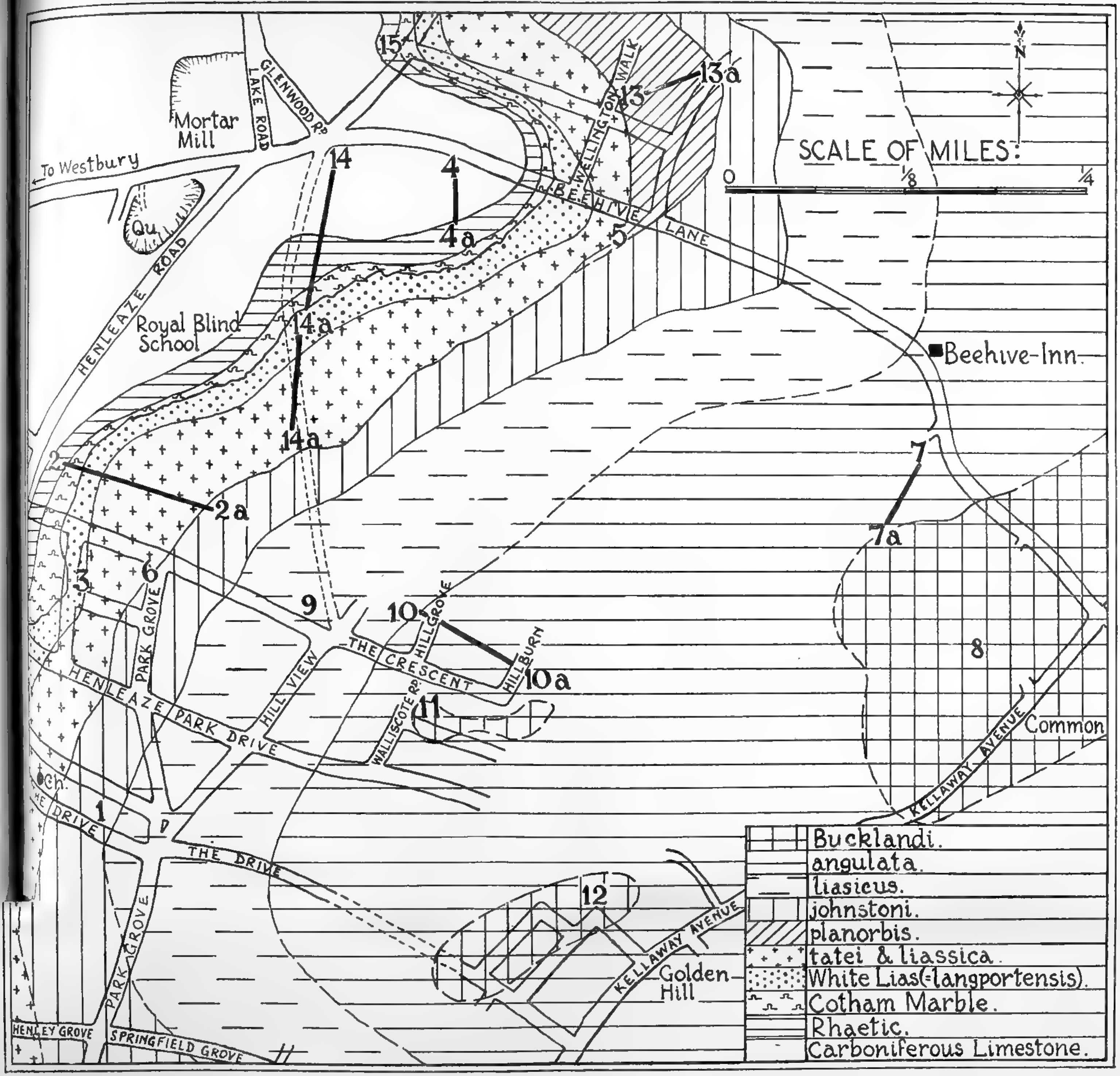


Fig. 2. MAP OF THE SOUTHERN AREA.

while to note a few points with respect to the topographical features of this district.

The little River Trym, which used to rise at Filton, flows in the direction of Henleaze Bathing Lake, roughly parallel to the main Southmead Road. It has cut through the Rhætian and Jurassic rocks, and has exposed the Carboniferous Limestone, giving rise to a small depression all along its course, and causing the appearance of a long tongue of Carboniferous Limestone on the surface map. From the bed of the Trym the land rises away on both the western and the eastern sides.

On the east there is a gentle incline (which finally becomes much steeper) composed mainly of Liassic rocks. Horfield and Filton are situated upon this hill, which is followed for nearly its complete length by Kellaway Avenue and the main Gloucester Road.

On the west the incline is much more gradual, the ground rising evenly to the top of the Carboniferous Limestone ridge which runs from Upper Knole by way of Brentry to Henbury. The major portion of this slope is overlain unconformably by areas of Rhætic and Lias.

Evidence of the presence of the following hemeræ has been found in the area.

Stages	Chronological sequence (Hemeræ)	Stratigraphical and Zonal terms
Sinemurian	*turneri* *gmuendense* *meridionalis* *bucklandi* *rotator* *conybeari*	Bucklandi Zone
Hettangian	*angulata* *liasicus* *Whæneroceras*	Angulata Zone
	johnstoni *planorbis* *liassica* *tatei*	Planorbis Zone
	langportensis	White Lias
Rhætian	*Estheria and Naiadites*	Cotham Marble Upper Rhætic
	Avicula contorta	Lower Rhætic

III.

These descriptions should be read in conjunction with the map of the Southern Area.

Section No. 1.

At Wanscow Walk, a small pit was dug and a few fragmentary fossils (probably of *johnstoni* age) were observed.

Section No. 2.

This section (running approximately W.-E.) was made at Roper's Farm near the Royal Blind Asylum.

Bed. No.	Lithology.	Thickness. Ft. In.	Hemeræ.	Palæontological Details.
1.	Clays with thin limestones, ...	2 0	*johnstoni*	*Caloceras intermedium*
2.	Limestones, thin, grey, with clay partings,	c 1 0	*liassica* and *tatei*	*Ostrea liassica* *Protocardium phillipianum* *Unicardium arenacea* *Pleuromya tatei*
3.	Limestone, white, with white and greyish clay partings, ...	0 4	*langportensis* = *White Lias*	*Modiola langportensis*
4.	Cotham marble, ...	0 $4\frac{1}{2}$	*Rhætic*	
5.	Clays, with thin, banded limestones, and ripple-marked sandstones at base,	2 6	*Rhætic*	*Naiadites lanceolata* *Gyrolepis* (scales) *Pecten valoniensis* *Avicula contorta*

Some interesting specimens were obtained from this section. One piece of limestone taken from the base of the exposure contained a species of *Modiola*, *Avicula contorta* and *Pecten* (*Chlamys*) *valoniensis.* The association of these forms indicates that at the base we have basal Upper Rhætic or the top of the Lower Rhætic : lithologically the evidence is in favour of its being basal Upper Rhætic.

Ripple-marked sandstones were not uncommon.

Section No. 3.

At the junction of Oakwood Road and Oakwood Avenue, the Cotham Marble and the *langportensis* beds are considerably thinner than they are in the previously mentioned section.

Section No. 4. Trench in Beehive Lane.

This trench was 180 yards long with a direction of N.N.W.-S.S.E. and an average depth of 6 feet.

Bed No.	Lithology.	Thickness. Ft. In.	Hemeræ.	Palæontological Details.
1.	Limestone, thin, gritty, and fossiliferous, ...	0 2	*Rhætic*	*Gyrolepis alberti* *Pecten valoniensis*
2.	Clay, mottled, with occasional gritty limestone, ...	4 0	*Rhætic*	*Myophoria emmerichi*
3.	Clay, yellow, ...	0 2		
4.	Clay, bluish grey, ...	0 6		
5.	Clay, brown,	0 5		
	Carboniferous limestone.			

Section No. 5.

Another trench was made on the same side of Beehive Lane just below the " Beehive Inn " running approximately N.-S.

The detailed section given here is incomplete since a continuance of excavations has shown that the *johnstoni* beds are present with abundant examples of *Caloceras intermedium.* No detailed measurements with regard to the presence of the *johnstoni* beds are available.

Bed No.	Lithology.	Thickness. Ft. In.	Hemeræ.	Palæontological Details.
1.	Limestone, brownish in colour, ...	0 2	*tatei*	*Pleuromya tatei*
2.	Clay, brown, ...	1 0		*Protocardium phillipianum*
3.	Limestone, ...	1 0		*Unicardium arenacea*
4.	Shale, brown,... ...	0 6		
5.	Shales, grey, ...	1 1	*langportensis*	*Macrodon hettangiensis*
6.	Limestones, white and very argillaceous,...	0 3		*Modiola langportensis* *Pleuromya langportensis*
7.	Clay, with gritty limestones, ...	1 0	*Rhætic*	*Gyrolepis alberti*

Section No. 6.

At the end of Park Grove the *johnstoni* beds were found to be fossiliferous. They consisted of white, sometimes ochre-stained, limestones about two feet thick with abundant examples of *Caloceras intermedium.*

Section No. 7.

This section was situated just above the " Beehive Inn " on the south side of Wellington Hill in a road now known as Broadway Road.

Bed No.	Lithology.	Thickness. Ft. In.	Hemeræ.	Palæontological Details.
1.	Limestone nodules in yellowish shales, ...	2 0	*angulata*	
2.	Limestone, nodular and sparsely scattered, with a blue core but weathering yellow,	1 6		*Schlotheimia extranodosa* *Calcirhynchia calcaria*

This section was very useful in helping to determine the zonal boundaries.

A little higher up the hill (8) some very good specimens were obtained mainly from the Bucklandi zone. Ammonites representative of the *rotator* and *conybeari* hemeræ were especially common, while near the top of the hill, large fragments of ammonites allied to *Coroniceras bucklandi* were found. The excavations were not carried to a sufficient depth for accurate measurements to be made.

Section No. 9.

This section (at Hill View) exposed the *liasicus* beds. Only excavated material was available for examination, and so no detailed work could be done.

The fossils obtained included the following:—

Alsatites liasicus (d'Orbigny).
Astarte consobrina Chapuis and Dewalque.
Lima succincta (Schlotheim).
Pholadomya glabra Agassiz.
Plagiostoma gigantea Sowerby.
Ornithella sarthacensis (d'Orbigny).
Montlivaltia guettardi Blainville.

The matrix consisted of nodular, grey and blue limestones in dark shales.

It is worth while mentioning at this point that a portion of an ammonite, possibly a species of *Whæneroceras*, was found at the base of the *liasicus* beds near Beehive Lane. This may probably represent a level which is not well developed in this district.†

Section No. 10.

A series of pits were dug for the laying of drains. They ran East for perhaps one hundred yards from the end of Hill View. Unfortunately they were not noticed until they were filled in, and the only details obtainable were those given by some workmen engaged there.

The pits were dug through an alternating series of nodular limestone bands and dark shale partings. Fossils were not common. The following list includes some of the fossils which were found:—

Scamnoceras cf. *angulata* (Schlotheim).
Schlotheimia depressus (Quenstedt).
Vermiceras delmaisi (Reynès).
Nautilus sp.
Pleurotomaria anglica (Sowerby).
Gryphea incurva Sowerby.
Plagiostoma gigantea Sowerby (and many other lamellibranchs).
Calcirhynchia calcaria S. S. Buckman.
Isocrinus sp.

This is a typical list of forms of *angulata* age.

Section No. 11.

At Walliscote Road excavations were made in the *conybeari* beds, specimens comparable with *Vermiceras conybeari* (Sow.) being obtained. The number of large *Gryphea incurva* was noticeable.

Section No. 12.

At Golden Hill specimens of *Vermiceras* cf. *conybeari* and *Rhynchonella triplicata* were obtained from a small trench. This indicates the presence of the Bucklandi zone (probably either *conybeari* or basal *bucklandi* hemera).

Section No. 13.

At Wellington Walk the following section was obtained.

Bed No.	Lithology.	Thickness. Ft In.	Hemeræ.	Palæontological Details.
1.	Limestones, thin and ochre-stained with clay and shale partings, ...	1 0	*planorbis*	*Psiloceras planorbis*
2.	Limestone, with shale partings, ...	2 9	*tatei*	*Lima valoniensis* *Pleuromya tatei* *Unicardium arenacea*
3.	Limestone, argillaceous, with white clay partings, ...	1 0	*langportensis*	*Modiola langportensis*

†*Proc. Brist. Nat. Soc.*, 4th Series, Volume v., Part v., page 276.

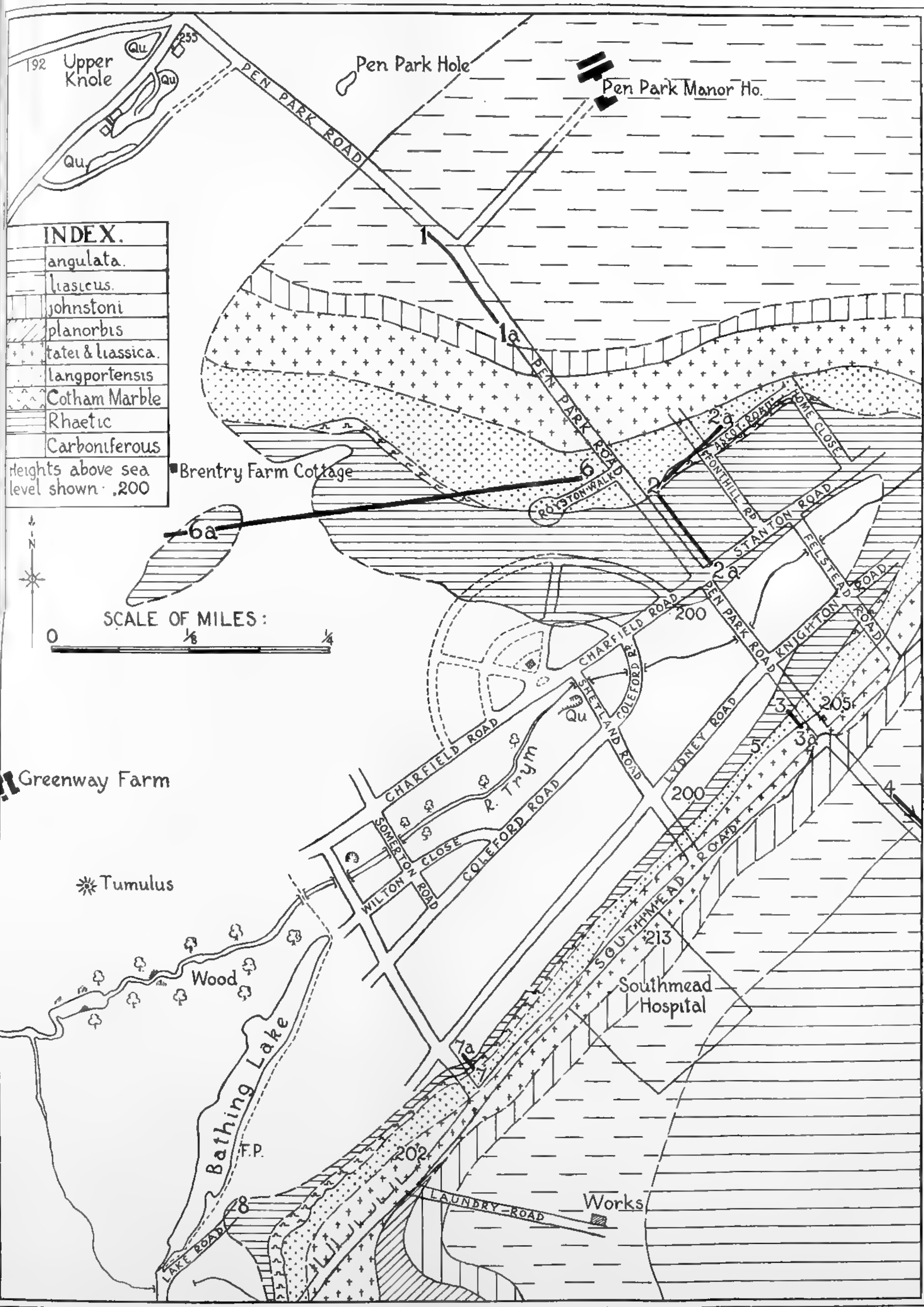


Fig 3. MAP OF THE NORTHERN AREA.

Section No. 14.

This section ran in a south-easterly direction from the main Henleaze-Southmead Road (at its junction with Beehive Lane) in the direction of Hill View. It was in two distinct parts, viz., 14—14a and 14a—14a.

The first part (14—14a) showed the Carboniferous Limestone overlain by deposits of Rhætic age. The Rhætic deposits consisted of:—

Upper Rhætic.—c. 2 ft. 6 in. in thickness.
Lower Rhætic.—Limestone—c. 6-9 ins. in thickness with *Schizodus concentricus* and *Avicula contorta*.
Black Shale—c. 2 ft. in thickness.

The Lower Rhætic Limestones were in the form of huge slabs sometimes four or five feet across. The stone itself was fissile and slightly crystalline; when split it was seen to contain a very large number of fossils, mainly *Schizodus concentricus* and *Protocardium phillipianum* with occasional examples of *Avicula* (*Pteria*) *contorta*.

The second part of the section (14a—14a) could be correlated lithologically (almost inch by inch) with Section No. 2, and therefore no further particulars are given.

Section No. 15.

This section is unimportant palæontologically, but it proved of great help in the construction of the map of the district. It showed the Cotham Marble to be about four or five inches thick.

IV.

These descriptions should be read in conjunction with the map of the northern Area.

Along the road which now runs from Filton to Brentry (Pen Park Road—so called after Pen Park Hole near which it passes), a number of excellent sections have been exposed. They show the most complete series of the Rhætic beds in the area and also the highest beds in the Lias which appear in the area.

Section No. 1.

The first of these exposures is one which is to all intents permanent. It is a roadside exposure about one hundred yards distant from Pen Park Hole, and just where the farm track from Pen Park Farm joins Pen Park Road. It shows a series of limestone nodules of a bluish colour (weathering yellow), set in a yellow and blue shale. It is not very fossiliferous, though fragments of an ammonite comparable with *Schlotheimia* sp. have been found. For this reason and others mentioned later, these strata have been included as of *liasicus* age.

Section No. 2.

The next exposure was a temporary one. Since on the map many roads are shown which are not yet (January 1932) completed, it will be wise to state the exact position of this exposure, or rather, series of exposures. The first pit was on the north side of Pen Park Road, almost opposite the junction of Ascot Road and Fonthill Road. The exposures then continued in a N.W. direction as shown on the map.

Bed No.	Lithology.	Thickness. Ft. In.		Hermeræ or Zone.	Palæontological Details.
1.	Cotham Marble, ...	0 3	Upper Rhætic	Cotham Marble	
2.	Clay, yellow, with thinly bedded partings of limestone and yellow shale, ...	1 0			
3.	Limestone, grey, hard and compact, with banding due to fossiliferous layers; weathering a greenish colour; argillaceous, ...	0 6		*Estheria* and *Naiadites*	*Naiadites lanceolata* *Estheria minuta* *Gyrolepis alberti* *Icthyosaurus* sp. *Sauricthys accuminatus* and other vertebrate remains, viz., scales and teeth
4.	Clay, yellow, with gritty, thin, micaceous and ripple-marked sandstone,	0 3			
5.	Shales, yellow, with thin micaceous and ripple-marked sandstone layers, ...	2 6			*Dimyodon intusstriata* *Pecten (Chlamys) valoniensis*
6.	Shales, greenish black, not very fissile, but fairly fossiliferous,	1 6	Lower Rhætic		*Acrodus minimus* *Gyrolepsis alberti* *Cardium cloacinum* *Pecten valoniensis* *Myophoria emmerichi*
7.	Limestone, dark grey, with fibrous top. Splits into two halves easily; very hard and sometimes crystalline,... ...	0 10		Upper *Pecten* Bed	*Gyrolepsis* sp. *Pleurophorus elongatus* *Pecten valoniensis*
8.	Shales, black, clayey, not very fossiliferous, ...	7 0			*Pleisiosaurus* sp. *Pecten valoniensis* Smooth pebbles
9.	Limestone, hard, grey pyritous, with fibrous top, ...	0 6		Lower *Pecten* Bed	*Pecten valoniensis* (fragmentary)
10.	Shale, hard, dark grey, only slightly fissile, ...	3 0			Small tooth of *Pleisiosaurus*

A glance at this section will show that the complete sequence from the Cotham Marble to the hard black shale which usually succeeds the *Ceratodus* bed, is present. The *Ceratodus* bone bed itself was not observed.

Section No. 3.

This section ran along Pen Park Road from its junction with Lydney Road to the main Southmead Road.

Bed No.	Lithology.	Thickness. Ft.	In.	Hemeræ.	Palæontological Details.
1.	Clay, with irregular limestone bands, ...	2	0	*johnstoni and planorbis* (?)	*Caloceras* cf. *intermedium* *Dentalium minimum* *Cidaris arietis*
2.	Limestone, grey, hard,	0	3		*Pleuromya* sp.
3.	Limestone, brownish, crumbly, ...	0	3		*Ostrea* cf. *lamellosa*
4.	Limestone, dark grey, with ochreish clay parting, ...	0	8	*liassica* and *tatei*	*Pleuromya tatei* *Unicardium arenacea*
5.	Shales, brown, ...	0	4		*Pleuromya tatei* *Protocardium phillipianum*
6.	Limestone, dark grey, hard, ...	0	4		
7.	Ochre parting, ...	0	1		
8.	Shale, brown, sandy,	0	2		*Ostrea* sp.
9.	Limestone, white and argillaceous, ...	0	5	*langportensis*	*Cypricardia* sp. nov. *Pleuromya* sp.
10.	Clay, with white, rubbly and argillaceous limestone, ...	2	0		*Pleuromya langportensis*
11.	Cotham Marble, ...	0	4	Upper Rhætic	*Pseudomonotis decussata*
12.	Clay, greyish and banded, ...	2	9		
13.	Shales, grey and blue,	2	0		
14.	Limestones, grey and yellow, arenaceous and argillaceous, with much ochre and sandy clay, ...	0	5		*Pecten valoniensis* *Naiadites lanceolata*
15.	Shales, grey, passing into a shale having a dark bluish colour,	1	0		*Icthyosaurus* sp.

Section No. 4.

The fourth of these sections is perhaps the finest in the area. It commences at the junction of Pen Park Road and Southmead Road, and runs the whole length of the continuation of Pen Park Road from Southmead to Filton. It shows a complete sequence (for this district) from the shales of *turneri* age to the base of the Angulata zone (i.e., *liasicus* hemera).

The *liasicus* beds will be seen to be of great thickness compared with any of the other beds. They are rather unfossiliferous, and are uninteresting lithologically, since they consist of nothing but alternating bands of limestone nodules with shale and clay partings.

Red. No.	Lithology.	Thickness. Ft.	In.	Hemeræ.	Palæontological Details.
1.	Shales, black, with three nodular limestone bands, ...	6	3	*turneri*	*Arnioceras* cf. *bodleyi*
2.	Clay, brown, ...	2	0		
3.	Shales, dark brown,	1	0		*Arnioceras* cf. *geometricum*
4.	Limestone, hard, blue,	1	0	*gmuendense*	
5.	Shales, black and grey,	2	0		
6.	Limestone nodules, ...	0	6		*Coroniceras gmuendense*
7.	Shale parting, ...	0	6		

8. Limestone, ...	0	6	meridionalis	
9. Shales, black, ..	1	2		*Oxytoma sinemuriensis*
10. Limestone, ...	0	6		*Megarietites meridionalis*
11. Shales, black, ...	0	6		
12. Limestone (with shale partings 6 in. thick),	4	0		
13. Shales, black, ...	1	0	bucklandi	
14. Limestone, with much calcite, ...	0	6		
15. Limestone, weathering brown, with hard blue interior, ...	1	0		*Coroniceras bucklandi*
16. Limestone, very massive and ochre-stained ; very fossiliferous, ...	1	0	rotator	*Coroniceras rotiforme* *Vermiceras* sp. *Ptychomphalus solaroides* *Rhynchonella triplicata*
17. Clay, with small limestone nodules, very fossiliferous, ...	0	7		*Coroniceras rotator* *Pleurotomaria anglica* *Gryphea* cf. *incurva* *Calcirhynchia calcaria*
18. Clay, dark grey in colour, ...	0	6	conybeari	*Vermiceras conybeari* *Gryphea incurva*
19. Limestone, grey, regularly bedded, ...				*Vermiceras* aff. *conybearoides* *Unicardium arenacea*
20. Clay parting, ...				
21. Limestone, nodular, and ochre-stained,	2	0		*Gryphea incurva* *Calcirhynchia calcaria*
22. Shales, black, clayish,	0	5		*Vermiceras conybeari*
23. Limestone, hard, grey,	0	3		*Calcirhynchia calcaria*
24. Shales, ...	0	8	angulata	
25. Limestone, white, but with grey interior,	0	4		*Radula hettangiensis*
26. Clay parting, ...	0	2		
27. Shales, black and clayish, with an abundance of carbonaceous material, ...	0	6		Fossil wood
28. Limestone (nodular), grey and argillaceous, ...	0	6		*Scamnoceras angulata* *Pleuromya* sp.
29. Clay, black, bituminous, ...	0	6		
30. Limestone, brown, ...	0	2		
31. Clay parting,... ...	0	3		
32. Limestone, grey, ...	0	4	liasicus	
33. Clay parting,... ...	0	3		
34. Limestone nodules, ...	0	6		*Gresslya* sp.
35. Clay parting,... ...	0	5		
36. Shales, black, ...	2	0		
37. Limestone nodules, ..	2	0		*Pleurotomaria anglica*
38. Shale. black, ...	0	6		
39. Limestone nodules....	0	4		
40. Clay parting, ...	0	2		
41. Limestone nodules, ...	0	4		
42. Clay parting,... ...	0	3		
43. Limestone nodules, ...	0	3		*Schlotheimia* sp.
44. Clay parting,... ...	0	4		
45. Shales, ...	0	2		

Bed No.	Lithology.	Thickness. Ft.	In.	Hemeræ.	Palæontological Details.
46.	Limestone nodules, ...	0	4	liasicus	
47.	Clay, grey, ...	0	2		
48.	Limestone nodules, ...	0	4		
49.	Clay, grey, ...	0	3		
50.	Rubbly limestones in clay, ...	0	2		*Pholadomya* sp.
51.	Limestone, with grey partings, ...	3	0		*Ostrea irregalaris*
52.	Clay, dark, rusty, ...	1	6		
53.	Limestone, rubbly, ...	1	0		*Ornithella sarthacensis*
54.	Clay, with limestone in rubbly form, ...	4	0		*Ostrea irregularis* (very common)
55.	Limestone, in flat slabs or nodules, being very shelly, ...	0	6		*Pleurotomaria anglica* *Plagiostoma gigantea*
56.	Clay, very dark in colour, ...	4	0		
57.	Limestone, white, argillaceous, ...	1	0		*Cidaris arietis*
58.	Clay, dark grey, ...	0	3		
59.	Limestone, grey, thinly bedded, ...	0	3	johnstoni (?)	
60.	Clay, dark grey in colour seen,... ...	1	0		Many small *Ostrea*

Section No. 5.

About one hundred yards north of Southmead Hospital, a trial pit was made. Some curious sandy layers were exposed. Sand of this kind was observed at various other localities.

The section was as follows:—

1. Loam and clay, 2 ft. 7 ins. thick.
2. Thinly scattered, gritty limestone, 1½-3 ins. thick, with *Acrodus* sp., *Gyrolepsis* sp., *Pleurophorus elongatus.*
3. Sand, 1 ft. thick.
4. Clay, 3 ft. 10 ins. thick.

Carboniferous Limestone.

Section No. 6.

This section, as will be seen from an inspection of the map, runs from Pen Park Road in a S.W. direction to a point near Brentry Farm Cottage. For the most part it ran through very much disturbed strata of *liasicus* or Rhætian age. It was not possible to make any detailed observations.

Briefly the section may be described as follows:—At Pen Park Road, where the section commences, all the deposits are normal, but as one proceeds in the direction of Brentry Farm Cottage, the White Lias and Rhætic deposits show signs of disturbance. Owing to a small depression produced by superficial drainage, the Carboniferous Limestone is next exposed. Finally, owing to a rise in the ground, another patch of Rhætic capped with Cotham Marble (very much broken up) is reached. This patch forms a miniature outlier of Upper Rhætic. It is of small extent, and may possibly be joined to the main mass. Its isolation is due to the action of a small stream which ran into the Trym lower down the valley.

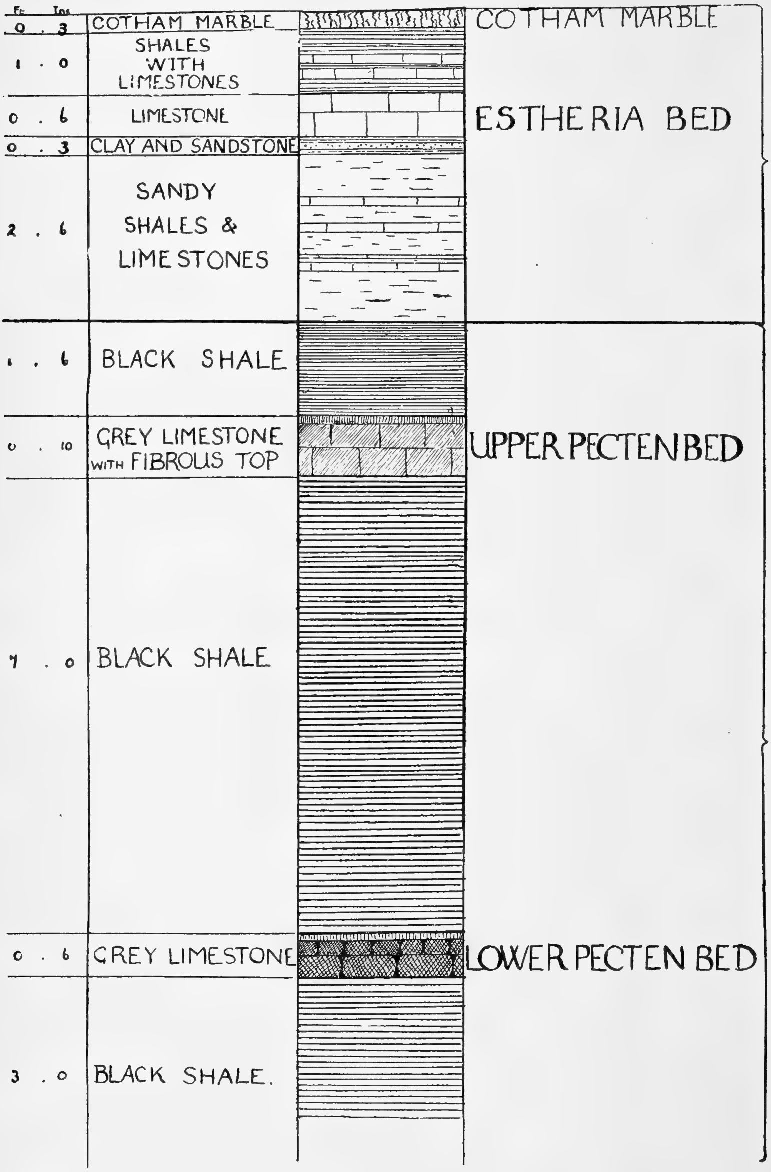


Fig. 4.—Section No. 2 (Northern area).

Section No. 7.

Was a useful exposure for mapping purposes. Lithologically and palæontologically it closely resembled Section No. 3, the only difference being that on the whole the individual beds were a little thinner.

Section No. 8.

At this locality black shales of lower Rhætic age were turned out. As far as could be judged the shales were lying in a depression in the Carboniferous Limestone, but it was difficult to trace the shales for any distance.

V.

The Carboniferous Limestone has exercised a considerable effect upon the strata directly overlying it throughout the area. In general the beds actually resting upon the Carboniferous Limestone are somewhat uneven. Limestones are broken up and lie in erratic positions in the clay, which often contains irregular sandy layers of a red, grey or yellow colour.

The surface of the limestone is usually worn and is sometimes quite deeply pitted or scarred, the pits being filled with Rhætic or Liassic material. No indications of the presence of strata of Keuperian age have been observed. This information enables some reconstruction to be made regarding the conditions which previously existed in the area.

After the Armorican movements which had such an effect upon the Palaeozoic rocks of the Bristol district there followed a long period of denudation. During this time the Brentry ridge was exposed to sub-aerial erosion.

While the Keuper Marls were being deposited the Carboniferous Limestone was slowly sinking, though it did not sink sufficiently to receive the Keuper Marls in this area. With the coming of the Rhætic period, the limestone gradually sank below the water and was just in time to receive the hard black shales above the bone bed (*Ceratodus* bed). The irregular surface of the Carboniferous Limestone and the gradual and often local subsidence of it beneath the waters of the Rhætic sea would be sufficient to account for the irregular way in which the Rhætic has been deposited.

The Rhætic. Many local observers have noticed the presence of a band of hard black unfossiliferous shale above the bone bed. (That is between the softer shale containing the maximum of *Avicula contorta* and the level at which vertebrate remains become predominant.)

This is borne out in the case of Southmead since the hard black shale, which is about 3 feet in thickness, only yielded one small fossil, viz., the tooth of young *Pleisiosaurous*.

The Cotham Marble (which forms the upper boundary of the Rhætic) has shown itself to be a very variable formation.

It is rather interesting to compare the thicknesses of the Upper and Lower Rhætic at Southmead with neighbouring exposures which have been described in detail. The Lower Rhætic has here been taken, for the purpose of comparison, as extending from the base of the Upper Rhætic to the base of the black shale above the bone bed (=*ceratodus* hor.). The Upper Rhætic extends from the Cotham Marble to the top of the upper black shale band.

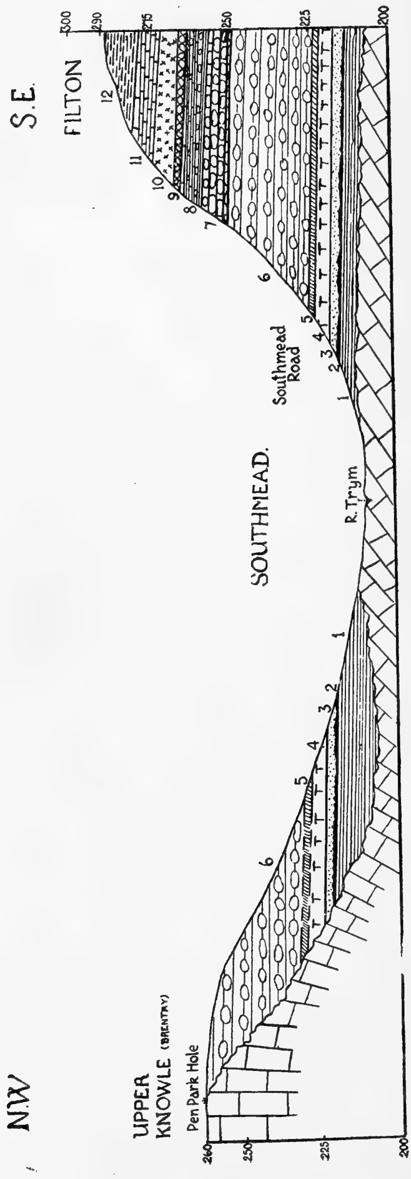


Fig. 5.—Section across the Trym valley from Upper Knole (Brentry) to Filton (Gloucester Road). Key to numbers:—1=**Rhætic.** 2=Cotham Marble. 3=White Lias. 4=tatei and liassica. 5=johnstoni and planorbis. 6=liasicus. 7=angulata. 8=conybeari. 9=rotator. 10=bucklandi. 11=meridionalis and gmuendense. 12=turneri. Length of section=(circa) 1½ miles.

Locality.	Aust.	Charlton.	Southmead.	Redland.
Thickness of Upper Rhætic,	11′ 2″	8′ 2″	4′ 6″	4′ 0″
Thickness of Lower Rhætic,	14′ 1″	13′ 3″	12′ 10″	8′ 6″

It will be seen that there is a general tendency for the Upper Rhætic to become thinner as one proceeds in a southerly direction. The same may be said of part of the Lower Rhætic (*i.e.*, all of the Lower Rhætic above the bone bed), though this generalisation must not be applied to the Lower Rhætic as a whole, since at Charlton there are twelve feet of strata below the *Ceratodus* level.†

The curious sandy layers of Rhætic age, which were mentioned in the description of Section No. 5 (Northern Area), are probably of Lower Rhætic age and may be a shore deposit. No fossils have been found in the sand itself.

The Lower Lias. The White Lias (=*langportensis* hemera) which rests conformably upon the Upper Rhætic, more rarely, unconformably upon the Carboniferous Limestone, is an attenuated formation. Though irregular it shows some slight signs of becoming thinner in the north. It is not very fossiliferous.

The *Pleuromya tatei* beds which merge imperceptibly into the White Lias below and the *liassica* beds above, are extremely fossiliferous but contain mainly lamellibranchs. At this level there is a band of very crystalline limestone with abundant examples of *Pleuromya tatei*. It is of a pinkish colour, highly crystalline and rather friable.

The *planorbis* beds were only separable from the *johnstoni* beds at one locality, viz., near Wellington Walk (southern Area, Section No. 13), but at that locality they were well developed, and this coupled with the fact that exposures on this level are rare, many mean that the information upon which the maps are based is incomplete.

The *johnstoni* beds are constant though usually thin. The ammonite which has been used as the zonal fossil for this bed is *Caloceras* cf. *intermedium* (Portlock).

The hemeræ included in the Angulata zone are of normal development (*i.e.*, normal in that they are similar lithologically and palæontologically to the Angulata beds of other localities in the Bristol district). They are fairly thick and often contain well-marked shale bands.

Much of the material in the Bucklandi beds on top of the Lias hill at Horfield and Filton is very badly weathered or remanié. Ammonites comparable with *Coroniceras bucklandi*, generally fragmentary casts, were found to be common in this zone.

The highest beds in the sequence were exposed at the top of Section No. 4 (northern Area). They were of *turneri* age and contained many fragments of Arnioceratidæ, *e.g.*, *Arnioceras* cf. *geometricum*. These *turneri* beds were also distinctive lithologically; being black shales they contrasted somewhat strikingly with the yellowish brown nodules of the Angulata and lower Bucklandi zones.

The following lists have been compiled from specimens obtained in the area covered by the paper.

†*Proc. Brist. Nat. Soc.*, 4th Series, Volume ii., Part i., pps. 5-21.

PALAEONTOLOGICAL LIST.

R=Rare. C=Common. No letter means the fossil occurs fairly often.

		Lower Rhætic.	Upper Rhætic.	*langportensis.*	*tatei* and *liassica.*	*planorbis.*	*johnstoni.*	*liasicus.*	*angulata.*	*conybeari* and *rotator.*	*bucklandi.*	*gmuendense* and *meridionalis*	*turneri.*
	VERTEBRATES.												
	Acrodus minimus Agassiz,	×											
C	*Gyrolepsis alberti* Agassiz,	×	×										
	Icthyosaurus sp.	×											
	Pleisiosaurus sp.,	×											
	PHYLLOPODA.												
	Estheria minuta Jones,		×										
	CEPHALOPODA (Ammonites).												
R	*Alsatites liasicus* (d'Orbigny),							×					
	Arnioceras bodleyi (J. Buckman),												×
	Arnioceras cf. *geometricus* (Oppel),												×
C	*Caloceras intermedium* (Portlock).						×						
	Charmassiceras charmassei (d'Orbigny),									×			
C	*Coroniceras bucklandi* (Sowerby),										×		
R	*Coroniceras lyra* Hyatt,										×	?	
	Coroniceras rotator (Reynès),									×			
R	*Epammonites* cf. *compressaries* (Reynès),										×		
R	*Megarietites meridionalis* (Reynès),											×	
	Paracoroniceras gmuendense (Oppel),											×	
	Psiloceras planorbis (Sowerby),					×							
R	*Psiloceras plicatus* (Quenstedt),					×							
C	*Scamnoceras angulata* (Schlotheim),								×				
	Schlotheimia depressus (Quenstedt),								×				
R	*Schlotheimia extranadosa* (Wähner),								×				
	Schlotheimia spp.,							×	×				
C	*Vermiceras conybeari* (Sowerby),									×			
	Vermiceras conybearoides (Reynès),									×			
R	*Vermiceras delmaisi* (Reynès),								×				
R	*Waehneroceras* sp.,							×					
	(Nautiloidea).												
	Nautilus spp.							×	×	×			
	SCAPHOPODA.												
	Dentalium minimum Strickland,						×						
	GASTEROPODA.												
	Gasteropod spp. (minute forms),		×										
	Pleurotomaria anglica (Sowerby).						×	×	×				
C	*Pleurotomaria* sp.,				×								
	Ptychomphalus (Cryptænia) solaroides (Sowerby),									×			
	PELECYPODA.												
R	*Arcomya* sp.,				×								
	Astarte consobrina Chapuis et Dewalque,							×					
	Avicula (Pteria) contorta Portlock,	×											

		Lower Rhætic.	Upper Rhætic.	*langportensis.*	*tatei* and *liassica.*	*planorbis.*	*johnstoni.*	*liasicus.*	*angulata*	*conybeari* and *rotator.*	*bucklandi.*	*gmuendense* and *meridionalis.*	*turneri.*
	Cardinia sp.,								×				
	Cardium cloacinum Quenstedt,	×											
	Cypricardia sp. nov.,			×									
R	*Dimyodon intustriata* (Emmerich),		×										
	Gervillia sp. (large),				×								
	Gresslya sp.,								×				
	Gresslya galathea Agassiz,							×					
C	*Gryphea* cf. *incurva* Sowerby,							×	×	×			
R	*Gryphea incurva* var. *crassirugata* Trueman,										×		
C	*Lima succincta* (Schlotheim),							×					
	Lima terquemi Tate,				×								
	Lima valoniensis de France,			×									
C	*Modiola langportensis* Richardson & Tutcher,			×									
	Macrodon hettangiensis (Terquem),			×	×								
	Modiola cf. *minima* Sowerby,		×										
	Modiola sp. (distinct from *M. minima*),		×										
	Myophoria emmerichi Winkler,	×											
C	*Ostrea irregularis* Münster,						×	×	×				
	Ostrea lamellosa Dunker,				×								
C	*Ostrea liasica* Strickland				×								
C	*Oxytoma sinemuriensis* (d'Orbigny),											×	×
	Oxytoma inequivalvis (Sowerby),											×	
C	*Pecten valoniensis* de France,	×	×										
C	*Pholadomya fraasi* Oppel,				×	×							
	Pholadomya glabra Agassiz,						×	×	×				
R	*Pholadomya hibberti* Terquem,				×								
R	*Pinna* cf. *semistriatum* Terquem,						×						
	Plagiostoma sp.,				×								
C	*Plagiostoma gigantea* (Sowerby), (Large range).												
	Pleuromya langportensis Rich. & Tutcher,			×									
	Pleuromya liasina (Schubler),						×		×				
C	*Pleuromya tatei* Richardson & Tutcher,				×								
	Pleurophorus elongata (Moore),	×											
	Pleurophorus angulatus (Moore),	×											
C	*Protocardium phillipianium* (Dunker),		×	×	×								
	Pseudomonotis decussata (Münster),		×										
C	*Radula hettangiensis* (Terquem),								×	×			
C	*Schizodus concentricus* Moore,	×	×										
C	*Unicardium arenacea* Terquem (Long range).				×					×			
	BRACHIOPODA.												
	Ornithella sarthacensis (d'Orbigny),							×					
C	*Calcirhynchia calcaria* S. S. Buckman,								×				
	Rhynchonella triplicata Quenstedt,									×	×	×	
	ECHINOIDIA.												
	Cidaris arietis (Quenstedt),					×							

	Lower Rhætic.	Upper Rhætic.	*langportensis.*	*tatei* and *liassica.*	*planorbis.*	*johnstoni.*	*liasicus.*	*angulata.*	*conybeari* and *rotator.*	*bucklandi.*	*gmuendense* and *meridionalis.*	*turneri.*
CRINOIDEA.												
C *Isocrinus* sp. (Large range).												
ANTHOZOA.												
R *Montlivaltia guettardi* Blainville, .							×					
PLANTÆ.												
Naiadites lanceolata Brodie, . .		×										

In conclusion, my grateful thanks are due to Mr J. W. Tutcher for his invaluable assistance in the production of this paper, which was undertaken at his suggestion.

On the Occurrence of the D_3-Subzone in the Mendip Area.

By F. B. A. Welch, B.Sc., Ph.D., F.G.S.

ALTHOUGH the "Millstone Grit" is exposed in several places on the flanks of the Mendip periclines, yet it is very rare to obtain a section showing a complete passage from the D_2 limestones to the "Millstone Grit." Near Stoke Lane, however, quarrying operations exposed such a section and revealed beds containing a D_3 fauna.

I wish to express my indebtedness to Dr Stanley Smith for examining the D_3 material, and also to Miss H. Muir-Wood, M.Sc., for naming certain of the Productids.

The exposure to be described lies one mile N.N.E. of the village of Stoke Lane, at the northern end of the valley in which Stoke Lane Swallet is situated. At this northern end are situate Gilson's quarries, of which a detailed plan is shown in the accompanying sketch map.

These quarries, which are three in number, are worked for limestone, "quartzite," and "firestone." The limestone and quartzite quarries are located on the western side of Bector Lane, the former being the more southerly. A little to the north, on the east side of the lane, lies the "firestone" quarry, a small excavation in Coal Measure sandstone.

The limestone quarry is at present being worked in massive D_2 limestone dipping at 80 N. 3 W. East of this and in similar beds, on the opposite side of the road, is an old quarry where, in addition to D_2, are exposed the basal beds of D_3. These have so far not been encountered in Gilson's limestone quarry.

Between the limestone and "quartzite" quarries stands an unquarried ridge, on the top of which a trench was cut with a view to ascertaining whether or not workable limestone was present. This trench, which was 3 feet wide and 4 feet deep, was cut through a thick clay and was scarcely deep enough to show much of the underlying rock; nevertheless, it was possible to examine thin bands of limestone, too thin to work, interbedded in shales which in most cases had weathered to clay.

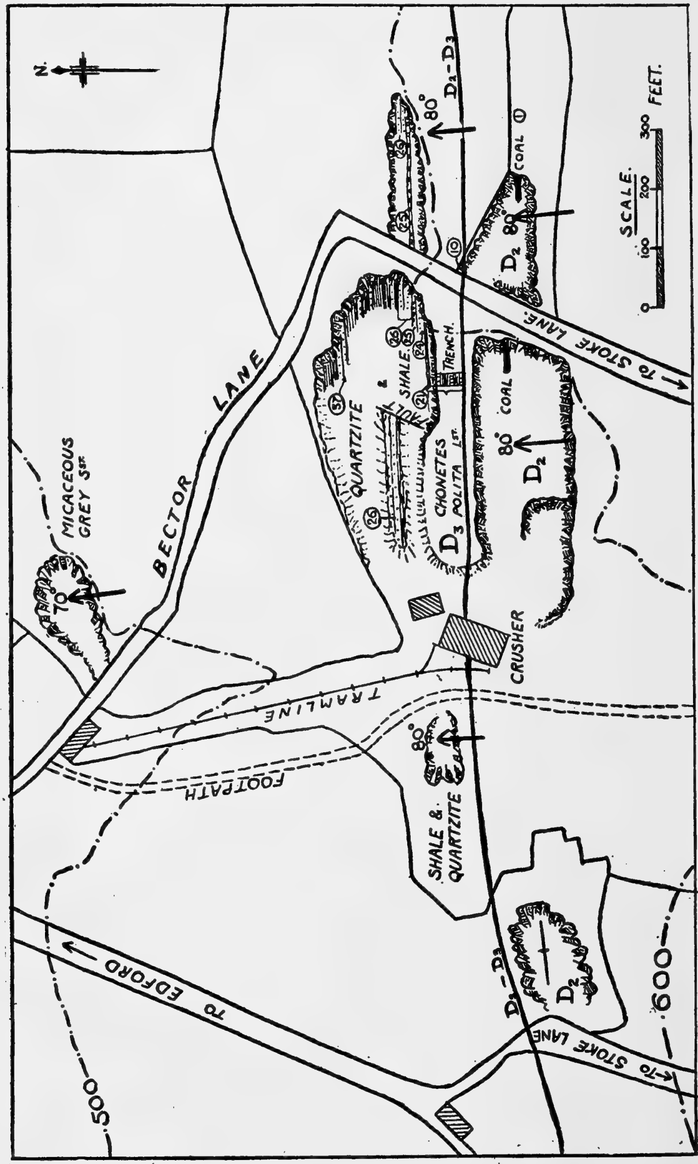
The limestones, of a yellowish rubbly nature, were submitted to Dr Stanley Smith for comparison with his material collected at Wick.[1] He identified the following fossil assemblage:—

Chonetes polita M'Coy.	*Buxtonia scabricula* (Martin).
Spiriferina octoplicata (J. de C. Sow).	*Productus* of the *concinnus*-type.
Camarotoechia sp.	*Orthotetes* sp.
Dielasma cf. *D. perovale* (L. G. de Kon).	*Phillipsia* sp.

and stated (*in lit.*, 2/3/31) that this material agrees very closely, both in matrix and fossil content, with the *Phillipsia*-Band and the arenaceous

[1] Smith Stanley, "The Carboniferous Inliers at Codrington and Wick (Gloucestershire)," *Q.J.G.S.*, vol. lxxxvi. (1930), pp. 331-54.

limestone in the "Millstone Grit" at Grandmothers Rocks (Wick): He considered that the limestones exposed in the trench represents the *Chonetes-polita* Limestone of Wick and not the higher "Mollusca-Band" (Wick paper, p. 342, *et seq.*).



Sketch Map of Gilson's Quarries and surrounding area, showing the localities of outcrop of the D$_3$-Subzone.
Small ringed numerals correspond to beds similarly numbered in text.

These *Chonetes-polita* Limestones are exposed as far as the north limit of the trench, which is formed by the south face of the "quartzite" quarry. Immediately succeeding the uppermost limestone, which contains *Chonetes polita* (Bed 18)[2], two shale beds with an intervening limestone (Beds 19, 20, 21) occur and contain a distinct fossil assemblage:—*Chonetes* near *Ch. hardrensis* (elongated form with very faint and fine ribbing), *Productus* [*Linoproductus*] *undatus* (Defrance), *Productus* [*Dictyoclostus*] *antiquatus* Sow. sp. and spines (abundant). The black calcareous shales (Bed 21) have yielded *Productus* sp., ? *P. concinnus* (crushed valves), a rhynchonellid cf. *Pugnax pleurodon* (Phill.), and Crinoid stems. There also occur red worm-like tubes, which, however, show no organic structure. This bed (21) is the uppermost horizon from which fossils have so far been obtained in the section, the succeeding beds belonging to the " shale-quartzite " series. Of this group, the bed principally quarried and considered of most value commercially is bed 26, a hard pink-purple quartzite with reddish irony flecks. Underlying this is the " Pebble Bed " (25), a conglomerate of ironstained quartz pebbles, together with angular fragments of greenish shale.[3] Both of these beds are also exposed in a disused quarry, a little to the east, in which the " Pebble Bed " forms the back-wall.

The remainder of Gilson's " quartzite " shows a succession of shales and quartzites, one of these shale bands being so carbonaceous as to resemble a poor coal. Bed 37 is a thin band of quartzite, which is occasionally worked, but for the most part these upper quartzites are thin and of poor quality, whilst shales predominate.

West of the present working face a small N.-S. fault is seen displacing the quartzite bed No. 26 (see sketch map). Close to this fault the strata are now concealed by tip, but from information received from the workmen the fault appears to have been of the nature of a small tear, the strata having been apparently buckled into an inverted "S" and been sheared northward along the middle limb.

Half-a-mile to the east, a second series of excavations (Whitehole Quarries) has been opened under the same management for working the quartzite. When last visited only trial trenches had been dug, the lowest bed seen apparently being the " Pebble Bed."

Throughout the Whitehole and Bector Lane Quarries the shaley beds and occasionally the thinner quartzite beds are seen to become inverted close to the surface of the quarry faces. This might be regarded as a tectonic feature, but the writer prefers to consider it as caused by hill-creep.

North of Gilson's Quartzite Quarry is the " firestone " quarry, showing greenish micaceous flaggy sandstone, weathering yellow-brown, and containing obscure plant remains, presumably of Lower Coal Measure age.

[2] Numbers correspond to similarly numbered beds in accompanying section.

[3] When last seen (March 1931) the Pebble Bed was becoming concealed by tippings from the neighbouring working.

Comparison with adjacent exposures. The writer in a recent paper[4] described the occurrence at Upper Vobster of certain quartzite-shale masses faulted into the limestone series. Lithologically, the quartzite-shale beds at the south-west corner of Vobster Quarry show strong similarity to beds 30-32 of Gilson's Bector Lane section.

In the same paper it was stated that grey-black shales yielding *Gastrioceras crenulatum* were observed in the north-east corner of Vobster Quarry, associated with quartzite fragments. It is thus possible that similar beds may be present at a short distance above Bed 38 of Gilson's Quarry; for, according to information obtained from workmen, the only band of quartzite occurring in the Nettlebridge Valley above Bed 38 is a thin seam at a slightly higher level. Thus the presence of a thin quartzite band together with the predominantly shaley character of the upper beds of the series, as compared with the Goniatite shales at Vobster, suggests that exposures a short way to the north of the present working would reveal shales with goniatites.

No actual break has been detected within the quartzite-shale series, though lithologically one is suggested by the Pebble Bed; but, since such beds occur frequently in the Wick region, it is at present unsafe to attach too much importance to its occurrence. It is thus still impossible to say how much of the quartzite-shale series is to be included in the Avonian.

[4] Welch, F. B. A. "The Avonian Inlier at Upper Vobster (Somerset)," *Geol. Mag.*, vol. lxviii. (1931), pp. 421-30.

Details of Strata from D_2—"Millstone Grit."

		Bed No.		Ft.	Ins.
Data from Gilson's Quartzite Quarry.	"Millstone Grit Series," probably higher beds of D_3	38.	Black shale ... seen	1	0
		37.	Quartzite, occasionally worked, but of poor quality ...	6	0
		36.	Purple red shale ...	2	0
		35.	Grey shale ...	0	8
		34.	Quartzite ...	0	8
		33.	Carbonaceous shale (poor coal) ...	2	3
		32.	Quartzite, red with shaley bleached partings resembling porcelain ...	2	6
		31.	Grey shale with sandstone bands ...	2	6
		30.	Yellow sandstone ...	1	0
		29.	Blue black shales with brick-red lenticles ...	8	0
		28.	Sandy yellow quartzite with shaley clay partings ...	10	0
		27.	Blue-grey shales ...	2	2
		26.	Pink quartzite with reddish specks (bed quarried and considered best quality commercially) ...	24	0
		25.	"Pebble Bed." Conglomerate of quartz pebbles coated with haematite. Pebbles up to 2½ ins. in length. Also contains angular fragments of green shale ...	4	0
		24.	Quartzite, tendency to be sandy and current bedded ...	10	0
		23.	Grey shale ...	0	9
		22.	Quartzite, pink ...	3	0
	D_3	21.	Shales, black, calcareous, with red worm-like inorganic bodies. Rhynchonellid, *Productus* sp. ?*P. concinnus*, Crinoids ...	6	0
		20.	Limestone, black, very hard. *Linoproductus undatus* (Defr.). *Dictyoclostus antiquatus* Sow. sp. and spines. *Chonetes* near *Ch. hardrensis* ...	1	6
		19.	Shale, black ...	1	0
		18.	Limestone, *Chonetes polita* M'Coy. *Spiriferina octoplicata* (J. de C. Sow). *Camarotoechia* sp. *Dielasma* ...	2	0
Data from Trench.		17.	Sandy decalcified limestone ...	5	0
		16.	Limestone, hard, unfossiliferous ...	1	0
		15.	Limestone with red ooliths. *Chonetes polita* M'Coy. *Camarotoechia* sp. *Orthotetes* sp. *Dielasma* cf. *D. perovale* (L. G. de Kon). *Buxtonia scabricula* (Mart.). *Productus concinnus*-type. *Spiriferina octoplicata* (J. de C. Sow) ...	5	0
		14.	Shale weathered to yellow clay ...	15	6
		13.	Clay ...	1	0
		12.	Limestone, grey crystalline splintery ...	0	4
		11.	Blue shaley clay ...	2	6
Old Quarry on East side of Bector Lane.		10.	Limestone with *Buxtonia scabricula* (Mart.). *Phillipsia* sp. *Prod. giganteus*, etc. ...	2	0
	D_2	9.	Limestone, fine grained blue-black compact, strongly crinoidal. Lower beds coarser and more gritty ...	5	6
		8.	Gritty conglomerate, irregular lenses of purplish sandstone and round fragments of gritty limestone weathering in honeycomb manner ...	1	4
		7.	Limestone, crystalline compact gritty. Polyzoa, Calamite ...	1	8
		6.	Sandy decalcified limestone ...	0	4
		5.	Limestone, gritty, containing quartz pebbles up to ¼-in. diameter ...	2	0
		4.	Limestone, black, fine-grained, compact ...	1	8
		3.	Limestone, with quartz pebbles up to ½ in. diameter ...	2	2
		2.	Thin gritty calcareous sandstone weathering "tiley"	1	0
		1.	Black and ochreous shales (in Gilson's "Limestone Quarry" represented by "coal") ...	2	0

Below are normal D_2 massive limestones with usual fossil content.

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TABLE OF CONTENTS.

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S	Shield, E. H.	78 Sefton Park Road, Bishopston
S	Shrimpton, D. F.	172 Brynland Avenue, Bishopston
*	Skene, Macgregor, D.Sc., F.L.S.	The University, Bristol
	Smith, Stanley, M.A., D.Sc., F.G.S.	The University, Bristol
A	Smith, Mrs W.	17 Vyvyan Terrace, Clifton
S	Stevens, F. H.	9 Osborne Villas, St Michael's, Bristol
S	Stone, R.	75 Clevedon Road, Weston-s.-Mare
S	Storey, R. G.	8 Oxford Chambers, St Stephen's Street, Bristol
S	Strudwick, Miss F.	26 Woodstock Road, Redland
	Sully, H. T.	Elmside, Stoke Bishop, Bristol
S	Sully, Mrs	Elmside, Stoke Bishop, Bristol
S	Sutton, H. C.	Stoneleigh, Cotham Park, Bristol
S	Tarring, E.	3 Narrow Wine Street, Bristol
	Taunton, W. C.	36 Egerton Road, Bishopston
S	Taylor, W. R., M.A.	12 Pembroke Vale, Clifton
*	Tetley, H., B.Sc., F.Z.S.	4 The Avenue, Sneyd Park
S	Tetley, Mrs	4 The Avenue, Sneyd Park
S	Thomas, Miss D. M. L.	79 Somerville Road, Bishopston
S	Thomas, J. I.	79 Somerville Road, Bishopston
S	Thomas, R.	131 Cumberland Road, Bristol
	Thomas, Miss R. L.	8 Clarence Place, Cotham
*	Thompson, H. S., A.L.S.	11 Buckingham Place, Clifton
	Thompson, Miss J. G., O.B.E., B.Sc.	Foxstones, Westbury Hill, Bristol
S	Thornton, P. T.	5 Goldney Avenue, Clifton
S	Tily, W. J.	6 Crofton Avenue, Horfield

	Tombleson, F. B.	Shirley, Briercliffe Road, Combe Dingle
S	Tomkins, Miss M.	62 Ashley Road, Bristol
	Tompkin, F. H.	7 Meridian Road, Redland
	Tuckett, C.	St Just, Chew Magna, Som.
	Tuckett, R. C.	5 Beaufort Buildings, Clifton
	Turner, H. W., M.A. (Oxon), F.G.S.	The University, Bristol
*	Tutcher, J. W., M.Sc.	57 Berkeley Road, Bishopston
S	Tyrell, E. B., B.A.	5 Addicott Road, Weston-s.-Mare
	Vaughan, Mrs	42 Fernbank Road, Redland, Bristol
S	Venning, Miss	31 Beauchamp Road, Bishopston
S	Vick, C. R.	29 Zetland Road, Bristol
S	Vizard, Miss E. M.	25 Logan Road, Bishopston
	Waight, Miss M.	14 Osborne Avenue, Ashley Down
	Walker, L. E.	5 Crowndale Road, Knowle, Bristol
	Walker, R.	5 Crowndale Road, Knowle, Bristol
*	Wallis, F. S., D.Sc., Ph.D., F.G.S.	90 Coldharbour Road, Bristol
S	Walsh, W. G.	6 Alma Vale Road, Clifton
S	Wann, Miss I.	35 Burleigh Road, St Andrew's Park
S	Waters, A. B.	Newhaven, Walton, Clevedon
S	Waters, A. C.	Newhaven, Walton, Clevedon
S	Waters, Mrs	Newhaven, Walton, Clevedon
	Webb, H. Vicars	58 Belmont Road, St Andrews, Bristol
	Wetherell, Miss	97 Pembroke Road, Clifton
*	White, E. Barton, M.D., F.E.S.	Mental Hospital, Fishponds, Bristol
	White, Mrs E. B.	Mental Hospital, Fishponds, Bristol
*	White, J. W., M.Sc., F.L.S. (dec'd.)	18 Woodland Road, Clifton
	White, Mrs J. W.	18 Woodland Road, Clifton
*	Wickes, W. H.	84 St Michael's Hill, Bristol
S	Willcox, E. P.	Stoke Hill Cottage, Stoke Bishop
S	Willcox, F. R.	Stoke Hill Cottage, Stoke Bishop
S	Willis, D. C.	360 Fishponds Road, Bristol
†	Wills, W. Melville	Bracken Hill, Leigh Woods, Bristol
S	Woolcott, J. W.	The Wabe, Hill View, Henleaze
	Woolley, W. H.	2 Nugent Hill, Bristol
S	Woollon, P. C. A.	30 St Paul's Road, Clifton
S	Woolls, Miss	5 Hamilton Road, Easton, Bristol
S	Wroughton, Mrs R. E.	Furringdons, Merriott, Som.
S	Wynne-Edwards, V. C., B.A.	McGill University, Montreal, Canada

Honorary Members.

Prof. C. Lloyd Morgan, LL.D., F.R.S., F.G.S., 79 Pevensey Road, St Leonards-on-Sea.

R. M. Prideaux, F.E.S., Brastead Chart, near Sevenoaks, Kent.

W. G. Scott, Cardiff.

Prof. H. S. Hele Shaw, M.I.C.E., LL.D., F.R.S., 64 Victoria Street, Westminster, S.W.1.

Prof. W. J. Sollas, M.A., LL.D., F.R.S., F.R.S.E., F.G.S., University Museum, Oxford.

Prof. Sydney Young, D.Sc., F.R.S., Trinity College, Dublin.

REPORT OF COUNCIL,

TO DECEMBER 31st,

1932.

THE various activities of the Society have been well maintained throughout the year, and the attendance at the winter meetings has increased.

Mr J. W. Tutcher, M.Sc., has continued in the chair for a second year, and gave as his Presidential address an interesting account of the application of the Divining Rod in locating subterranean water. He is now resigning the office of President in favour of Dr F. S. Wallis, D.Sc., F.G.S., another well-known geologist, whose zeal and enthusiasm have done much to enhance the reputation of the Geological Section. The Society may therefore look forward with confidence to another year of steady progress.

Work in the field of research is chiefly carried on by the Sections, and new recruits are being constantly added to them, but unfortunately the membership of the Society remains almost stationary. A few sectional members have taken up full membership, but it is to be regretted that more do not avail themselves of the advantages to be gained by the privilege of free access to the excellent and well-stocked Library. Their support would also help materially the Society to continue the publication of "Annual Proceedings."

Two past Presidents have been added to the list of Honorary Members. Sir Ernest Cook, D.Sc., well known in the West of England for his many years' work as Chairman of the Bristol Board of Education; and Mr H. Womersley, A.L.S., recently appointed the entomologist to the South Australian Museum, Adelaide, on his retirement from an entomological post in Perth, Western Australia.

The Exhibition meeting in October was on a larger scale than usual, and the aim of the exhibitors was to try and reflect as far as possible the history of the Society since its formation in 1862 and show the advances made in the knowledge of the various branches of Natural History. Several rooms in the Botanical Department of the University were kindly lent for the occasion, and these were filled with a splendid display of portraits of past presidents and workers, with examples of their published papers, an excellent series of photographic bird-life studies and plant water colour drawings, geological specimens and illustrations, and a collection of local Diptera.

The Botanical Section showed marked vitality in arranging an exhibit of over 200 freshly gathered wild flowers and fruit found within a 12-mile radius of the City, and a large collection of living fungi and Mycetozoa of the district. There was a very good attendance of members and friends, who took a keen interest in the exhibits, and expressed the wish that it could have been found possible to extend a similar opportunity to the public on the following day.

The 5th Annual Dinner in February attracted a record number of members and friends. Prof. W. W. Watts, F.R.S., late of the Imperial

College of Science, was the guest of the evening, and, in proposing "Prosperity to the Society," congratulated the members on the continuity of the Society's history, and the way in which they had upheld the science of observation rather than that of experiment. The speaker paid fitting tribute to the many geologists who had been associated with the Society and had done good work in the interest of Science. During the evening the President, on behalf of the members, presented Miss Roper with a handsome fur coat and set of toilet brushes in recognition of her work as Hon. Secretary for the past 15 years.

The Summer Excursion to Beacon Hill, a vantage point of the Mendip range, was also well supported by the members, who appreciated the arrangements made by the Officers of the Field Section to visit such a picturesque spot when the display of rhododendrons was in full bloom.

The Society, as usual, has taken part in the doings of kindred Societies. Mr H. Audcent attended as delegate the centenary festivities of the Entomological Society of France, held in Paris in July, and presented on behalf of our Society a congratulatory address.

Congratulations have also been sent to the Director of the Botanic Gardens, Rio de Janeiro, on the unveiling of a monument in honour of Eugène Warming and Peter Wilhelm Lund, two distinguished Scandinavian botanists.

The Hon. Secretary attended as delegate the Conference of Corresponding Societies at York during the meeting of the British Association, and later the National Conference for the Preservation of Rural England, held at Norwich for three days under the Presidency of the Earl of Crawford and Balcarres, F.R.S.

In October the Society lost by death its oldest member, Mr J. W. White, M.Sc., F.L.S. He joined the Society in 1878, and always took a keen interest in its botanical activities. He was an ex-President and Secretary of the Botanical Section for over 30 years. An appreciation of his work is published in the "Proceedings."

We have also to record with regret the death of Mr Richmond H. Hellyar, a talented naturalist, who passed away at the early age of 29. He had been a member since 1926.

The "Proceedings" for 1931 were published early in the year and distributed to the British and Foreign Societies with whom exchanges are effected. Thanks are given to the authors for defraying the cost of the blocks that illustrated their papers.

IDA M. ROPER, *Hon. Secretary.*

The Hon. Treasurers in Account with the Bristol Naturalists' Society.

Dr. GENERAL ACCOUNT FOR THE YEAR 1932. *Cr.*

	£	s.	d.		£	s.	d.
To Members' Subscriptions :—				By Subscriptions to Societies :—			
Ordinary,	44	5	6	Ray,	1	1	0
Associate,	1	0	0	Zoological Record,	2	10	0
Arrears,	1	0	0	,, Cost of *Proceedings*, 1931,	49	15	0
In advance,	3	15	0	,, Printing, Postage, etc.,	10	15	8
,, Field Section Capitation Fee,	3	18	0	,, Lecture Expenses,	0	10	0
,, Donations to Publishing Fund,	8	7	0	,, Rent and Fire Insurance,	1	11	0
,, Donations to Library :—				,, Dinner Expenses,	18	5	6
Geological Section,	2	0	0	,, Grant to Field Section,	3	0	0
Ornithological Section,	1	0	0	,, "British Birds," 18 vols.,	10	0	0
,, Sale of Publications,	4	13	9	,, Bookbinding,	9	6	6
,, Sale of Dinner Tickets,	21	3	6	,, Cash in hand,	119	9	8
,, Interest on Deposit,	2	19	2				
,, Balance from last Account,	132	2	5				
	£226	4	4		£226	4	4

Audited and found correct.

December 31st, 1932.

ERNEST H. COOK,
CHARLES BARTLETT, F.C.A. } *Auditors.*

LIBRARIAN'S REPORT,

FOR THE YEAR 1932.

THE remarks made in the Reports of past years that greater use should be made by members of the valuable collection of reference and periodical literature are at last bearing fruit. Over 100 books and pamphlets have been taken out for home reading during the year, which, though a small number considering the membership, is a great improvement and encourages the hope that still greater use will be made of the library by the newly-elected members.

It is gratifying, too, to note that the interest in the current publications from exchange Societies displayed on the Library table is well maintained, and students are availing themselves of the opportunity to consult works in their own particular line of research. It is also an encouraging sign that advantage is again being taken of the facilities offered by the London Science Museum Library for the loan of reference books.

It is unfortunate that the bookbinding fund is exhausted, whereby the many unbound volumes are not more accessible for study.

Prof. S. H. Reynolds has completed the task of cutting up the long series of the Palaeontographical Society and arranging them into completed monographs, and cordial thanks are given to him and his wife for the amount of time spent in preparing them for the binders. By the help of several duplicate volumes from the Library of the Universities of Bristol and Cambridge 61 volumes have been rebound, and in addition 5 volumes that were lacking have been purchased and incorporated in this valuable collection of geological monographs.

The demand for "The Avonian of the Avon Gorge," by the late Arthur Vaughan, continues, and a copy was recently purchased by an American Professor when paying a short visit to Bristol.

The first 18 volumes of "British Birds" have been purchased to supplement the yearly volumes presented by the Ornithological Section since 1923.

In addition to the usual exchanges made with corresponding Societies a new exchange has been effected with the Ohara Institute for Agricultural Research, Okayama-Ken, Japan.

The following books have been added to the Library and cordial thanks are given to the donors :—

"British Birds," Vol. 27, from the Ornithological Section.
"Entomological Monthly Magazine" and "The Entomologist," 1932, from the Entomological Section.
"Geological Magazine," 1932, and "Palaeontographical Society," Vol. lxxxiv, from the Geological Section.
Hyde, H. A. "Welsh Timber Trees," 1931, presented by Mr H. S. Thompson.
Womersley, H. "Protura of Australia" and "Tasmanian Collembola," presented by the author.
Woodward, Marcus. "How to enjoy Birds," 1928, presented by Miss A. Morley.
Hellyar, R. H. "W. N. P. Barbellion," 1926, and
Case, G. O. "Use of Vegetation for Reclaiming Tidal Lands," 1913, presented by Miss Roper.
Baily and Spoehr. "Development of Forestry in N. America," 1929, and
Bigelow, H. B. "Oceanography," 1931, presented by Nat. Academy of Sciences of U.S.A.
Matthews, L. H. "Lobster Krill," reprint from "The Discovery" Report, presented by the author.

IDA M. ROPER, *Hon. Librarian.*

BOTANICAL SECTION,

1932.

UNDER the chairmanship of Miss Roper, the keenness and enthusiasm which have been shown by members in previous years were maintained during the past year. There has been an increase in the membership, and meetings have been well attended. Eleven meetings were held in the Botanical Library, and the Section is grateful to Prof. Darbishire for the continued use of this room with its attendant advantages.

The exhibits for discussion brought by members have been more numerous than ever this year, and it has been difficult at times to discuss all of them fully in the allotted time.

An innovation was made at the December meeting when it was decided that, as far as possible, exhibits should consist of Evergreens. It is hoped that this will be continued so that, in addition to naming and exhibiting specimens, members who do not undertake any particular line of study, may direct their attentions along definite channels.

This more specialised work is being carried on by some, and the Section has thereby been afforded opportunities of examining and comparing groups. These have included certain types of Aliens, Plantains, Liverworts and Lichens.

In order that the vegetation of Bristol and the surrounding districts might be well represented at the Exhibition held in October, members were responsible for certain localities. There was a goodly array of flowers, fruit, fungi, etc., representative not only of the season but also of the neighbourhood.

F. F. GLASSPOOL, *Hon. Secretary and Treasurer.*

ORNITHOLOGICAL SECTION,

1932.

THIS Section has always adopted in the past the policy of having meetings at the house of one of its members, but it had until lately kept to the confines of Bristol. An experiment, however, was made this autumn of having a meeting outside Bristol and so successful was this that the policy has been continued.

The attendance, satisfactory in the main, has been particularly good at these last meetings, while the number of members has increased slightly to 38.

Altogether seven meetings have been held during the year, and the papers read at three of them deserve special mention. Mr J. H. Savory has taken up "Hawking" with enthusiasm and gave a vivid description, illustrated by slides, of this sport at the present day coupled with his researches into the literature of the past.

Mr A. C. Leach, in reading a paper on the birds of the Barrow Gurney reservoirs which included a detailed list of 72 species that have occurred there, outlined the results of observations made in the last ten years or so, in which he and other members of the Section have played a leading part.

On a third occasion the Section, as it has done previously from time to time, digressed to hear a paper on a British Mammal, this time on the Badger, of which a number are found in the Bristol area. This was a combined effort of Messrs C. Tuckett and F. R. Willcox, and, besides being illustrated by a number of excellent photographs, contained a large amount of good information as to the distribution and habits of these animals.

It has been decided that this Section should form a collection of photographs, taken by the members, of Birds and Mammals, to be housed in the B.N.S. Library.

H. TETLEY, *Hon. Secretary and Treasurer.*

ENTOMOLOGICAL SECTION,

1932.

DURING the year four new members have joined the Section, and there have been no losses. The financial position is satisfactory, with a slight increase in the balance carried forward.

Seven meetings have been held. They have been well attended, and many interesting exhibits have been shown.

By kind permission of the Director, the January meeting was held at the Bristol Museum. The private insect collections were made available for inspection, and Mr H. Tetley, B.Sc., Curator of Zoology, gave an account of their history and scope.

At the February meeting, our President, Mr C. Bartlett, F.E.S., read a paper on Winter Species of Lepidoptera. A full list of the species usually occurring during the period from October to April had been drawn up and was analysed on the basis of family, species, and duration of occurrence. A general account of the characters and habits of the species was given.

A very interesting address was given at the April meeting by Mr A. Kromler on his experiences in collecting Lepidoptera (usually at night) in a lane at Northwoods, Winterbourne. This lane was assiduously worked for a number of years, until despoiled by building operations, and yielded a large number of interesting species.

The International Congress of Entomology, held at Paris in July, was attended by Mr H. Audcent as delegate of the Section and the Society. At our October meeting Mr Audcent gave a detailed report of the proceedings, in which he had taken an active part as member of a special committee to consider a question of nomenclatorial practice.

At the December meeting there was a lively discussion on "Aims and Objects in Collecting." In initiating the debate, Mr Tetley pointed out that Museums derived their material largely from private collections, many of which were shorn of much of their scientific value by lack of data, and he drew attention to the problems of distribution, variation, etc., that well-documented specimens might help to solve. A subject that received earnest consideration during the discussion was how to assist in the preservation of rare species of insects in danger of extermination from over-collecting. One outcome of the debate was the decision to keep a Sectional Note-Book (after the manner of the Geological Section) in which members could from time to time record particulars of interesting observations.

The attempt to re-establish *Papilio machaon* in some of its old haunts, in which this Section is co-operating with the Entomological Section of the Somerset Archaeological and Natural History Society, has been put into operation. Adult butterflies have been liberated in selected areas, and eggs have been affixed to the food plants. The fact that healthy caterpillars have since been seen in the area encourages the hope that next season may produce evidence of the success of the experiment.

J. V. PEARMAN, *Hon. Secretary and Treasurer.*

FIELD SECTION,

1932.

ALTHOUGH adverse weather conditions in October and a plethora of reasons in September have reduced the average attendance at the Field Meetings to 32, the Section reports a year of continued interest and zeal in the pursuit of scientific problems.

The membership has increased—it now stands at 103—but with such a wealth of natural history in the vicinity of our city it is felt that the number is far too meagre. An extensive membership campaign will have to be inaugurated when the national situation is more propitious.

The Section acknowledges with thanks a generous contribution from the parent Society towards the cost of printing the programme. They feel that the standard and format of the programme must be maintained and trust that additional members will be forthcoming to secure financial stability.

At the Annual Meeting held in January, Dr F. S. Wallis and Mr G. H. Beacham were re-elected President and Vice-President respectively, Miss T. Shaw consented to act again as Treasurer, and Miss M. D. Hiley continues the duties of Secretary. Several exhibits were shown, and the President made a few remarks on "Why am I a member of the Field Section?" He suggested that a love of the methods of natural science probably formed the basic reason and alluded to the real essence of these methods, pleading for the controlled use of the imagination. Due appreciation of the purpose of science should be part of the cultural equipment of every citizen.

A meeting was held in the Spring for the purpose of giving leaders an opportunity of explaining the aims of the Field work. Although the standard of leadership has increased greatly in the past few years, it is felt that this meeting did not meet with a sufficient response from those for whom it was intended.

The scheme adopted for the Session was that of concentration on the Mendip Hills—in reality a broad form of regional survey. Representative districts were selected and our thanks are due to Messrs C. H. Blathwayt and B. W. Tucker, who, with some of our members, kindly supplied suggestive and helpful notes.

In May Mr and Mrs Barke led a party to the Draycott area. After visiting that well-known but little explored Nyland Hill, the party retraced their steps and proceeded through the gorge to Westbury Beacon. The botanists were exceptionally fortunate in Rodney Stoke woods, and all members were interested in the Dolomitic Conglomerate quarries at Draycott.

The Annual Field Meeting of the parent Society was as usual held under the auspices of the Section, the President and Secretary acting as leaders. After visiting Slocker Hole a short run took the party to the Moon's Hill and Waterlip quarries. Assembled at Beacon Hill, items of archaeological as well as of natural history interest were pointed out by members. The inspiring views of the country to the south of this vantage point were greatly admired.

The unusual feature of a second meeting by charabanc took place in July under the leadership of Mr G. E. J. McMurtrie. At Wookey the members were joined by Mr H. E. Balch, M.A., F.S.A., who, in his graphic and energetic manner, described the various prehistoric folk who had inhabited the cave. In the evening the party ascended to one of the higher points of Mendip and saw clear evidence of the tremendous thrusts that had displaced the rocks.

In September Mrs E. M. Vaughan explained the structure and chief features of that characteristic Mendip upland lying between Winscombe and Axbridge. Remnants of the old mining days were noted and many members first explored the rugged beauties of Hale Combe.

Despite extremely bad weather, a small party with Miss I. M. Roper as leader visited Purn Hill in October. The strata in the new road at Uphill were examined and later the ponds and rhines claimed attention. Members were also fortunate in securing the services of the Rector of Bleadon in describing the church and its records.

Your Section again records with gratitude the work of Mr H. Vicars Webb, who reports as follows :—

April 30th. Saltford District. Sixteen members attended. In a glen a Nightingale seen and heard at close quarters. Willow and Wood Warblers, Common Wren, Blackbird, Song Thrush, Chaffinch, Great and Blue Tits, all in song. Cuckoo calling, and one or two Swallows seen.

May 11th. Evening damp and cheerless. Five members came to St Anne's Wood. Willow Warblers and Blackcap in song. Blackbirds dominated the wood, a pair of Tawny Owls nesting, female seen on a nest.

May 21st. The Banks of the Froom. River in full spate of flood water. Numerous species of birds observed. At the Duchess Pond most interesting observation of Little Grebes nesting, numbers of Water Hens and crowds of Swifts in flight over the lake, and a few House Martins among them. Rockeries and flower beds at the old Mill in full bloom. Wooded heights of the glen in charming leafage. Five members attended.

May 28th. Brean Down. Only four members assembled at Temple Meads. Leader being unwell, these went on by train without him. On their arrival at Brean they were conducted round by Mr Harry Cox, the Watcher. Weather rather unfavourable for the Down.

June 8th. Leigh Woods and Abbots Leigh. A party of fourteen for this evening ramble. Bird songs checked by the easterly wind. At the Pool several Mallard and Ducks with their nestlings. June foliage in full beauty and a beautiful sunset scene.

Again this year Mr Ivor Evans has taken charge of the Botanical meetings, and he reports as follows :—

April 27th. Conham Vale to Brislington. Number present ten. The party proceeded from Hanham to the River Avon, crossed the Ferry and returned to Brislington. Plants observed—*Arabis hirsuta*—Hairy Rock Cress, *Sisymbrium Alliaria*—Hedge Garlic, *Sedum acre*—Biting Stonecrop, *Nepeta Glechoma*—Ground Ivy, *Luzula sylvatica*—Hairy Wood Rush, *Lamium purpureum*—Purple Deadnettle, white variety.

May 18th. Westbury, Henbury and Brentry. Number present five. Absence of members owing to wet evening. Leaving Westbury car, Henbury was reached and a return made via Brentry. Trees and plants seen—Hornbeam, Chestnut (Horse and Spanish), Hairy Rock Cress, Salad Burnet, Early Grasses and Carices, also various shrubs and trees.

June 11th. Bridge Yate. Granham Rocks and Bitton. Number present eleven. Bridge Yate 'bus conveyed the party, a ramble was made via Granham Rocks, Upton Cheney and Bitton. Summer flowers in abundance and varieties of Grasses and Carices, etc., all noted and discussed. Many interesting plants of local interest seen.

July 23rd. Charfield and Nibley Monument. Number present fourteen. Train to Charfield, walked to the Monument at Nibley. After delightful field and lane ramble, and tea, the Monument was ascended. Later, quarries inspected for flora. Plants observed beside the river—Frog Orchis, Bee Orchis, Tway-blade, Water Ragwort, St John's Wort species, Grasses, and Rushes in great variety.

M. DORIS HILEY, *Hon. Secretary.*

GEOLOGICAL SECTION,

1932.

At this time of the year much is written in the way of analysis both of the past and of the future. The Section has reached a position of *status quo* and little of outstanding interest takes place from year to year. Five new members have been elected and with the inevitable resignations, the membership now stands at 65 (nett increase of five).

The President and Vice-President were re-elected. It was felt desirable to separate the dual offices of Secretary-Treasurer and Mrs E. M. Vaughan was elected Treasurer, whilst Dr F. S. Wallis continued to serve as Secretary. The Committee consisted of Mesdames Barke and Marsden, Dr Stanley Smith, and Messrs H. F. Barke, G. A. Kellaway and A. Selley.

The Section has continued to place the current volumes of the Palaeontographical Society and Geological Magazine in the Library of the Society, and has also been able to give a donation towards the cost of completing and binding the volumes of the Palaeontographical Society. Our President is to be congratulated on the completion of this useful task.

The informal discussion class has continued to meet, immediately before each winter meeting, in the Library under the leadership of Mr J. W. Tutcher, M.Sc., and others. The value of this class increases yearly, and its informal methods have as usual been of great assistance to beginners.

At the January meeting, in addition to the formal business matters, members inspected the geological gallery of the Bristol Museum and Art Gallery. Special interest was shown in the case exhibiting the evolution of the elephant.

In February, Dr L. J. Wills, M.A. (Birmingham University), lectured on " Problems in the Development of the River Severn." The course of the river was outlined and special attention paid to the effects of the Ice Age.

The popular feature of short papers by members was again held in March. Miss T. Shaw spoke on " Geology and Everyday Life." This paper is printed elsewhere in the *Proceedings*. Mr G. E. J. McMurtrie gave some notes on the Somerset Coalfield. He enumerated the series and illustrated his remarks with a wealth of diagrams.

In October, Prof. S. H. Reynolds gave an instructive paper on some recent work he has been doing in collaboration with Dr Sibly in the Forest of Dean, especially in the small area of the Wigpool syncline. Zonal terms and the old nomenclature for the beds were tabulated and contrasted. The large amount of dolomitisation and haematisation was noticed.

At the last meeting of the year Mr L. R. Wager, B.A., B.Sc., of Reading University gave a lecture on " Geological Work in East Greenland during the British Arctic Air-route Expedition, 1930-1." He showed that gneisses and schists, probably of Archaean age, Tertiary basalts and minor intrusions together with thermally metamorphosed sediments containing poorly preserved fossils comprise the systems represented. The scenic effect of the ice and snow was well shown by lantern slides, many of which had been made from air photographs.

In April a field meeting was held at Westbury, Wilts., under the leadership of Mr P. M. Mathews. The old iron workings were first inspected and after tea members visited the new G.W.R. cuttings in the Corallian and Kimmeridgian beds.

Prof. S. H. Reynolds and Dr Stanley Smith again led the members to Cattybrook in July where the highly contorted nature of these Upper Avonian and Coal Measure rocks was observed.

A charabanc field meeting in August to Vallis under the leadership of Mr and Mrs H. F. Barke proved successful. The vale was entered at the western end and the whole was traversed to Hapsford Bridge, a short detour being made to examine the quarries in Egford Brook.

F. S. WALLIS, *Hon. Secretary.*

Account of the Annual and General Meetings.

THE 69TH ANNUAL MEETING.

January 21st, 1932.

Mr J. W. Tutcher, M.Sc., was elected President for the second year. He delivered his first Presidential Address, entitled "The Divining Rod" (see p. 248). Mr T. V. T. Baxter, M.A., B.Sc., was elected a Vice-President, with minor alterations in Council.

THE 558TH GENERAL MEETING.

February 11th, 1932.

THE 5TH ANNUAL DINNER.

The President, Mr J. W. Tutcher, M.Sc., presided over a record attendance of nearly 80 members and friends, and an enjoyable evening was spent. Dr W. W. Watts, F.R.S., late Professor of Geology in the Imperial College of Science, was the guest of the evening, and in proposing "The Society," congratulated the members on reaching its 70th year of existence, for it was not too easy now-a-days to sustain interest in any one subject, and to obtain the necessary support. The Society, by its scheme of observation rather than that of experiment had, however, contributed in a very important degree to the progress of science throughout the country.

The speaker paid tribute to a long list of distinguished names associated with the Society, and the wonderful work they had done; he especially referred to Arthur Vaughan as the most brilliant geologist of his time.

An excellent programme of music and recitations was contributed by Mrs James Rafter, Miss McMurtrie, Miss Hughes, and Mr Ivor W. Evans.

In the interval Miss Roper, the Hon. Secretary, was presented with a handsome fur coat and set of enamel toilet brushes in recognition of her many years' work for the Society. During her thirty years' membership she had held almost every office, including that of President.

THE 559TH GENERAL MEETING.

March 3rd, 1932.

"Glaciers," by Mordaunt Miller.

Above the snow-line snow accumulates to a great depth, especially on plateaux and in the valleys. The pressure of the over-lying layers consolidates the under parts into a firm mass, which is known as névé. As this névé accumulates it begins to move downwards, and forms what are generally known as glaciers. This ice is able to flow, and in many ways its behaviour is analogous to that of a river.

In the higher parts of the Alps glaciers are very abundant, and so 1200 permanent and independent masses of ice have been enumerated.

Sometimes the glacier falls over a steep slope, forming an ice-fall. This causes tension and results in the formation of transverse cracks of varying width called crevasses, which are often of great depth. Also, since the ice behaves more or less like a viscous fluid, the centre flows more quickly than the sides, and this results in the formation of crevasses, starting from near the sides and pointing upstream. Sometimes also longitudinal crevasses are formed and the diagonal crevasses may be regarded as the result of combined transverse and longitudinal strains.

Glaciers of the Alpine type, surrounded by areas of bare rock, which are constantly undergoing denudation, collect a great amount of stone, and this is known as moraine.

The lecture was illustrated by a magnificent series of lantern slides made from negatives taken by Mr Miller.

THE 560TH GENERAL MEETING.

April 7th, 1932.

I.—"Bird Protection," by W. R. Taylor, M.A.

The position with regard to Bird Protection is one of concern to anyone who reflects upon it. A number of beautiful birds, e.g., the Kite, once so numerous as to give its name to a child's toy, the Gos Hawk, the noblest of our Hawks, the Great Bustard, the Osprey, the White-tailed Eagle, the Honey Buzzard, the Hen Harrier, the Avocet, the Bittern, the Golden Oriole, the Dartford Warbler—forming part of our national heritage, are in danger of extinction as breeding species, if they have not already been extinguished; and this, not because of any general cause of economic change or spread of civilisation as a rule, but because of the ignorance or selfishness of individuals.

The dangers that threaten our rare birds are fourfold:—

(a) Reclamation or cultivation of land, or increase of human population

(b) Ignorant and wanton persecution by "hedge-moochers"—boys and gunmen of the countryside.

(c) Pheasant-petting landlords.

(d) Acquisitive collectors.

These dangers can be lessened by the action of Natural History Societies, and the lecturer appealed to the members to keep an eye on the local situation, and make representations with regard to local species to City and County Councils and landlords; to make recommendations for the amendment of the existing laws; to take up a stern attitude towards the acquisitive collector; and to educate and go on educating until the collecting mania is killed.

II.—"Moth Collecting on the Sea Coasts," by Dr E. Barton White, F.E.S.

The methods of collecting were described, whether by shaking the overhanging marram grass and so disturbing moths in hiding, or going out at night and catching them hovering over clumps of *Silene maritima*, or by enticing them up, from their inaccessible haunts half-way down the cliffs, by means of a mixture of rum and treacle flavoured with jargonel pear, which is smeared on squares of cork fixed to posts.

While collecting over a wide area of coastland of Devon and Cornwall it was found that *Agrotis ripae* showed some interesting variations. On the North Devon coast is a dark form, on the Cornish coast it is lighter and has a greenish white shade when fresh, while in South Devon it is reddish, and on Chesil Beach a pale whitish buff and much larger.

It is noticed that some species never come to sugar, others never to light, and some to neither. And, as a list of these drawn up fifty years ago remained true in practice to-day, research into this interesting problem is required.

Field Mice, the Little Owl, the Long-eared Bat, and the Great Green Grasshopper (*Phasgonura viridissima*) were all on the alert to capture the trapped moths.

And, beneath a post by a coastguard station, sat a large Toad waiting for moths overcome by rum to tumble down within his reach.

All lovers of Nature can in their leisure hours at home study their collection, gathered on an enjoyable holiday, and help to unravel the many interesting and complex problems that arise.

SUMMER EXCURSION.

June 18th, 1932.

Beacon Hill, E. Mendips, was chosen for the Summer Excursion, under the leadership of Dr F. S. Wallis and Miss M. D. Hiley, the President and Secretary of the Field Section. Leaving Bristol viâ Keynsham and Newton St Loe, the hilly road was taken over Rush Hill to the Fosseway and thence to Radstock and Stoke Lane. A detour of half a mile over the fields at Stoke Lane brought the naturalists to Stocker Hole, where normal drainage is superseded by underground streams, and many were interested to see the actual point at which the water disappears.

Another short run brought the party to the famous Moon's Hill quarry, where the oldest rock—volcanic—of the Mendips can be studied *in situ.* The large Waterlip quarries were also visited, and many fossils collected from the carboniferous limestone.

After tea in the open, the members congregated on Beacon Hill, and from that splendid vantage point Mr H. W. Maxwell pointed out the Fosseway for many miles. Dr F. S. Wallis also outlined the geological history of the Mendips. He pointed out that, as far as present records show, the scene opens in Silurian times with submarine volcanoes pouring forth lavas and ashes into a sub-tropical sea. This is followed by a quiet period of sedimentation lasting throughout Old Red Sandstone and Carboniferous times, at the close of which the widely spread Armorican earth movements ridged up the deposits, a portion forming the east and west range now known as Mendip. The area suffered enormous denudation, some of the arches being worn down to the level of the Silurian rocks, whilst others only reached the Old Red Sandstone sediments. Part of this product of weathering now remains as an odd beach deposit under the name of Dolomitic Conglomerate. The area was again depressed beneath the sea and part of the Meozoic sequence deposited on the upturned edges of the older rocks. Again the area was elevated and recent weathering is now revealing the Triassic landscape.

Afterwards the botanists enjoyed the magnificent display of Rhododendrons at Beacon Pond and noted amongst other plants *Geum rivale*, the white form of *Ajuga reptans*, *Listera ovata*, *Juncus squarrosus*, and *Lastraea spinulosa*. *Stenocybe byssacea* Nyl., a rare lichen found by Mr D. A. Jones growing on alder branches, was a new record for North Somerset.

THE 561st GENERAL MEETING.

October 6th, 1932.

Exhibits of Natural History by the Members.

In order to mark the 70th anniversary, the exhibits were designed to give a general idea of the life and progress of the Society.

Those laid out by the members of the Botanical Section included a collection of over 200 freshly gathered flowers and fruits of the district; living fungi from Brockley Combe and photographs of the rarer species by Dr W. R. Ivimey Cook; water colour drawings of local plants by Miss Strudwick; alpine plants by Miss Macpherson; large collection of Mycetozoa by Miss Agnes Fry; record of work carried out on Berrow marshes by H. S. Thompson; and the genera *Symphytum* and *Euphrasia* from the herbarium of the late Cedric Bucknall.

The Entomological Section displayed a chart giving a brief historical synopsis, and a list of members indicating their special interests. The fact was brought out by the chart that during the seventy years of its existence the Section has been served by only three Presidents and three Secretaries. Short sketches of the researches of past and present members were accompanied by copies of their contributions to scientific literature. Included therein were G. C. Griffith's study of " The Frenulum of the Lepidoptera "; A. E. Hudd's " Catalogue " of local Lepidoptera; H. Womersley's review of " Australian Protura "; J. V. Pearman's revision of " The genus Psocus "; and H. Audcent's " Catalogue of local Diptera." Examples of little known insects were shown by A. H. Peach (scarce Lepidoptera) and H. Audcent (Diptera, families Trypetidae and Pupipara).

The main exhibit in the Geological Section, organised by Prof. S. H. Reynolds and Dr F. S. Wallis, illustrated the early history of the Section, which has functioned continuously since 1864. Portraits of many of the older members were shown, accompanied by a short account of their services to geological science and examples of their chief contributions to the Society's *Proceedings*, these being illustrated in some cases by the specimens with which their names are particularly associated. In addition, G. A. Kellaway arranged a series of ammonites and other fossils from the Jurassic rocks. These included a fine specimen of *Stephevurus humphriesianum*, an important species rarely obtainable; H. F. Barke, another series of Jurassic fossils ranging from the Cornbrash to the Portlandian; B. A. Baker, an excellent example of a Silurian Trilobite, *Calymene*, and photographs of geological interest; Mordaunt Miller, lantern slides of Swiss glaciers; and Dr F. S. Wallis provided a selection of tools and other requisites for effective work in the field.

The Ornithological Section, first formed in 1896 with the object of preparing a list of Bristol birds, was disbanded in 1901 on the completion of the work. It was, however, revived in 1922, and the present members were able to exhibit a splendid series of photographs to illustrate the activities of the Section. W. C. Taunton had taken bird life on Lundy Island; L. A. Hawkins in Somerset, which included fine examples of the Great Crested Grebe; J. H. Savory in Somerset and Holland; and F. R. Willcox and C. Tuckett had excellent studies of Badgers taken in the Bristol district. They also gave a demonstration during the evening of the flashlight apparatus used in photographing these creatures. H. Tetley showed, from the Bristol Museum, preparations by the late Dr C. K. Rudge of the tracheae and syrinyes of certain British diving ducks.

Miss Roper, the Librarian, had arranged portraits and published works of most of the past Presidents of the Society; also of Adolph Leipner, the founder and first Secretary.

THE 562ND GENERAL MEETING.
November 3rd, 1932.

"The Making of a Flower," by Macgregor Skene, D.Sc., F.L.S.

To define a flower is a matter of some difficulty, but we may take the term for our purpose in its popular sense. It is a reproductive structure, bearing stamens and carpels, with a bright-coloured corolla, often scented and producing nectar. Its function is seed-production. Seed-bearing plants are known from early geological deposits; they were abundant in carboniferous times; but indications of the appearance of flowers are much more recent. Two groups of plants have been thought to throw light on the origin of the flower. The first is that of which Cycadeoidea is the most important representative. Its affinities are with the Cycads, but it bore a hermaphrodite cone, superficially resembling a large flower, like that of the Magnolia. The complex stamens, and the fact that the seeds are not enclosed in true carpels, tell against the theory that it is the fore-runner of modern flowers. The Caytoniales is a small group found in Jurassic rocks, in which the ovules are enclosed in carpel-like structures. But its reproductive structures are unisexual and have no floral envelopes. In later geological formations many modern families of flowering plants appear without any indication of their point of origin. We are left without any definite knowledge of how the gap between the naked-seeded unisexual cone of the gymnosperms and the hermaphrodite flower of the angiosperms, with its enclosed seeds, was bridged in evolution.

The main influence, which has been responsible for the characters of the flowers we know, has undoubtedly been that of the insect world. Pollination of brightly coloured flowers is generally carried out by insects. In the nectar they find their inducement to visit flowers, and bright colour and scent are the signs which guide them to their food supply. The form, too, of the flower is often closely related to visits by insects. The fundamental facts of insect pollination were first established by C. K. Sprengel in his book " The Secret of Nature Discovered in the Build and Fertilisation of Flowers " in 1793. But it is only in comparatively recent years that the brilliant work of von Frisch has shown in detail how the colour sense and sense of scent of bees is closely related to the colours and scents actually found in flowers. Finally it is of interest to know that, in the tropical flowers which are pollinated by small birds, the colours produced are different from those of insect-visited flowers, and are related to the different colour sense of birds.

THE 563RD GENERAL MEETING.

December 1st, 1932.

" British Birds in Legend, Lore, and Superstition," by J. H. Savory.

Connected with birds there is much of legend, lore, and weird superstition from the past. Before the coming of fire-arms birds were less timid than they are to-day and many now rare or shy were common, so that bird observation was easy. To our agricultural ancestors weather forecasting was most important, and, having no barometers, they used their observation of birds to this end and proverbs arose, such as, " If fowl roll on the sand rain is at hand," " If the thrush sings at sunset a fine day will follow." Some of these sayings are extremely accurate; others, as that, " Swans are hatched only during thunderstorms," are false and fantastic. Connected with the cuckoo were many harvest prognostications.

Birds were commonly named from characteristics of colour, form, cry, or habit, as Black-cap, Crossbill, Peewit, and Dipper. Names varied with the locality, so that the Woodpecker is known by 46 titles. The same bird legend appearing in countries widely apart points to the migration of peoples and to the antiquity of the legend. This also applies to the familiar nursery rhymes, fables, and fairy-tales which are frequently legends in disguise. Bird legends may be classified into various groups, as follows:—Birds associated with the gods of ancient mythology; birds occurring in sacred legends of the Christian faith, including the Cross legends; the transformation of human beings into birds and *vice-versâ*; birds endowed with powers to discover stones or herbs possessing magic qualities; birds as fire-bringers; lightning birds; quaint old beliefs regarding migration; extraordinary explanations of cries, plumage, and form peculiar to certain birds; superstitions regarding the Devil and evil spirits: their influence on, and frequent embodiment in certain birds; divination by flight and behaviour of birds; omens, good and bad.

Birds have been a source of sport throughout the ages. Our land has practised wild-fowling, hawking and falconry, and cock-fighting. To-day pigeon-racing is the poor man's sport.

Even on stamps and coins birds have been delineated, and they are much in evidence in heraldry.

"When a land forgets its legends,
Sees but falsehood in the past,
When a nation views its Sires
In the light of fools and liars
'Tis a sign of its decline
And its glories cannot last."

Mr H. Tetley exhibited the Musk Rat and gave particulars of its life history and its rapid spread over the greater part of Great Britain; and Mr H. S. Thompson the rare albino-fruited *Evonymus europaeus*, f. *leucocarpus* DC.

PRESIDENTIAL ADDRESS, 1932.

Historical Sketch of the Society.

1862-1932.

By J. W. Tutcher, M.Sc.

On May 8th next (1933) the Bristol Naturalists' Society will have completed seventy years of activity in fostering the study of Natural History in this City. It may therefore be appropriate to review some of the more eventful episodes in its career, not only for its general interest to present members, but also as a means for estimating the extent to which the methods employed have been successful. This is not a new idea; in 1922 the late Dr A. B. Prowse, who was for many years Librarian to the Society, published in the *Proceedings* a sketch of its earlier history. The present communication will necessarily traverse some of the same ground but with additional detail and the inclusion of subsequent events.

Early in 1862, Mr Adolph Leipner, impressed with the need for organising the activities of local students of nature, associated himself with six other citizens with a view to bringing about the formation of a society for that purpose. These six gentlemen, with Mr Leipner as their Honorary Secretary, constituted themselves a Provisional Committee and proceeded to sound the scientific mind of Bristol upon the question of the proposed society. The response was most encouraging, 168 persons signifying their willingness to join.

The inaugural meeting was held on the 8th of May 1862 in the lecture theatre of the Philosophical Institution, Park Street, a building now known as the Freemasons' Hall. At this meeting Mr Leipner read a paper in which he set forth the objects to be aimed at by this organisation; as a consequence of the resulting discussion a code of laws was adopted, and the first officers of the Society appointed. Mr William Sanders was elected President; the Rev. Canon Guthrie and Dr Alfred Day, Vice-Presidents; Mr A. Leipner, Honorary Secretary; and Mr W. W. Stoddart, Honorary Treasurer. The Committee of the Philosophical Institution (known later as the Bristol Institution) very generously placed their premises at the disposal of the newly-formed Society for the purpose of their meetings, and these facilities were continued when, in 1871, the Bristol Institution, merged with the Library Society under the title of Museum and Library Association, occupied the newly-erected building in Queen's Road.

For the 22 years during which accommodation had been provided by the Bristol Institution no financial *quid pro quo* was requested, but the Naturalists voluntarily contributed ten pounds each year to the funds of the Institution, excepting a few occasions when only half that sum could be afforded. The Naturalists also presented to the Museum of the Institution many specimens which had been obtained by gift and purchase, including a cast of that remarkable fossil bird *Archeopteryx*, which cost the Society £10; this specimen may still be seen in the Museum. The difficulty of arranging lectures which involved the use of physical and chemical experiments appears to have been the determining factor in bringing to a conclusion this long association with the Bristol Institution as a meeting place for the Naturalists. However, the Governors of the adjoining University College, where such facilities were available, generously offered to accommodate the Society, and this privilege has been continued by the University to the present time. In recognition of this accommodation the Naturalists continued to subscribe £10 annually to the funds of University College until the year 1909.

THE LIBRARY.

In 1864 Mr Leipner suggested the desirability of forming a Library of books relating to Natural History. This suggestion was adopted, and although the collection grew very slowly at first, only 14 books having been acquired by 1866, a catalogue was printed in 1888 in which about 1000 items were indexed, many of these being small papers and authors' separates, but by 1922 the collection consisted of about 3000 volumes. Nearly double that number of books, covering every branch of Natural Science, is in the Library at the present time, and many of these works could not be easily obtained from any other local source. It may be mentioned here that when the Microscopical Society was dissolved in 1905 the books they had acquired, 250 volumes, were bequeathed to the Naturalists' Society; these included an almost complete set of the magnificent works on Natural History published by the Ray Society, many of which are very rare. After the Society became established at University College the Library was transferred to a room rented for the purpose in Berkeley Square. The accommodation this apartment afforded was inconvenient and became inadequate, and when in 1922 the Committee and Director of the Museum generously consented to place a room at the disposal of the Society for use as a Library, the offer was gratefully accepted.

"PROCEEDINGS."

The method of publication of the Society's "Proceedings" have undergone a process of evolution. For the first four years the only detailed records of the Society's activities consisted of newspaper excerpts distributed to the members by the Reporting Secretary, Mr W. Lant Carpenter, son of the celebrated Dr W. B. Carpenter, who also was a member. Unfortunately, a complete set of these newspaper extracts has not been preserved, thus, to the extent of the missing parts, the Society does not possess a complete set of its own "Proceedings." The late Dr A. B. Prowse ascertained that it was possible to recover all these early extracts from the files of the local Press. He expressed the hope that, when the Society's finances permitted, these would be assembled and reprinted in pamphlet form. From January 1866 printed " Proceedings " have been issued to the members. At first these appeared monthly, then quarterly, and finally, as now, in yearly parts. The cost of printing its " Proceedings " has always been a considerable item in the Society's expenses, and at one time the Secretary proposed publication should be discontinued until the financial position improved. This course was, happily avoided by forming a guarantee fund to overcome what appears to have been only a temporary difficulty.

The terms of subscription have been twice raised. At first the members paid 5/- per annum. In 1866 this sum was increased to 7/6, and in 1874 the annual subscription was fixed at 10/-, with an entrance fee of 5/-, the same as at present excepting the entrance fee, which for the time being is in abeyance. Each increase in the subscription coincides with an enlargement of the published " Proceedings."

MEMBERSHIP.

The care taken by the founders to form the Society on a sound working basis is indicated by the rules adopted at the first meeting in 1862. These remain substantially the same at the present time, although some slight amendment and a few additions, chiefly due to extended operations, have been necessary.

At first only male members were contemplated, but within a few months ladies were permitted to attend the meetings " when the subject under consideration was likely to be of interest to them." It was not until 1868 that ladies were admitted to membership, and then only as Associates, but in 1872, ten years after the formation of the Society, full membership was graciously conceded. This reluctance to recognise equality of the sexes was perhaps characteristic of the mid-Victorian age, and the ladies themselves appear to have been timid of association with Science, since the first paper contributed to the Proceedings by a lady member appears without the author's name. Since then the ladies have amply justified the innovation, not only by their contributions to the discussions and " Proceedings," but also by qualifying for every important office, including that of President in the person of our present Secretary.

It is not surprising to find that during the course of 70 years the membership figures have fluctuated to a considerable extent. Starting with a list of 168 names in 1862, the numbers rose to 240 in 1865; ten years later, in 1875, the membership had decreased to 158; during the next ten years the figures advanced to 250, rising rather suddenly towards the end of that term. The improvement in membership during that decade may have been partly due to the formation of an Engineering Section; this Section had a very short life, and we find the membership of the Society falling gradually to 138 in 1900. A further decrease to 112 took place during the war years, and with slight variations the membership has remained at about that figure to the present time; but if Section members, now listed with ordinary members, are included the membership roll contains 250 names.

An unusual incident occurred in the Society's second year. The original method of electing members was by ballot, one black ball in ten to exclude. In 1863 a clergyman was nominated for membership by Mr W. H. Wills, who, later, became Lord Winterstoke. This nomination was seconded by Dr S. H. Swayne, yet the candidate was not elected. It will be noted that under this scheme a very small minority, probably two or three adverse votes, would be sufficient to prevent election. At the next Council meeting it was reported that a dozen members, including some clergymen, had resigned, although they had been elected only a few months previously. One is impelled to connect these two events, and it is significant that the number of adverse votes necessary to exclude was doubled. Soon after these events the duty of electing members was transferred to the Council, and no ballot was necessary unless demanded. There is no other instance recorded of an unsuccessful nomination.

EXCURSIONS.

The earliest rules of the Society provided not only for lectures and the reading of papers on Natural History subjects, but also for the arrangement of excursions in the field during the summer months. As an example of these the excursion taken on June 17th, 1864, may be related.

More than seventy persons, including several ladies, attended. The party traversed the right bank of the Avon to Shirehampton and Avonmouth. Mr Sanders and Mr Stoddart explained the geology of the Avon Gorge, and the marshes provided the botanists and the microscopists with opportunity for adding to their collections. Cold dinner was provided at the hotel, where a little difficulty occurred as some members had failed to give notice of their intention to be present. Such incidents are not unknown in recent times. After dinner, Professor James Buckman, of the Royal College of Agriculture, Cirencester, and Secretary of the Cotswold Field Club, addressed the members. He stressed the desirability of making an intensive study of grasses, because the kind of grass which grew on any piece of land was a better guide to the agricultural condition of that land than any chemical analysis of the soil.

This excursion concluded with an unexpected incident. It had been arranged that the steamer Fairy Queen should call at the Shirehampton slip on her way from Portishead to convey the party home to Bristol. The Fairy Queen duly appeared but proceeded up the river without keeping her engagement. She was promptly renamed the Vixen by the waiting members, who had no resource but to walk back to Bristol as they had walked out, the only horsed vehicle obtainable being used to convey the most fatigued of the ladies.

Many of the early excursions occupied the whole day, and quite distant places were visited, including May Hill, Malvern, Avebury, Stonehenge, and Watchet, but the majority of the excursions were of a more local character.

SECTIONS.

Two years after the foundation of the Society a resolution was adopted by Council which permitted the formation of an Entomological Section, with power to elect its own officers, make its own rules, and manage its internal affairs, subject only to the names of the officers and the rules being submitted to the Council for approval, and with the proviso that only members of the Naturalists' Society may belong to the Section. A few months later Botanical, Geological, and Zoological Sections were formed, subject to the same conditions. In later years Biological, Ornithological, Chemical and Photographical, Microscopical, and Engineering Sections have been established. Some of these disappeared, and others became merged with kindred sections.

The Ornithological Section was first formed in 1896, was later merged with the Biological Section, but was revived as a separate section in 1922. The Botanical Section has had a varied career; it was merged with the Biological Section in 1890, and when in 1897 that section ceased to function the botanists reformed as a separate section, but during the war years there are no records of activity as a section. This does not mean the botanists were idle during that period; papers and records by individual members continuously appear in the "Proceedings," and in 1925 the botanists again operated as a section, which, under Miss Roper's guidance, has become exceedingly popular and useful. It may be observed that the Entomological and Geological Sections have continuously functioned since they were first formed 68 years ago. In 1923 the regulation that only members of the parent Society may join sections was relaxed; this led to a considerable increase of sectional members and facilitated the affiliation of another society, "The Field Club," as a field section of the Naturalists' Society in 1927. About 30 members of The Field Club were already members of the Naturalists' Society, but the affiliation brought within the orbit of the Society's influence about 70 other persons interested in various branches of Natural History research founded upon observations in the field.

It is to be hoped that many of the field and other section members will decide to become full members of the parent Society, if only in order to have the advantages of the Society's publications and the use of its splendid Library. This latter alone should be worth the subscription for full membership.

REGIONAL SURVEY.

Early in 1864 Mr Leipner proposed the Society should make itself responsible for the systematic registration of objects of Natural History in the Bristol district. It was first suggested that the area covered by Landers' map, with a radius of nine miles from the Guildhall, should be taken, but this limited area was increased to include the whole of the Bristol Coal Field, which had recently been mapped by Mr W. Sanders on a scale of four inches to the mile.* The area thus included

*Landers map was published in 1850, and W. Sanders map in 1862.

extends from Berkeley in the north to Shepton Mallet in the south, Bath in the east to the Severn and Channel in the west.

This scheme is referred to in succeeding reports for several years, but the Treasurer of the Society, Mr Walter Stoddart, promptly proceeded to give practical effect to the idea by producing at his own expense a publication entitled "Palaeontologia Bristoliensis," in which he proposed to describe and illustrate the principal fossils of the district. The illustrations were actual photographs of the specimens, made by Mr Stoddart and inserted opposite the appropriate description; the negatives from which the prints were made are still in existence. Only three complete sets of this little work can now be traced, two of these are in Bristol and the other in "The Museum of Practical Geology," London; unfortunately, there is no copy in our own Library. Mr Stoddart's publication is of some historical interest, it being the first published attempt in this country, and with one exception the first attempt anywhere, to illustrate palaeontology by photographs, a method now generally employed for the purpose. When the Society in 1866 commenced to publish "Proceedings" Mr Stoddart's separate publication ceased, his contributions being diverted to the new channel in somewhat changed form. Other members of the Society, either in their individual capacity or in conjunction with their respective sections, have published in the Society's "Proceedings" lists and other information relating to the fauna, the flora, and the geology of the district in accordance with the scheme proposed by Mr Leipner. Some of these contributions are of monographic proportions, for example, the "Flora of the Bristol Coal Field," by the late Mr J. W. White, who commenced his series of contributions on this subject in 1880, and in later years published the records in book form. Other subjects which have been more or less exhaustively dealt with are the Desmids, Mosses, and Fungi. A list of the local Rotifera was compiled by Dr Hudson, who later collaborated with P. H. Gosse in a magnificent monograph of that group of organisms. The Mollusca and the Birds have also been catalogued, whilst the entomologists have contributed, and are still contributing, papers on many orders of Insects. Geology has always been strongly represented in the Society's activities, and a mere list of the contributions on this subject would occupy several pages of the "Proceedings."

During the seventy years of the Society's history many hundreds of papers covering every branch of Natural Science have been contributed to the "Proceedings." In the earlier years short papers were popular, and sometimes two, three, or four were included in one meeting.

Many scientists of distinction have been associated with the Society, and happily some of these are still with us; to record their names here is impossible, and the invidious task of making a selection will not be attempted. There is, however, one name which will ever be prominent in the annals of the Bristol Naturalists. Frederick Adolph Leipner was not only instrumental in founding the Society, he also initiated in the earlier years the chief movements which made it useful and successful. The Library, of which we are justly proud, and the scheme of regional survey which is still in operation, were his children, so that he is justly regarded as the Father of the Society. During the first thirty-four years of the Society's history, Mr Liepner, until he died in 1894, was assiduous in promoting its welfare, and for the greater part of that period served it as Secretary. His versatility is indicated by the variety of his many contributions to the "Proceedings"; they include papers on Zoology, Botany, and Palaeontology. Those of us who came into personal contact with Mr Liepner will ever remember his enthusiasm, his geniality, and his sympathetic method of teaching.

In concluding this review we may pause to enquire whether the Society has justified the confident expectations which inspired its authors to found it. In the main a favourable answer may be given to this question, but no Society can live on the inheritance of the past, and although numerical strength is not the only qualification for usefulness, it is desirable that in a city of this size more members should be attracted to its ranks. With this object efforts have been made by the Council to increase the membership, but the innovation, ten years ago, of an open lecture at the commencement of each session has not proved so effective in that direction as was anticipated. Much depends on the goodwill and influence of individual members to make the Society and its advantages known to others. Any method which occurs to a member calculated to increase the strength of the Society should be communicated to the Council, where any practicable scheme would be considered.

It would be presumptuous to remind this audience of the utilitarian and aesthetic advantage to be derived from Natural History studies, to do so would be preaching to the converted, but as a text for propaganda an observation by Professor Huxley may be quoted:—"To a person uninstructed in Natural History his country or seaside stroll is a walk through a gallery filled with wonderful works of art, nine-tenths of which have their faces turned to the wall. Teach him something of Natural History, and you place in his hands a catalogue of those which are worth turning round."

James Walter White.

1846-1932.

ONE of the most honoured of our members passed away on 26th October 1932, at the age of 86, after a lingering illness. By the death of Mr J. W. White, F.L.S., Hon. M.Sc. (Bristol), the West of England loses its leading phanerogamic botanist, and England one of the best of the declining school of field-botanists; for White was rarely happier than when collecting and examining plants in the field.

Over twenty years ago he was appointed Special Lecturer in Systematic Botany at the University of Bristol, and in 1927 was awarded the Hon. M.Sc. degree. His very fine and extensive herbaria of British and Continental flowering plants and ferns, together with a number of his books, are bequeathed to the University. This addition makes Bristol rank in the matter of herbaria at British Universities probably next in importance to Oxford, Cambridge and Manchester.

Born in London, 8th August 1846, White went to Dorchester in 1851, and was at school under William Barnes, the Dorset poet. Leaving school at about fourteen, he was apprenticed for five years to Mr T. B. Groves, pharmaceutical chemist at Weymouth, where he came under the influence of the late W. B. Barrett, the botanist; and he won the medal offered by the Pharmaceutical Society for the best herbarium. Thence he went as an assistant at Allen and Hanbury's, where Daniel Hanbury encouraged him and sometimes invited him to his house at Clapham Common. A few years later White started in business himself at Hampton-on-Thames; and on his twenty-fifth birthday was married to Miss Mary Naldrett, who, with their seven sons and four daughters, survives him. Mr and Mrs White celebrated their diamond wedding in 1931.

In 1874 he was invited by a fellow-student at Hanbury's to unite with him in taking over the important chemist's business at Clifton of Giles and Sons, afterwards well known as Giles, Schacht and Co.

He joined the Bristol Naturalists' Society in 1878, and was President, 1907-09. Notwithstanding an exacting business, he early contrived to do much botanical work, particularly in N. Somerset and W. Gloucester. His " Flora of the Bristol Coal-field " appeared in six yearly parts of the " B.N.S. Proceedings " from 1881, and was published in book form in 1886. The area dealt with was that of Wm. Sanders' geological " Map of the Bristol Coal-fields and Country Adjacent." This large district extended from Berkeley in the north to Huntspill and Shepton Mallet in the south, and comprised some 720 square miles, very few of which probably White had not visited.

In these " Proceedings " for 1900 a résumé of the previous twenty years' work appeared under the title " Bristol Field Botany in 1901." And he wrote for the Jubilee Report, 1913, " Fifty Years of Botany in Bristol." Reference is there made to the Botanical Club founded in 1903 by the late George Brebner. For a number of years this little club held its informal meetings at the house of Mr White in Woodland

Road, and the energetic Hon. Secretary (Miss Roper) rarely missed a meeting.

Much other preparation and numerous further notes and papers in the " Journal of Botany " and in these " Proceedings " culminated in 1912 in his *magnum opus*, " The Flora of Bristol," which in the opinion of not a few is one of the best works of its kind. It excels particularly in its admirable introductory matter, the numerous interesting notes under many of the species, and the accuracy in which the habitats (as distinct from localities) are given.

Since then copious supplemental notes and records have been published. His last paper on " The Botany of Bristol " was written for the Bristol Meeting of the British Association, 1930, but owing to there being no " Handbook " issued, it unfortunately was not published until the next year in " B.N.S. Proceedings." This was based on the chapter he wrote in the " Handbook " for 1898.

Many British and Continental botanists have had cause to appreciate White's beautifully prepared specimens; and readers of the " Pharmaceutical Journal " have often enjoyed his racy articles, especially those descriptive of botanical tours in Spain, the Balearic Isles, etc. These tours were made usually in the company of his old friend, Cedric Bucknall, and once or twice with David Fry or C. E. Salmon.

He was a valued and active member for many years of the two British Botanical Exchange Clubs, and also of the Continental Club formerly managed by Dörfler at Vienna. On the morning that he died a parcel of dried plants was actually found in his study addressed to the Distributor at Cambridge of the Watson Botanical Exchange Club.

Being wisely cautious, and having a sound idea of what constituted a good species, White gave names to but two or three new plants. ***Rubus** Bucknalli*, found on wooded slopes above Wotton-under-Edge, was described by him in " Journ. Bot.," 1899, though discovered by his friend, C. Bucknall. Another Bramble (from Sussex) which he called *R. Naldretti*, is now placed as a variety of *R. mutabilis*. A new and well-marked variety of *Juncus maritimus* from the Scilly Isles he named var. *atlanticus*. In 1906 he recorded *Prunella laciniata* as British.

One of his earliest papers in these " Proceedings " and in " Journ. Bot.," 1884, was on the " Life History of the Purple Gromwell," in which he pointed out important facts apparently overlooked about the development and propagation of this beautiful and rare plant which is locally abundant near Axbridge and Congresbury, etc., its headquarters in Great Britain being on and about the Mendip Hills.

Mr White's kindness of heart made him ever ready to help other botanists, young and old, and he was always encouraging. He was a prompt and admirable correspondent, and his caligraphy was clear and beautiful almost to the end. He was also a good draftsman. After the death of E. S. Marshall he was President of the Botanical Section of the Somersetshire A. & N.H. Society for three years, 1922-24.

Our much lamented friend was buried at Canford Cemetery, after a short service at Clifton Parish Church, where he had worshipped so many years. I.M.R. and H.S.T.

Geology and Everyday Life.

By Theodora Shaw.

GEOLOGY can make distinct appeal, not alone to the scientist who devotes his life to the study, and to the enthusiast who makes it the hobby of his leisure hours; but also as a part of the general education of those who may not care to specialise in it, yet to whom it offers a satisfactory understanding of their daily surroundings, widening and quickening their outlook on commonplace things, and giving opportunity of release from routine duties and petty cares into wide regions of impersonal thought and speculation.

Apart from the utilitarian value of the Science to the miner, farmer, builder, and others, in their callings, and to anyone in such matters as the choice of a house or garden, of a healthy school for children, or of a suitable holiday resort, the interest of Geology as the history of the Earth, which is our home and physical origin, and as explaining phenomena which perpetually surround us, is so intense that it should be the most popular of the natural sciences, and not, as hitherto, a rare study and one in which it is commonly difficult to obtain instruction.

This initial difficulty of obtaining instruction is probably the real hindrance to the more general pursuit of the study. In Geology, even more than in most studies, an instructor is needed at first to open the eyes of the student, especially in field-work. Having learnt *how* to see, solitary advance can be made by observation and the aid of books and museum exhibits.

In Societies like our own the beginner and the non-specialist may gain information and assistance without real hindrance to the work of the more truly scientific members from whom they receive light.

Because *some* acquaintance with several other sciences must be acquired in the pursuit of Geology, and because Geology is itself helpful to other studies and interests, both directly and by its splendid cultivation of observation and reasoning power, it may be considered a liberal education.

Through Geology we see the beauty and marvel of the Earth as it was and is, our wonder growing as understanding increases. Landscape and stone alike speak and become full of meaning. In the small the great may be mirrored for our observation. The pavement beneath our feet may become a magic carpet to carry us to distant scenes and far other ages.

We are, indeed, heirs of *all* the ages and our humblest needs are served by seas that have rolled, winds that have blown, the rise and submergence of lands, and a succession of plants and animals, throughout unknown millions of years. Geology reveals the wonder of our heritage.

Indoors or out-of-doors, in town or country, inland or by the sea, at home or abroad, a knowledge of Geology is companionship and recreation at our will, and the tedium of work or travel may be often relieved through it. Even in other intellectual pursuits it can at times aid in the solution of difficulties.

In a town material for geological attention is always at hand. The stones of buildings, monuments, and roadways silently await recognition. Ignorance sees simply "stones," noting little distinction save in polished granite and marble. To the understanding eye each variety claims its separate place and age in the structure of the earth's crust and has its own peculiar characteristics and values to offer for consideration. Quite possibly, as has twice happened in my own case, may be found fossils in wall or paving-flag at a moment when a friend is asking where fossils *are* found, as he never saw any save in museums.

Through Geology we may not only appreciate more fully the beauty of decorative stones used for the adornment of handsome buildings, but also understand better the skill of the craftsmen who prepared them, as we will the labour bestowed in ancient Egypt to cut the hard syenite and porphyry into statue or sarcophagus, and by early Kentish masons in squaring the flints they used for important buildings. In museums, the Geological and Mineralogical Collections cease to be sealed to our comprehension, and though we may only be able to vaguely spell out their meaning by the aid of very elementary knowledge they prove full of delight, and a source from which to draw further information.

Whilst waiting for a 'bus we may be so fortunate as to find the sandstone of some projecting wall deeply cut by wind-driven grit from the road, illustrating well one method by which desert rocks are eroded, the material cut becoming in its turn the cutting instrument. In a heap of beach-sand placed for road repair it may be possible in this district to find, with modern shells, numerous fossil specimens of an early Liassic Gryphea, showing the beautiful concentric markings of Beekite, and to plan a quest for the beach from which they were brought. Or we may discover in a wall what a child described as "a whole museum of fossils," and wonder, as he did, if the owner knows of his possession.

Trenches opened in a roadway or for the foundations of buildings are, to the most amateur geologist, peeps into the history of his locality, not merely disfigurement to be wished absent. Even the imprints of a dog's paws, made on the cement of a paving-slab while it was in a soft condition will remind us that in like manner Saurians left their tracks across muddy Triassic sands, which, hardening, have preserved them for our reading to-day.

On some bank of earth, after heavy rain, the work of water in land-sculpture may often be well traced; hill, valley and gorge, stream-bed, lake-basin and even boulder-capped pinnacles, being seen in miniature; all an aid to the fuller interpretation of scenery.

In the house even the drudgery of housework *must* be lessened when metal, stone and brick, the asbestos in the gas-fire filling, soda and emery-powder, glass and earthenware, bathbrick and mineral-oil, even the weathering of walls and steps, can each give rise to interesting trains of thought, bearing the mind into wider environment even while the hand toils over its limited task. The house-wife, or house-*maid*, will not take less interest in her work if the marble she polishes can speak to her through its fossil forms or metamorphic character. Nor will a fire be worse laid when the layer can visualise the story of the coal and find interest in pyrites or chance fossil found among it; while the understanding of stratification will enable the fire to be arranged for bright-burning or long-smouldering, according to desire, and will certainly assist in easy and economical breaking of the coal.

Bread can scarcely seem commonplace when we know that, besides the mysterious growth of the seed, the food for the wheat was prepared by natural forces working patiently to build, and disintegrate, and dissolve the solid rock before it could be absorbed by the plant. We learn *how* we are of the dust of the earth, and the Myth of Deucalion, casting stones behind him that they should arise as men, gains scientific significance.

Water flowing from a tap may carry thought to limestone-caverns, wave-washed cliffs, lake and river and waterfall, tiny spring or mighty glacier, each with a tale of work done; or it may suggest the thermal spring and the recent theory of the probability of such waters being newly-created from the gases of the earth's interior, leading us to dream of Mother Earth still actively labouring to prolong conditions suitable to life upon our planet.

The re-action of the geologist to commonplace phenomena of every-day life may differ much from that of the non-geologist. Last Autumn, while friends of mine in Birmingham were complaining of the weird noises of what they called "water-hammer" in their water-pipe, I was re-calling similar noises heard on a vaster scale in Wookey Hole, and eagerly awaiting the occasions when the more common clapping-sound gave place to strange growlings and rumblings, or to smothered explosions, wondering if that little pipe could possibly hold a clue to yet unexplained sounds of Wookey.

The interest that Geology can afford to the country-dweller is obvious, even though the study of Botany may, perhaps, claim equal attention from him. The solitude and the absence of artificial amusements in the country incline for reflection and the study of surroundings. Scenery asks for explanation and the old-time answer that assigned every marked feature to the cataclysmic action of volcano or earthquake will satisfy few to-day, although it appears to still survive in a surprising manner. Not long ago a lady, highly versed in languages and the Classics, and who had travelled much, was standing beside me on a rustic bridge across the gorge of a mountain stream. She asked if some fearful earthquake had opened the cleft for the water. Pointing to the rushing torrent below, I said, "*That* made it." But it was not until I had reminded her of the Avon Gorge and the caverns of the Mendips, and had pointed out, as we travelled further, various stages of cutting done by streams, that she believed in the part water had in earth-sculpture and began to trace it for herself. She had never realised the chemical and dynamic work of water, or that caverns resulted from it.

In the country and by the sea, hill, valley and plain; spring and stream; cliff and quarry-face; boulders and gravel; lake and cave; peat-bog and submerged forest; raised-beach and river-terrace; outcrop of rock; and fossils or minerals lying on the surface of ploughed land alike offer unsought problems for solution, and even the casual visitor may find the reading of Nature's book more fascinating than the customary holiday novel or sea-side amusement.

At home or abroad the traveller who has any knowledge of Geology reaps enjoyment from his science and meets constantly both the familiar and the unfamiliar. He may observe and learn even if he does not burden himself by collecting, although to bring home self-captured spoils from a holiday is to most an intense joy, and such treasures may well possess more interest for one's self and friends than can the usual souvenirs purchased by travellers.

During an overland journey interest can be found in an endeavour to identify the geological formations passed over by the aid of cuttings, outcrops of rock, and the material of local buildings, particularly of field and cottage walls. Even the colour and character of the soil and the species of plants growing by rail or road-side may suggest the nature of the underlying rock. With experience, too, the eye begins to connect certain types of scenery with special rock formations, and to trace work of water and ice upon the landscape, as well as to notice consciously outstanding features such as igneous dykes, ice-borne boulders, marked folding in a rock-face, or exposed unconformity of strata.

The traveller abroad may well feel less in a strange land when he finds that the rocks resemble those of his homeland and speak to him in familiar language. To the leisure and skill of the specialist must belong the recognition of differing fossils and mineralogical characteristics, but the most elementary student can appreciate much that the totally unversed cannot.

The young lady who imagined the central moraine of a glacier to be a carriage-road up it would have found more joy and profit in her visit to Switzerland had she possessed even a little geological knowledge, as would another who at Montreux wished to cross the Lake of Geneva because the people on the other side had made such lovely paths up the mountains. Her "lovely paths" were the dry beds of torrents, and to her the great delta at the head of the Lake told nothing.

On the Rhine I travelled with an elderly doctor who, although he had seen Staffa and the Giant's Causeway, scorned the beautiful basalt columns of a cliff not far from Lintz because he imagined them to be what he called "common sandstone." Nor could he understand my interest in dark cinders used as gravel on some of the riverside paths, and which proved to be of volcanic origin, having been brought from the crater-lake of the Laacher See, in the Eifel district nearby. This gentleman surely never observed the polygonal prisms formed by drying mud, or drying starch, or he would have recognised the similar form in the basalt. Nor would he have scorned sandstone had he known more about it, seen the marvel of flexible sandstone, or felt the thrill that I felt when, quite ignorant regarding Torridon sandstone and the former controversies about it, a few grains under a microscope revealed to me by chance the desert conditions of its origin and at once set it quite apart from the Old Red Sandstone.

Geology can further enrich everyday life by its help to other interests.

The lover of photography may find through it new subjects of scientific as well as of artistic value.

The walker and the climber may both combine it with their sport.

Botany and Geology are mutually helpful. Geology may suggest to the botanist where he may hope to find some plant he seeks, the flora of a district depending considerably on the nature of the geological formation and the drainage and character of the soil. Plants may equally suggest to the geologist the underlying rock; or a sudden change in the type or luxuriance of the vegetation point to a change of strata.

Those with Archaeological taste may often find knowledge of Geology valuable. A difference in the stone used in a building may assist in discovering alterations, additions, or re-construction, or stone brought from a distance may suggest a particular builder. The type of stone used for a monument may help to trace its history, as a study of ornamental marbles has helped experts in Rome to decide from which of the ancient Temples or Palaces many of the lovely columns seen in Roman Churches were taken. Most of us know how the geological tracing of the inner circle of stones at Stonehenge to their source in Pembrokeshire has added to the mystery of that ancient monument and suggested new ideas in its story. A worn slab of coarse pink breccia or conglomerate, an unusual form of memorial stone, in an aisle of Wells Cathedral, quite possibly has connection with some columns of Draycott Stone in the interior arcading of the West End of the building. It may be that the donor of the columns, perhaps a past owner of the quarry, lies beneath the slab. Geology and Archaeology work together on the earliest records of man and through Geology show that humanity has had a much longer existence than was once imagined.

The interest of the ordinary man in Geology may not only benefit himself but must tend to be of value to the Science. *His* interest arouses interest in those he is in contact with, so that anything unusual is brought to his notice, and matter of worth is less likely to escape observation. A lad breaking stones in the Walton-in-Gordano roadside quarry brought to me a new type of fossil from a block he split. It was a fish-spine—the first observed there—and showed that the Fish-bed of Bristol and Clevedon extended viâ Walton.

Tusks of a boar were in the same way brought by a child from a trench near the main-road through the village. This trench was sunk in the same type of sand that is piled about the Bone-Cave below Walton Castle and which also occurs at Swiss Vale, this blown sand being evidently of considerable extent.

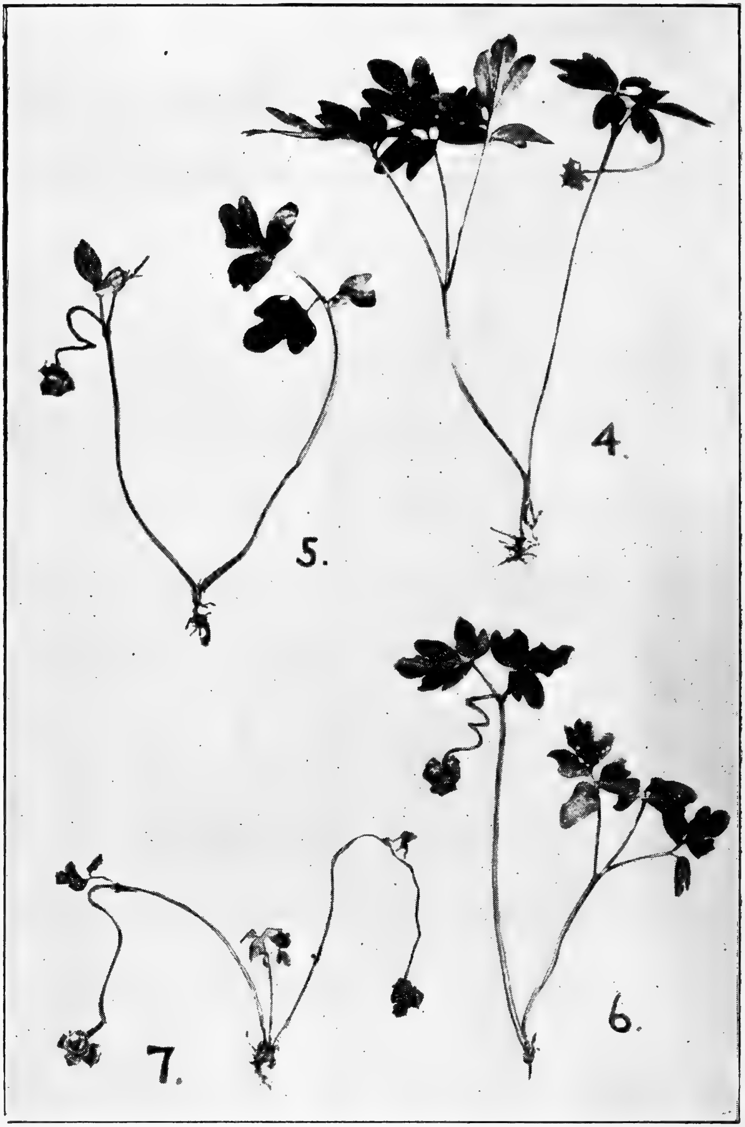
Small details like these, gleaned in the course of everyday-life, may sometimes help to extend the knowledge of the Geology of a district.

But the great value of Geology to the ordinary individual is the joy it can give through enriching his understanding of so much that he sees around him, and to some types of mind it may even afford in degree, a scientific approach to that mystic vision to which, in the words of Francis Thompson:

"All things . . . . . .
Near or far,
Hiddenly,
To each other linkéd are,
That thou canst not stir a flower
Without troubling of a star."

ADOXA MOSCHATELLINA.

Photo. by G. F. Gardiner



ADOXA MOSCHATELLINA.

Photo. by G. F. Gardiner.

Observations on Adoxa Moschatellina.

By Joan Fraymouth.

DURING the years 1930-31, observations have been made on plants of *Adoxa Moschatellina* growing in the Isle of Wight.*

Events, which take place during the production of the fruits, have been observed which are not recorded in the otherwise very complete monograph by Dr Karl Sturm (1).

These events, which lead to the deposition of the fruit and seed in the soil some distance from the parent plant, are striking and of ecological interest adding yet another method of seed-dispersal to the long and varied list of ways by which plants are dispersed and reach a suitable habitat.

The plants flower early in March in this locality. Inflorescences picked at this time possess a most foul smell thus indicating that the flower is pollinated by some dipterous insect. Small flies, grammarsows, and beetles have been observed crawling over the heads of the flowers and apparently feeding from the yellowish discs surrounding the pistils. One watched for ten minutes was seen to walk all over the five flowers in the inflorescence and afford a very good chance for pollination to take place. The flowers are protandrous (Sturm, 1). Plants kept indoors with the necessary insects set seed satisfactorily.

The events which take place during the formation of the fruits are chiefly changes in the growth of the peduncle. These changes are only seen in those plants in which the flowers show signs of having been pollinated. The stages of development are described below. Plants have been photographed at each important stage.

As soon as the ovary begins to swell, the peduncle grows rapidly in length (Figs. 1 and 2). The growth is greater on one side than on the other and this causes an arching to take place and the head of flowers to be removed from its original position above the parent plant (Fig. 3). An elongation also takes place in the axis below the bracts of the peduncle† (Figs. 1, 2 and 3). This growth in a curve takes place towards the light in all observed instances. That the curvature is due to growth and not to shrinkage is shown in the following table of measurements made:—

	Length of peduncle above bracts.			Length of peduncle below bracts		
	Flower Stage.	Fruit Stage.	Increase.	Flower Stage.	Fruit Stage.	Increase.
A	1.1 inch	2.4 inch	1.3 inch	3.5 inch	3.8 inch	.3 inch
B	1.6 inch	3.0 inch	1.4 inch	4.0 inch	4.3 inch	.3 inch
C	1.2 inch	3.1 inch	1.9 inch	5.2 inch	5.9 inch	.7 inch
D	.8 inch	2.0 inch	1.2 inch	3.6 inch	4.2 inch	.6 inch

*Exactly similar observations on the development of the peduncle were made at Failand near Bristol, but these were neither regular nor continuous.

†Like changes have been observed in other early flowering plants of similar habitat, e.g. *Ranunculus Ficaria and Anemone nemorosa.*

At this stage, early in May, there is a very great increase in the leaf area (Fig. 4), and the bracts of the peduncles become so large that they cover and *hold down* the ripening fruit. The petioles of the leaves grow in length and the leaves form a canopy over the whole. In this condition, when there is a shower, the fruits now swollen and affording an irregular surface collect a considerable amount of water. They are bent down under the leaves by their increased weight and become more entangled in their own foliage.

A twist is soon observed to occur in the ridged peduncle of every plant. This appears to be due to shrinkage of the irregularly developed organ (Fig. 4). The twist rapidly becomes a spiral (Figs. 5 and 6). The process takes about eight days, and during this period, owing to the development of the spiral, the degree of entanglement is increased. Held as it is by its leaves and those of its neighbours the fruit is practically touching the damp soil five or six inches from the parent plant. For the purpose of photography each plant had to be unravelled from its neighbours.

The overground portion of the plant withers in June as a result, according to Fritsch and Salisbury (2), of the lack of light in its habitat. It may be eaten, or attacked by rust (*Puccinia Adoxae*). The fruits remain turgid and a bright translucent green. According to Sturm (1) they contain citric acid. During the fine dry weather of June the peduncle withers (Fig. 7) and the slightest touch causes it to break and liberate the fruits. If the weather is wet the peduncle may remain attached but it withers and rots very soon. In a large number of plants the peduncle was eaten through by snails before it had completely rotted, but the fruits were not touched.

Thus is the fruit placed in the ground at some distance from the parent plant.

The manner in which the seeds are liberated from the berries is a further point of interest. Experiments were performed in which a whole plant was kept indoors and provided with a snail and a beetle from the plant's natural habitat. The leaves were all eaten first and then the peduncle, and it was only after some days of hunger that the animals attacked the fruits. The seeds were thus liberated but not touched.

Under normal conditions the seeds on the soil might be liberated by three methods:—

1. The fruit often forms a substratum for moulds which cause the walls of the berry to become mushy. This allows the seeds to be washed away by surface water in wet weather.
2. The fruits *may* be eaten by snails, etc., as shown above.
3. According to Sturm (1) birds may eat the berries. This I did not observe myself as the habitat was so dark at the time that no birds appeared to search for food there.

Vegetative reproduction seems to be of first importance in the habitat under observation. During May, when the development of the leaf area is most rapid, long underground runners and also greenish overground stems are produced. These have scale leaves underground, white and swollen with food reserves. The overground stems have small reduced scale leaves. Both produce adventitious roots from an end bud and become established 7-9 inches from the parent before July.

I should like to express my thanks to Dr Bracher of the Botany Department of the University of Bristol, for assistance in the collection and preservation of material. Thanks are also due to the Bristol University Colston Research Society for a grant towards the cost of the plates, the photographs for which were very effectively taken by Mr G. F. Gardiner.

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(1) Sturm, K., " Monographische Studien über *Adoxa Moschatellina* L.," 1910.

(2) Fritsch and Salisbury, "Introduction to the Study of Plants," 1928.

EXPLANATIONS OF FIGURES ON PLATES.

Figures 1, 2 and 3 show the growth of the peduncle with the swelling of the ovary, also the growth in length of the stalk below the bracts.

Figure 4. Leaf area has increased, and the peduncle exhibits a twist.

Figures 5 and 6. The twist in the peduncle has become more marked.

Figure 7. The twisted peduncle has now withered and become brittle.

Landslips.

By S. H. Reynolds, M.A., Sc.D.,
Professor of Geology in the University of Bristol.

UNDER the term landslips are included rock-falls and founders, landslides and slumpings, all terms indicating the movement of rock-masses from a higher to a lower level. These terms are not, however, very clearly defined, their use by different authors not being always identical. Such movements are primarily due to gravity, but depend in part on the nature of the rocks affected, on their disposition and on the surface configuration of the land.

Landslips may conveniently be divided into those occurring (1) along lines of cliff—as a rule sea-cliffs and (2) those of mountain regions.

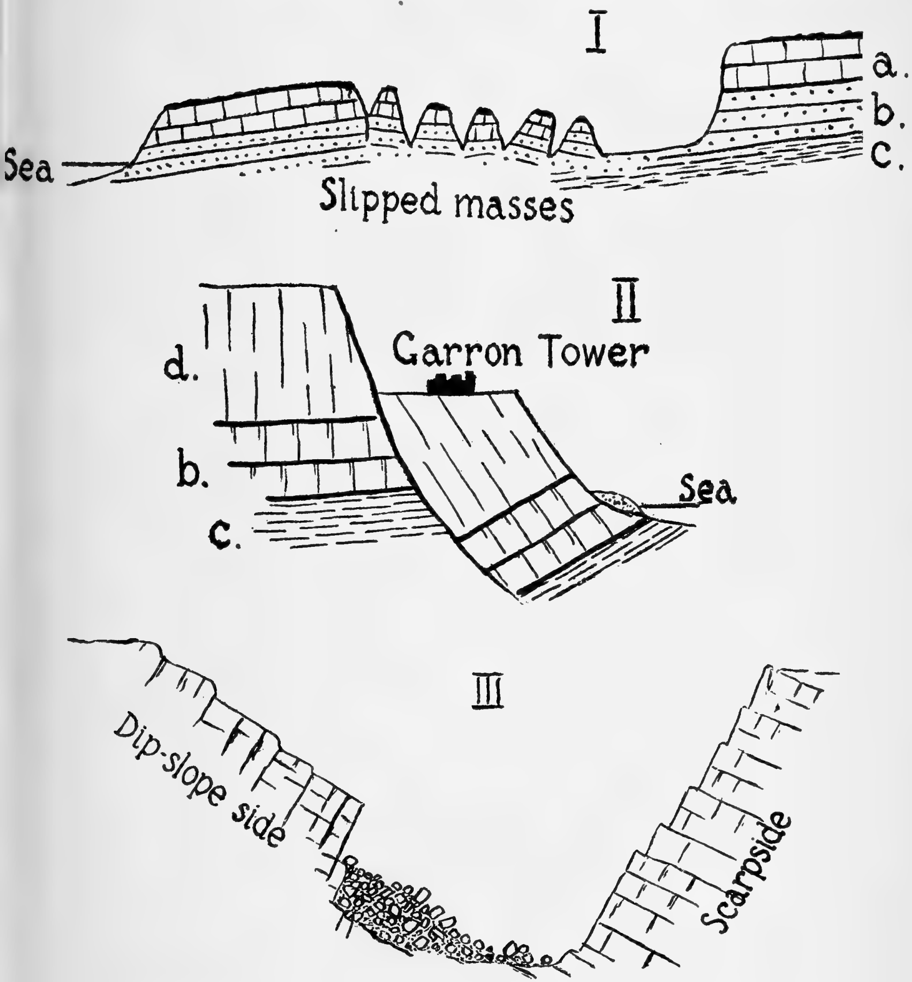
(1) Cliff-landslips and founders are, apart from the action of gravity, primarily the effect of rain-water percolating through porous rock and soil and may be divided into two groups:—(a) those in which the chief movement is in a vertical plane; (b) those in which it is in a horizontal plane.

(a) Movements of the former class—best termed founders or slumpings, are continually taking place on a large or small scale at many points round the British coasts. The rain as it penetrates the more or less porous material at the top of a cliff, tends to reduce its cohesion by dissolving and washing out cementing mineral matter, and the material is further loosened when there is a frost, the water between the rock-particles expanding when it passes into ice and tending to force them further apart. The stability of a cliff may also be lessened by the undercutting and battering of the waves at its base (Pl. I, A). Cracks then disclose themselves at the top of the cliff, frequently involving the shifting of path and fence further inland and finally a mass of material detaches itself along nearly vertical divisional planes and slumps down. Instances of this may be noted at numerous points along the southern and south-eastern coasts of England especially where these are composed of relatively soft and porous material having a fairly uniform grain such as Chalk and the Lower Greensand of the Isle of Wight. Aust Cliff affords a good local instance. An example of a fall of a Chalk cliff is that which occurred a few miles east of Brighton in 1891 when over 10,000 tons of material fell to the beach carrying away part of the road.

The coasts of Yorkshire between Flamborough Head and Spurn Point, of Norfolk and of the Isle of Sheppey afford further examples of localities where cliff-falls and slumpings are of frequent occurrence.

In other cases especially when the cliffs are not very high or vertical and are composed of not very homogeneous material, in place of a sudden fall there may be a gradual settlement in successive slices (Pl. II, A). A tract of boggy country may thus be produced, which is sometimes, as in parts of the north coast of the Isle of Wight, practically impassable in wet weather.

(b) Cases where the movement is mainly in a horizontal plane take place on a larger scale and are specially frequent round parts of the coast where a porous rock, such as sandstone or limestone, rests on an impervious one such as clay, particularly if a layer of loose sand over-



DIAGRAMS OF LANDSLIPS.

Fig. I.—The Axmouth or Rousdon Landslip.
Fig. II.—Landslip of the Antrim type.
Fig. III.—The Cheddar Rock-Fall.

a. Chalk. b. Greensand. c. Lias. d. Basalt.

lies the clay and if the rocks dip or slope slightly seawards. In such a case water percolating through the upper porous rock is arrested by the clay and mingling with the sandy layer may convert it into a kind of quicksand and the top of the clay below into a slippery mass along which movement may readily take place. In the British Isles the coasts of Dorset and East Devon and of the Isle of Wight are the classical localities for such occurrences.

The most famous example of such a landslip is that variously known as the Axmouth, Dowlands or Rousdon landslip (Pl. II, B, and fig. 1) of the Dorset and East Devon coast west of Lyme Regis described by Conybeare and Buckland and by Lyell.* The rocks here consist of Greensand overlain by Chalk both porous rocks resting on impervious Lias clay, the whole series dipping seaward at a low angle. The slip took place on December 24th, 1839, large fissures opened in the ground and eventually thirty-two acres of land slipped down seawards breaking up into a confused mass of mounds and terraces and producing a great hollow about a thousand yards long and upwards of two hundred feet deep.

Further to the east in the neighbourhood of White Nothe about five miles east of Weymouth and near St Alban's Head, S.W. of Swanage (Pl. III, A) similar slips have taken place. Near White Nothe the Chalk and Greensand have slipped over the surface of the Gault with the Kimmeridge Clay below. Near St Alban's Head the Portland beds with the overlying Purbeck have slipped over the Kimmeridge Clay.

The Undercliff of the Isle of Wight (Pl. III, B) owes its existence to the survival in the Ventnor district of a mass of Upper Cretaceous rocks —Chalk and Greensand which have been removed by erosion from the remainder of the southern half of the Island. These porous rocks are underlain by the impervious Gault Clay and along the whole length of the Undercliff from near Blackgang to Bonchurch extensive slipping his taken place. This slipping has been in the main prehistoric, but there have been a number of important occurrences in historic times. Thus in 1795 there was a big slip at the western end—Gore cliff, the site of the recent slip to be alluded to immediately. In 1810 a big slip occurred at the eastern end in the Bonchurch-Luccombe area. As is mentioned in the Survey memoir on the Geology of the Isle of Wight† " the most striking feature in the central part of the Undercliff is the succession of short escarpments produced by the fall of slices of the Upper Greensand cliff. These portions range in size from mere blocks up to slices half a mile in length. They have broken off along the vertical joints by which the sandstone is traversed and as their bases slid forward over the Gault have slowly acquired a steep landward (northerly) dip. The process has been repeated several times, thus producing at different levels in the Undercliff a series of Upper Greensand escarpments separated by deep hollows . . . . The distance to which they have descended varies indefinitely. Above Bonchurch a very long but narrow slice has moved a few feet only and still forms the principal face of

*_Principles of Geology_, i, p. 536.

†p. 62.

the cliff. But many others, with a portion of Chalk above them, have descended to the beach some 300 feet below and from a quarter to half a mile distant."

The landslip near Blackgang† in 1928 (Pl. I, B) involved two movements. The first, which took place on July 26th, was quite analogous to previous occurrences—a mass of Greensand with overlying Chalk estimated at about 200,000 tons falling from the face of the cliff on to the road below. Here, for a time, the fallen mass rested, but its foundation consisting of Gault clay and the debris of earlier if smaller falls was an insecure one, and about September 20th the fallen mass again began to move with remarkable effects upon the undercliff which became split up in all directions by fissures and traversed by numerous pressure ridges. In a hollow behind one of these the pond shown in the photograph was formed. The whole Rocken End promontory was driven for some distance into the sea and the sea-bed was forced up as far as a point well below low water mark.

At Sandgate in March 1893 a large mass of Lower Greensand slipped down towards the beach destroying many houses. This is the most important landslip which has occurred in the British Isles subsequent to that of Axmouth in 1839.

In the neighbourhood of Bath there have been frequent slips of the Great Oolite over the Fuller's Earth below and along the Cotteswold escarpment there have been many analogous slips of the Inferior Oolite over the Lias. H. B. Woodward remarks that the overthrow of the nave of the church on Glastonbury Tor has been attributed to an earthquake, but as the tower was not affected, it may be that the foundations of the church were partially undermined by springs carrying away portions of the Oolitic Sands on which the church was built.

In Murchison's "Silurian System" there are references to landslips in the Silurian of Putley, Marcle and Shucknell in the Woolhope area of Herefordshire and near Ludlow. In each case the dip of the strata is considerable and the porous Upper Ludlow with the Aymestry Limestone has slipped over the surface of the more impervious Lower Ludlow shales.

On the coast of Antrim in the neighbourhood of Garron Point (Pl. IV, A, and fig. 2) there have been frequent landslips involving movement partly in a horizontal, partly in a vertical plane. The coast here consists of basalt overlying porous Chalk which rests on impervious Lias clay. Movement along a nearly vertical plane running roughly parallel to the coast for about two miles has let down a mass of basalt and Chalk for a distance of about 150 feet and this mass has slipped forward over the Lias becoming at the same time strongly tilted inland (Pl. IV, B).

Round the edge of the basalt plateaux of some of the western islands of Scotland—Skye, Mull, Raasay and Eigg (Pl. V, A) an undercliff is often formed by the innumerable masses of fallen basalt which are often many yards in diameter. These masses have separated off

†See photographs and description by J. F. Jackson published by the British Association Geological Photographs Committee.

along vertical lines of joint and so are of the nature of founders or rock-falls rather than true landslips. The pinnacles and crags of the Storr rock, Skye, are also formed of masses of basalt which have become detached from the main plateau through movement depending on the softer underlying Jurassic rocks.

A local example of a rock-fall is afforded by that of Cheddar in 1906 (Pl. VI, and fig. 3). The rocks of the Cheddar Gorge are inclined at an angle of about 20-25° causing a marked contrast between the two sides. On the right or scarp side as one ascends the cliff is principally determined by erosion along the joint planes and is nearly vertical; on the left, the side of the valley roughly coincides with the bedding planes and slopes much more gently. At one locality near the lower end a quarry was opened on the left side and the rock being quarried away along the joint-planes, came to overhang somewhat. For some weeks before the rock-fall the joints at the top of the quarry began gradually to gape open and eventually great masses broke off along the joint-planes and fell into the gorge which was blocked for a time (Pl. VI, B).

(2) The landslips which occur in mountain regions are more frequent and vastly more important and destructive than cliff-landslips. Some are due to the common cause of cliff-landslips, the resting of porous on impervious strata. Thus the disastrous fall of the Rossberg, a mountain near the Rigi in Switzerland, was of this type. After the rainy summer of 1806 part of the mountain side consisting of red sandstone and conglomerate the cohesion of which had been lessened by the water and estimated at 15,000,000 cubic metres swept down into the valley of Goldau burying a square mile of fertile land with four villages, in which 457 inhabitants lost their lives. The published sections show that the rocks were dipping at an angle of about 20° towards the valley and that they separated off along the bedding planes.

Other mountain landslips are due to the accumulation of masses of debris—either talus or morainic material on mountain sides. These masses may get water-logged leading to increase in their weight and reduction of their friction against the mountain side and may eventually slide down into the valley, the final catastrophe being preceded by slow movement which may continue for several years. Professor Heim in his well-known work on Swiss landslips describes several instances. In some cases the downward movement has been arrested by draining the mass of debris, thereby producing sufficient friction to check its progress.

The great majority of mountain landslips are, however, rather of the nature of rock-falls, *i.e.*, are due to the detachment of a mass of solid rock mainly along joint planes. Hundreds of such occurrences have taken place in the Alps alone in historic times. Professor Heim states that no Alpine valley is without such fallen rock-masses (Pl. V, B), and the statement is equally true of the Pyrenees and other great mountain ranges.

Though great fallen masses of rock may be seen in the Scottish Highlands they are relatively rare. The Scottish mountains are so ancient

A.—NEAR THE SOUTH-WESTERN END OF PORTLAND ISLAND.

A mass of limestone partly undercut by the sea is separating off along a joint plane. Similar fallen masses are seen at the foot of the cliff.

B.—LANDSLIP OR FOUNDER OF 1928 FROM THE GORE CLIFF, NEAR BLACKGANG, ISLE OF WIGHT.

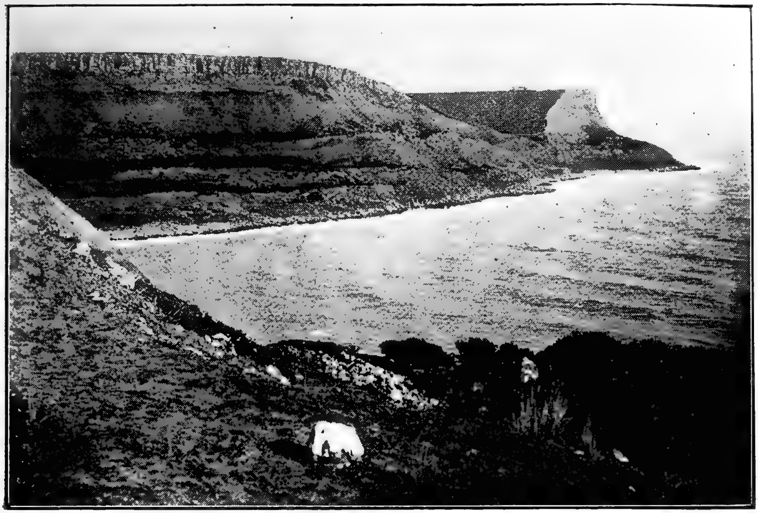
The photograph shows the fallen mass of Chalk and Greensand and a pond accumulated in a pressure hollow.

PLATE I.

A.—COAST ABOUT HALF-MILE N.E. OF SANDOWN, ISLE OF WIGHT.
Shows the breaking away and settlement of a low cliff of Wealden marls.

B.—THE ROUSDON OR AXMOUTH LANDSLIP.
The broken ground in the middle of the valley is formed of slipped masses of Chalk and Greensand which are seen in place on the right.

PLATE II.



A.—ST ALBAN'S HEAD (RIGHT) AND EMMIT HILL NEAR SWANAGE.
The top of the cliff is formed of limestone (Portland Stone) with sandy beds (Portland Sand) below, the base of the cliff of clay (Kimmeridge Clay). The slipping of the Portland beds over the clay has produced a broken undercliff.

B.—THE CLIFF AND UNDERCLIFF S.E. OF NITON, ISLE OF WIGHT.
The cliff is formed of Greensand, the undercliff of Gault Clay with slipped and fallen masses of Greensand.

PLATE III.

A.—GARRON TOWER, ANTRIM.

The high ground on the right consists of horizontal basalt and Chalk. Garron Tower is built on a slipped mass of these rocks.

B.—COASTAL ASPECT OF THE SLIPPED MASS, GARRON TOWER.

The slipped mass of Chalk with overlying basalt is seen to have acquired a marked inward dip.

PLATE IV.

A.—BASALT CLIFFS NEAR THE NORTHERN END OF THE ISLE OF EIGG.
The foreground is occupied by a great mass of fallen basalt blocks.

B.—ANCIENT LANDSLIP NEAR THE STAFFEL ALP, ZERMATT.
These great masses of rock have fallen from a mountain just N.E. of the Matterhorn.

PLATE V.

A.—CHEDDAR ROCK-FALL OF FEBRUARY 6TH, 1906.
The cliffs on the left are due to the joint-planes along which the fallen masses have separated off.

B.—THE CHEDDAR ROCK-FALL OF FEBRUARY 6TH, 1906.
The road through the gorge was for a time blocked by the fallen masses.

PLATE VI.

A.—THE FALLEN MASS WHICH FORMS A BARRIER HOLDING UP LOCH LAUVITEL IN SAVOY SEEN FROM BELOW.

B.—VIEW OF PART OF THE BARRIER AND OF THE EDGE OF THE LAKE.

PLATE VII.

that any detachable masses of rock have, in the main, fallen long ago and been gradually broken up by erosion.

Full accounts of the chief Alpine landslips may be found in the works of Heim and Baltzer. Descriptions of such occurrences are mainly a record of the estimated amount of material which fell and of the destruction and loss of life involved.

Many great landslips have occurred in the Rocky Mountains, the most remarkable of recent years being that of Frank, Alberta. In 1903 the whole eastern face 2½ miles long of Turtle Mountain, estimated at 40,000,000 cubic yards, separated off, not to judge from the accounts along any specially defined divisional planes and slid down into the valley. When the mass came to rest it covered an area of over a square mile, and it is estimated that the time it took to descend was not more than 100 seconds. There appear to have been several causes apart from the character and disposition of the rocks contributory to this great landslip, but the chief was heavy rainfall causing an unusual saturation of the rocks, succeeded by severe frost which was followed by warm weather. Earthquake tremors are believed to have hastened the slip and intense tunnelling operations at the base of the mountain may have affected its stability.

Earthquakes have often been the direct cause of landslips, such as those of Greece in 1870, and those in relation to the Calcutta earthquake in 1897.

A further source of danger occurs when a landslip descending into a narrow valley holds up the drainage and causes a lake to accumulate (Pl. VII). The river may be able to cut a channel of escape for itself, or the water may sometimes run off through the loose material of the barrier, but in other cases the water rises till it bursts or overtops the barrier and disastrous floods result. Thus in 1893 a great landslip blocked the valley of the Ganges at Gohna in Garhwal, 150 miles above Hardwar. In three days 800,000,000 tons of rock fell producing a dam nearly 1000 feet high behind which a lake accumulated which reached a length of four miles before it overtopped or burst the barrier nearly a year later. In view of the fact that the lake would eventually discharge, safety marks were set out on the valley side indicating the height above which the water was not likely to rise, and a telegraph line was installed from the dam to Hardwar. Eleven months after the landslip the dam burst and in four hours 400,000,000 cubic yards of water were discharged which flooded the valley to a depth of from 100-170 feet and rushed down with a speed of 20 miles an hour. Owing, however, to the warning given practically no lives were lost.

Bristol Insect Fauna.

DIPTERA (Part V).

By H. Audcent.

THE rest of the Cyclorrapha are divided into two groups. In the first group, Calyptratae, the flies have large calyptra or squamae, two pairs of membranous appendages attached to the thorax at the base of the wing. This group is divided into the two following families.

I. LARVAEVORIDAE

(including former Tachinidae and part of former Muscidae).

These flies all have bristles on the hypopleura, a chitinous lateral plate of the thorax lying between the middle and hind coxae. The eyes, which may be bare or hairy, are usually separated by a frons in both sexes, but the frons is usually broader in the female than in the male. There is always a long, strong bristle at each corner of the mouth. The antenna has three joints and the third bears a dorsal arista which may be bare or plumose. The whole body is generally very bristly; the number, strength and position of the bristles are factors employed in the determination of the species, hence the importance of inserting the mounting pin on one side of the mid-line of the thorax. Many species, especially among the Sarcophaginae, are determined mainly by differences in the male genital organs, hence the necessity of pulling these organs out with a pin when setting these flies. In the wing the fifth longitudinal vein (discal vein) is bent up towards the fourth (cubital) at the apex of the wing; the bend may be angular and the discal vein may end in the cubital; at the angle there may be a veinlet or fold which looks like a prolongation of the discal vein. The seventh vein (anal) never reaches the margin of the wing and the eighth (axillary) is very short or absent. The wings are usually held outspread when the fly alights. The flies are nearly all parasitic in the larval stage (the Calliphorinae and Sarcophaginae are coprophagous but some may become parasites), their hosts are usually larvae of other insects, but some attack Woodlice, Earthworms and Snails.

As in all parasites, these flies are in a state of flux, and the determination of the species is difficult. The following books are useful:—

1. Meade. Annotated List of British Tachinidae, " E.M.M.," 1891-4. Very out of date and not very useful for determination.
2. Wingate. " Durham Diptera," 1906. Useful for broad outline only.
3. Stein. Tachiniden Mitteleuropas, " Arch. fur Nat.," 1924. An excellent work including many non-British genera and species.
4. Lundbeck. " Diptera Danica," Part VII, 1927. A splendid work but many British species not included.
5. Wainwright. British Tachinidae, " Trans. Ent. Soc." 1928 and 1932. Essential; especially valuable for its short descriptions.
6. Collin. Lucilia, " Trans. Ent. Soc.," 1926.

It was thought that it would add to the utility of the list if the names of the usual hosts were given, where known. The names of the Lepidoptera are those given in Meyrick's "British Lepidoptera," 1927.

Sub-family LARVAEVORINAE.

No ventral membrane; abdominal sternites hidden; antennae inserted above middle of eye; arista bare or at most pubescent.

Actia=*Thryptocera*.

Actia anomala Ztt. G., Stroud (W. B. Davis), ex *Leucophthalma annulata* Sch., 31/8/04.

,, *antennalis* Rnd. (*aristalis* Rnd.). G., Shepperdine (A.), 20/8/24.

,, *crassicornis* Mg. G., Stroud (Davis), ex *Pterophorus lithodactylus* Tr., 18/7/08; Stroud (Davis), ex *Phtheochroa rugosana* Hübn., 7/8/03; Stroud (Davis), ex *Cacoecia xylosteana* L., 24/6/08; Bristol (H.), ex *Cacoecia podana* Scop.

,, *frontalis* Mcq. (*lamia* Mg.). G., Stroud (Davis), ex *Eucosma pflugiana* Haw., 4/6/03.

,, *pilipennis* Fln. (*reducta* Vill.). G., Bristol (B.), 22/7/26. S., West Town (Wm.), 21/7/28.

Bavaria jucunda Mg. S., Backwell (A.), 25/4/26. On *Stilpnotia salicis* L.

Bithia (*Demoticus*) *spreta* Mg. G., Shepperdine (A.), 4/8/24; Hallen (A.), 24/9/27.

Carcelia comata Rnd. (*cheloniae* Rnd.). G., Bristol (B.), ex *Arctia plantaginis* L.; Painswick (W.), ex *Arctia caja* L. S., Portishead (C. Bartlett), ex *Clisiocampa neustria* L., ex *Orgyia antiqua* L.; Blagdon (W. R. Taylor), 5/31; West Town (Wm.); Kewstoke (Wain), all ex *Arctia caja* L.

,, *rutila* B. & B. G., Stroud (Davis), ex *Abraxas sylvata* Scop.

Ceromasia (*Vibrissina*) *sordidisquama* Ztt. G., Littledean (A.), 25/5/31.

Chaetotachina rustica Mg. G., Cirencester (T.), 4/7/24. S., Taunton (Pa.). On *Acronycta aceris* L.; *Melanchra brassicae* L.

Craspedothrix zonella Ztt. G., Stroud (Davis), ex *Dasycera sulphurella* F., 24/5/03.

Crocuta=*Bucentes*=*Siphona*.

Crocuta cristata F. G. and S., fairly common.

,, *geniculata* Deg. G. and S., common.

,, *maculata* Staeg. G. and S., fairly common.

All species of *Crocuta* are generally parasitic on species of *Tipulinae* but have also been bred from *Agrotis* spp. and *Melanchra* spp.

Demoticus plebeius Fln. G., Cirencester (T.), 11/7/24. S., Sharpham (A.), 22/4/24.

Digonochaeta setipennis Fln. G., Bristol (B.), 23/6/27. On *Forficula* (Earwigs).

Echinomyia fera L. G., Cranham (W.); Cirencester (T.); Kingsweston (A.), 20/5/22. S., Minehead (Bl.); Dunster (A.), 8/16; St Audries (A.), 19/8/29. On *Leucania obsoleta* Hübn., *Lymantria dispar* L., *Lymantria monacha* L.

,, *grossa* L. S., Dundry (C.); Banwell (J.); Cheddar (J.); Sharpham (A.), 10/8/25. On large *Lasiocampidae*.

Eriothrix (*Olivieria*) *rufomaculatus* Deg. (*lateralis* F.). G. and S., common.

Exorista cincinna Rnd. (*intermedia* B. & B.). G., Cranham (Wt.).

,, *fimbriata* Mg. G., Stroud (Davis), ex *Zygaena filipendulae* L., 8/04.

,, *glauca* Mg. G., Painswick (W.); Stroud (Davis), ex *Acronycta psi* L.

,, *hortulana* Mg. (*ingens* Stein.). S., Portishead (Bartlett), ex *Acronycta alni* L.

,, *tritaeniata* Rnd. G., Stroud (Davis), ex *Thecla rubi* L., 17/5/20.

Fabriciella (*Fabricia*) *ferox* L. S., Wellington (Bl.); Portishead (Bartlett); Tickenham (A.), 20/7/23; St Audries (A.), 19/8/29.

Fausta (*Ernestia, Echinosoma*) *nemorum* Mg. (*pectinata* Girsch.). G., Tormarton (A.), 13/7/29.

Gymnochaeta viridis Fln. G. and S., fairly common in spring. On *Xanthorhoe limitata* Scop., *Caradrina arcuosa* Haw. and *Lymantria monacha* L.

Helicobosca distinguenda Vill. G., Cirencester (T.), 9/7/23.

Histochaeta (*Thelymorpha*) *marmorata* F. (*vertiginosa* Fln.). G., Blaise Castle (A.), 15/5/26, on *Lymantria dispar* L., *Clisiocampa neustria* L., *Arctia caja* L., *Cucullia verbasci* L.

Larvaevora (*Tachina*) *fasciata* Fln. S., Portishead (Bartlett), ex *Zygaena filipendulae* L.

,, ,, *larvarum* L. G., Blaise Castle (A.), 9/21. On *Clisiocampa* spp., *Zygaena* spp., *Orgyia* spp., *Acronycta* spp.

Lydella (*Ceromasia*) *gricescens* R. D. (*Paraphorocera senilis* Mg.). G., Hallen (K.), 26/7/27. On *Clisiocampa neustria* L.

,, ,, *stabulans* Mg. G., Selsley (Wt.); Painswick (W.). S., Cheddar (W.), 2/8/98; Tickenham (A.); Backwell (A.), 17/7/26; Clevedon (A.), 14/5/27. On several Heterocera chiefly *Abraxas* spp.

Lydina (*Somolia*) *aenea* Mg. (*simplicitarsis* Ztt., *rebaptizata* Rnd.). G., Clifton (H.); Cirencester (T.); Shepperdine (A.), 13/8/24; Hallen (A.), 1/8/29. S., Clevedon (W.), 18/8/01; St Audries (A.), 24/8/29.

Lypha (*Aporomyia*) *dubia* Fln. G. and S., fairly common. On *Eriogaster populi* L. and *Lycaena argiolus* L.

Megalochaeta (*Epicampocera*) *conspersa* Mg. G., Littledean (A.), 25/5/31. On *Monima* spp.

Meigenia bisignata Mg. G., Selsley (Wt.); Cranham (Wt.).

,, *mutabilis* Fln. (*floralis* Fln.). G. and S., common in spring. On larvae of *Chrysomelidae*.

Micropalpus vulpinus Fln. G. and S., common on Heather. On *Hadena scabriuscula* L., *Polia porphyrea* Esp., and *Agrotis strigula* Thnb.

Microtachina (*Tachina*) *erucarum* Rnd. G., Painswick (W.).

Monochaeta albicans Fln. (*leucophaea* Mg.). S., Taunton (Pa.). On *Hydriomena dubitata* L., *Operophtera brumata* L.

Myiobia (*Soliera*) *tibialis* v. Ros. (*montana* B. & B.). G., Selsley (Wt.); Cirencester (T.), 4/7/24; Olveston (A.), 30/7/22; Hallen (B.), 9/7/29. S., Tickenham (A.), 24/6/26.

Nemorilla floralis Fln. (*notabilis* Mg.). G., Selsley (Wt.); Chalford (Wt.). S., Clevedon (R. Beck), ex *Notarcha ruralis* Scop.; Sharpham (A.), 22/4/22.

Neopales (*Pales*, *Phorocera*) *pavida* Mg. (*cilipeda* Rnd.). G., Stroud (Davis), ex *Pterophorus lithodactylus* Tr. S., Portishead (Bartlett) ex *Arctia caja* L.; Shapwick (A.), 3/9/22. On *Panolis piniperda* Pz., *Monima miniosa* F., *Polia protea* Bkh.

Panzeria (*Erigone*, *Ernestia*) *nielseni* Vill. (*minor* Vill.). G., Cranham (Wt.). On *Monima pulverulenta* Esp. and *Caradrina trapezina* L.

,, ,, ,, *rudis* Fln. G., Selsley (Wt.); Bristol (C.); Cirencester (T.). S., Tickenham (A.), 5/21. On *Monima stabilis* View.

Pelatachina tibialis Fln. G., Chalford (Wt.); Cirencester (T.), 30/5/23. S., Ashcot (J.); Taunton (A.), 6/6/31; Keynsham (A.), 1/6/29; Chew Magna (A.) 30/5/31. On *Vanessa* spp.

Phorocera (*Chaetogena*) *assimilis* Fln. S., Tickenham (A.), 5/21.

,, ,, *caesifrons* Mcq. G., Selsley (Wt.); Littledean (A.), 25/5/31; Kingsweston (A.), 6/5/24. S., Leigh Woods (A.), 7/5/32; Backwell (A.), 22/4/27. On various Geometridae.

Phryno vetula Mg. G., Littledean (A.), 5/6/22. S., Leigh Woods (Wm.), 25/4/26; Heaven's Gate (Ch.), 14/6/25.

Phryxe nemea Mg. G., Painswick (W.), ex *Vanessa atalanta* L. S., Portishead (Bartlett), ex *Abraxas grossulariata* L.; Keynsham (A.).

,, *vulgaris* Fln. G. and S. The commonest fly bred by lepidopterists. It has been bred from *Argynnis euphrosyne* L., *Abraxas grossulariata* L., *Zygaena filipendulae* L., *Zygaena lonicerae* Esp., *Vanessa urticae* L., *Vanessa io* L., *Acronycta psi* L., *Pieris rapae* L., *Lycaena corydon* Pod., and *Odonestis potatoria* L.

Phytomyptera nitidiventris Rnd. G., Stroud (Davis), ex *Adaina microdactyla* Hübn.

Platychira (Ernestia) radicum F. G. and S., common. On Macrolepidoptera.

Ptychomyia selecta Mg. G., Cirencester (T.), ex *Hyponomeuta cognatella* Hübn., 25/7/23.

Ptychoneura rufitarsis Mg. G., Dursley (A.), 18/5/30.

Rhacodineura antiqua Mg. G., Bristol (W.); Cirencester (T.), 9/7/24; Hallen (A.), 24/7/28. On Earwigs and *Monima miniosa* F., *Lymantria dispar* L.

Rhynchista prolixa Mg. G., Painswick (W.), first British record; Selsley (Wt.); Stroud (Br.). On *Pyrausta* spp.

Salmacia (Gonia) fasciata Mg. G., Kingsweston (A.), 5/4/25. S., Clevedon (W.); Crook's Peak (K. Howard), 13/4/25.

„ „ *ornata* Mg. S., Berrow (A.), 8/4/29. On *Euxoa vestigialis* Rott.

Servillia lurida F. S., Axbridge (Rd.); Bridgwater (Sl.). On *Cucullia verbasci* L.

„ *ursina* Mg. G., Bristol (C.). S., Clevedon (W.); Leigh Woods (H.); Sharpham (A.), 17/4/24.

Thelaira nigripes F. (*leucozona* Pz.). G. and S., common. On *Arctia caja* L., *Harmodia capsincola* Hübn., *H. carpophaga* Borkh., *Lasiocampa trifolii* Esp.

Tricholyga sorbillans Wied. S., Portishead (Bartlett), ex *Saturnia pavonia* L.

Trixa oestroidea R. D. G., Selsley (Wt.); Chalford (Wt.); Cirencester (T.), 26/6/24. S., Hutton (J.); Tickenham (A.), 24/6/24; St Audries (A.), 26/8/29.

Viviana cinerea Fln. G., Dursley (A.), 15/7/31. On Carabidae.

Voria (Plagia) ruralis Fln. G., Selsley (Wt.); Chalford (Wt.). S., Taunton (Pa.); Ham Green (A.), 10/20; Burnham (A.), 9/20. On *Plusia iota* L., *Plusia gamma* L., *Plusia chrysitis* L., *Melanchra brassicae* L.

„ „ *trepida* Mg. G., Selsley (Wt.); Cirencester (T.), 27/6/24. On *Plusia gamma* L., *Eucosma sordidana* Hübn., *Epineuronia popularis* F.

Wagneria (Phorichaeta) nigrans Mg. S., Berrow (A.), 6/21; Tickenham (A.), 6/21.

„ „ *succincta* Mg. G., Olveston (A.), 2/7/22.

Winthemia quadripustulata F. S., Leigh Woods (Wm.), 3/8/20. On *Biston hirtarius* Clk., *Vanessa* spp., *Cucullia* spp., *Smerinthus* spp., *Plusia* spp.

Zenillia (Exorista) roseanae B. & B. G., Stroud (Davis), ex *Scythropia crataegella* L. On *Cacoecia pronubana* Hb. *Sarropthripus revayana* Scop. *Eurrhypara urticata* L.

Zophomyia temula Scop. G., Selsley (Br.), 15/5/94.

Sub-family Dexiinae.

No ventral membrane; abdominal sternites hidden; antennae inserted below middle of eye; arista plumose; abdomen narrow, elongated; legs long.

Dexia rustica F. G., Wotton-under-Edge (P.). S., Tickenham (A.), 20/7/23.

„ *vacua* Fln. G., Wickeridge Hill (W.). S., Cheddar (C.).

Dexiosoma caninum F. G. and S., fairly common in autumn.

All three on larvae of Cockchafer (*Melolontha*) and on Snails.

Myiocera carinifrons Fln. S., St Audries (A.), 24/8/29.

Sub-family Rhinophorinae.

No ventral membrane; second abdominal sternite visible, also other sternites may be visible; antennae inserted below middle of eye; arista pubescent; fifth longitudinal vein of wing generally ends in the fourth at or before its apex; under squama narrow, its inner margin bending away from scutellum. Small, black species parasitic on Woodlice and Beetles.

Frauenfeldia rubricosa Mg. G., Painswick (W.), 7/03.

Macquartia nitida Ztt. (*chalconota* Mg.). G., Cranham (Wt.); Cirencester (T.), 14/10/24; Hallen (A.), 24/9/27. S., Taunton (Pa.); Shapwick (A.), 3/9/22.
,, *nubilis* Rnd. G., Chalford (Wt.); Olveston (A.), 8/10/22.
,, *praefica* Mg. G., Sheepscombe (St.), 18/6/27. S., Sharpham (A.), 3/8/23.
,, *tenebricosa* Mg. G., Cranham (Wt.); Yanworth (J. Collins).
Melanophora roralis L. (*atra* Mcq.). G., Bristol (C.); Painswick (W.); Cirencester (T.). S., Leigh Woods (H.); Portishead (C. Bartlett).
Minella (*Ptilops*) *chalybeata* Mg. G., Selsley (Wt.); Cirencester (T.), 4/7/24; Sheepscombe (St.), 18/6/27; Olveston (A.), 18/6/22; Hallen (A.), 13/6/26. S., Sharpham (A.), 2/8/25.
Plesina (*Stevenia*) *maculata* Fln. G., Olveston (A.), 8/10/22.
Phyto melanocephala Mg. G., Painswick (W.), 12/8/91; Selsley (Wt.); Cirencester (T.). S., Clevedon (W.), 5/9/02; Tickenham (A.), 24/6/24; Taunton (A.), 6/6/31.
Rhinophora (*Clista*) *lepida* Mg. G., Olveston (A.), 30/8/23; Shepperdine (A.), 8/8/24. S., Clevedon (W.), 25/8/04; Berrow (K.), 17/7/27; Tickenham (A.), 27/7/22.

Sub-family SARCOPHAGINAE.

No ventral membrane; second sternite, and usually others, visible; arista plumose or bare; discal vein of wing continued as a veinlet beyond the angle. Rather large flies of a greyish colour. The Sarcophaga are coprophagous, the others parasitic on larvae of fossorial Hymenoptera, and Orthoptera.

Brachycoma devia Fln. G., Cirencester (T.), 27/6/24. S., Dunster (A.), 8/16; Tickenham (A.), 23/6/29. In nests of *Bombus* and *Vespa*.
,, *erratica* Mg. G., Alleged to have been bred by Mr C. J. Watkins of Painswick from pupae found in a nest of *Pemphredon* sp., May 1892, and described by Rev. R. H. Meade in " E.M.M.," May 1893.
Metopia campestris Fln. G., Bitton (C.). S., Leigh Woods (C.).
,, *leucocephala* Rossi. G., Cranham (Wt.).
Miltogramma punctatum Mg. G., Penpole Point, Bristol (Wm.), 16/7/22.
Morinia (*Anthracomyia*) *nana* Mg. G. and S., fairly common.
Nyctia halterata Pz. G. and S., common.
Ravinia striata F. (*Sarcophaga haematodes* Mg.). G., Bully (W.); Cirencester (T.).
Sarcophaga aratrix Pand. G., Selsley (Wt.); Painswick (W.), 21/7/91; Tormarton (A.), 18/7/27; Kingsweston (A.), 25/6/31.
,, *carnaria* L. G. and S., very common. Records of *S. agricola* Mg. and *S. atropos* Mg. probably referred to this species.
,, *crassimargo* Pand. S., Keynsham (A.), 1/6/29.
,, *dissimilis* Mg. (*infantula* Rnd.) (*Heteronychia chaetoneura* Br.). G., Stockend (W.); Cranham (Wt.); Wotton-under-Edge (P.); Filton (A.), 1/6/22; Kingsweston (A.), 25/6/31. S., Keynsham (A.), 1/6/29; Taunton (A.), 6/6/31.
,, *ebrachiata* Pand. G., Amberley (E. Bury).
,, *filia* Rnd. G., Selsley (Wt.).
,, *frenata* Pand. G., Cirencester (T.), 26/6/24. S., Cheddar (W.), 22/8/98.
,, ,, var. *cruentata* Pand. G., Kingsweston (A.), 25/6/31.
,, *haemorrhoa* Mg. G., Bristol (C.); Kingsweston (A.), 21/6/24. S., Sharpham (A.), 1/8/25.
,, *haemorrhoidalis* Mg. (*nurus* Fln.). G., Bristol (C.); Cirencester (T.); Shepperdine (A.), 15/8/24. S., Dunster (A.), 2/6/24; Shapwick (A.), 3/9/22; Taunton (A.), 6/6/31.
,, *incisilobata* Pand. G., Selsley (W.); Tormarton (A.), 13/7/29; Clifton (Wm.), 9/5/20.
,, *melanura* Mg. S., Dunster (A.), 8/16; Berrow (A.), 27/8/24.
,, *nigriventris* Mg. G., Painswick (W.); Bitton (C.); Cirencester (T.); Sheepscombe (St.), 29/7/24. S., Berrow (A.), 8/4/29; Sharpham (A.), 22/4/22; Rodney Stoke (A.), 6/4/29.

Sarcophaga offuscata Sch. G., Tormarton (A.), 13/7/29.
,, *pumila* Mg. G., Cirencester (T.), 1/6/23. S., Sharpham (A.), 26/8/22.
,, *setipennis* Rnd. G., Painswick (W.); Selsley (Wt.); Cirencester (T.).
,, *sinuata* Mg. G., Chalford (Wt.).
Sphecapata conica Fln. S., Berrow (A.), 13/7/30.

Sub-family Calliphorinae.

No ventral membrane; all abdominal sternites visible; eyes bare, touching in the male; arista plumose. Medium size flies. *Pollenia* is dark with golden hair on thorax, *Lucilia* and *Protophormia* are metallic green (Greenbottle Fly), *Onesia* dark blue, *Calliphora* and *Protocalliphora* metallic blue (Bluebottle Fly). Larvae live mainly in carrion.

Calliphora erythrocephala Mg. G. and S., very common.
,, *vomitoria* L. G. and S., common.
Engyzops pecchiolii Rnd. (*micronyx* B. & B.). G., Cranham (Wt.); Painswick (St.), 25/6/23; Cirencester (T.). S., Tickenham (A.), 28/6/09; Clevedon (W.), 29/8/02.
Lucilia caesar L. (*ruficeps* Mg.). G. and S., common.
,, *illustris* Mg. (*splendida* Mg., *simulatrix* Pand., *sylvarum* Mg.). S., Tickenham (A.), 19/7/24.
,, *richardsi* Col. G., Olveston (A.), 30/7/22. S., Rodney Stoke (A.), 6/4/29.
,, *sericata* Mg. (*nobilis* Mg.). G., Bristol (A.), 4/21.
Melinda (*Onesia*) *coerulea* Mg. (*cognata* Mg.). G., Kingsweston (A.), 21/6/24. S., Freshford (C.); Rodney Stoke (A.), 6/4/29; Backwell (A.), 18/4/27. On Snails.
Onesia agilis Mg. (*aculeata* Pand.; is the *O. sepulchralis* L. of former lists). G. and S., common.
Pollenia rudis F. G. and S., very common. On Earthworms. Cluster Fly.
,, *varia* Mg. G., Olveston (A.), 14/9/29.
,, *vespillo* F. G. and S., fairly common.
Protocalliphora coerulea R. D. (*sordida* Ztt., *azurea* Fln.). G. and S., fairly common.
Protophormia terrae-novae R. D. (*groenlandica* Ztt., *coerulea* Ztt.). G., Painswick (W.); Cirencester (T.), 8/6/24; Bristol (A.), 8/17; Kingsweston (A.), 13/3/26. S., West Town (Wm.), 10/7/27; Cheddar (C.). Larvae in carrion and nests of birds.

Sub-family Phasiinae.

Ventral membrane present or absent; eyes bare, separated in both sexes; antennae inserted just above middle of eye; arista bare. Small flies, not very bristly with long and narrow or broad and flat or globose abdomen. Probably parasitic on Hemiptera and Orthoptera.

Allophora hemiptera F. G., Chalford (Wt.).
Parallophora pusilla Mg. G., Selsley (Br.); Chalford (Wt.); Cirencester (T.), 18/5/23: Penpole Point, Bristol (Wm.), 17/7/22; Hallen (A.), 30/7/24.

Sub-family Hypoderminae.

Ventral membrane present; mouth organs absent. Large, hairy, but not bristly, species. Parasitic on Cattle (Warble Fly).

Hypoderma bovis L. G., Olveston (C.); Painswick (W.).
,, *lineatum* Vill. G., Damery (A.), 7/6/30.

Sub-family Oestridae.

Ventral membrane present; mouth organs absent. Large bare species. Parasitic on Sheep. (Sheep Nostril Fly, which causes disease called Staggers).

Oestrus ovis L. G., Painswick (W.).

II. MUSCIDAE

(including former ANTHOMYIDAE and part of former MUSCIDAE).

These flies somewhat resemble the Larvaevoridae but they can always be distinguished by the lack of hypopleural bristles. There are usually fewer strong bristles on the body and the discal wing vein either runs straight to the edge of the wing or is bent in a shallow curve. They should be pinned like the Larvaevoridae and the wings and legs should be pulled away from the body but not set horizontally. The following books are useful:—

1. Séguy. Diptères Anthomyides, "Faune de France," Vol. 6, 1923.
2. Karl. Muscidae, "Tierwelt Deutschlands," 1928.
3. Stein. Anthomyidae, "Arch. fur Nat.," 1913 and 1915.
4. Wingate. "Durham Diptera," 1906. Quite out of date.
5. Collin. British Limnophora, "E.M.M.," 1921.

Sub-family MUSCINAE.

Fifth longitudinal wing vein (discal) bent in a bow; arista plumose. All coprophagous.

Dasyphora cyanella Mg. (*Pyrellia eriophthalma* Mcq.). G. and S., common.
Graphomyia maculata Scop. G. and S., common.
,, *picta* Ztt. S., Sharpham (A.), 20/8/25.
Haematobia stimulans Mg. (A biting fly). G. and S., fairly common.
Mesembrina meridiana L. G. and S., very common in autumn.
Morellia aenescens R. D. (*curvipes* Mcq.). G. and S., common.
,, *hortorum* Fln. G. and S., frequent.
,, *simplex* Lw. G. and S., common.
Musca corvina F. (*autumnalis* Deg.). G. and S., very common.
,, *domestica* L. (House Fly). G. and S., moderately common.
Muscina (*Cyrtoneura*) *assimilis* Fln. (*caesia* Mg.). G., Bristol (A.), 6/8/31.
,, ,, *pabulorum* Fln. G., Cirencester (T.), 2/8/23; Bristol (A.), 10/10/24. S., Leigh Woods (A.), 12/4/30.
,, ,, *pascuorum* Mg. G., Olveston (C.).
,, ,, *stabulans* Fln. G., Bristol (Wm.). S., Kewstoke (Wm.), 24/9/22.
Myiospila meditabunda F. G. and S., common.
Orthellia (*Cryptolucilia, Euphoria*) *caesarion* Mg. G. and S., common.
,, ,, ,, *cornicina* F. G. and S., common.
Pyrellia cadaverina L. G., Wotton-under-Edge (P.). S., Batheaston (Br.).
, *cyanicolor* Ztt. G., Kingsweston (A.), 6/4/33. S., Dunster (A.), 8/16.
,, *serena* Mg. G., Painswick (W.); Wotton-under-Edge (P.).
Stomoxys calcitrans L. (Biting fly.) G. and S., common.

Sub-family PHAONIINAE.

Fifth longitudinal wing vein (discal) straight, the seventh (anal) does not reach edge of wing; two pairs of praesutural dorso-central bristles, an outer bristle on the tibia of the hind leg. All coprophagous.

Acanthiptera (*Sphecolyma*) *inanis* Fln. S., Taunton (P.); Bridgwater (Sl.); St Audries (A.), 23/8/29.
Alloeostylus diaphanus Wied. (*flaveola* Pand.). G., Painswick (W.). S., Clevedon (W.); Leigh Woods (A.), 18/10/24.
., *simplex* Wied. S., Freshford (C.); Leigh Woods (H.).
Coelomyia spathulata Ztt. (*mollissima* Hal.). G., Cirencester (T.), 21/4/23; Dursley (A.), 24/4/30; Blaise Castle (A.), 11/4/27. S., Leigh Woods (A.), 7/5/22.

Drymeia hamata Fln. G., Painswick (W.), 2/7/92; Wotton-under-Edge (P.). S., Shepton Mallet (Ch.), 19/6/25.

Fannia = Homalomyia.

Fannia aerea Ztt. G., Cirencester (T).

,, *armata* Mg., G., Painswick (W.), 6/6/01; Cirencester (T.); Olveston (A.), 18/6/22. S., Taunton (P.); Sharpham (A.), 7/9/25.

,, *canicularis* L. G. and S., very common in houses.

,, *coracina* Lw. G., Painswick (W.); Cirencester (T.), 11/7/24; Blaise Castle (A.), 9/21. S., Backwell (A.), 17/7/26.

,, *fuscula* Fln. G., Painswick (W.), 7/7/94. S., Prior Park, Bath (A.), 18/6/25; Backwell (A.), 17/7/26.

,, *genualis* Stein. G., Painswick (W.), 8/7/91.

,, *hamata* Mcq. G., Cirencester (T.), 28/6/23; Hallen (A.), 24/9/27. S., Tickenham (A.), 5/21; Leigh Woods (H.), 11/6/19.

,, *incisurata* Ztt. G., Painswick (W.); Wotton-under-Edge (P.); Olveston (A.), 14/9/29. S., Tickenham (A.), 2/6/25.

,, *manicata* Mg. G., Cirencester (T.); Hallen (A.), 24/9/27.

,, *mutica* Ztt. G., Painswick (W.), 26/8/91; Shepperdine (A.), 23/8/24. S., Sharpham (A.), 7/9/25; Shapwick (A.), 7/9/30.

,, *pallitibia* Rnd. G., Stone (A.), 28/7/28; Blaise Castle (A.), 6/9/30. S., Banwell (A.), 20/10/28.

,, *pretiosa* Schin. G., Olveston (A.), 1/9/23.

,, *scalaris* F. G. and S., fairly common.

,, *serena* Fln. G., Painswick (W.), 8/6/92; Olveston (A.), 3/9/23; Cirencester (T.). S., Shapwick (A.), 10/8/21; Keynsham (A.), 1/6/29.

,, *sociella* Ztt. G., Painswick (W.), 3/9/93; Cirencester (T.), 16/5/23. S., St Audries (A.), 29/8/29; Prior Park, Bath (A.), 4/6/30.

Hydrotaea albipuncta Ztt. G., Painswick (W.), 23/9/24; Cirencester (T.), 3/6/23.

,, *armipes* Fln. G., Olveston (A.), 16/6/28.

,, *ciliata* F. G., Wotton-under-Edge (P.); Painswick (W.), 27/5/92. S., Batheaston (Bl.); Sharpham (A.), 26/8/25.

,, *cyrtoneurina* Ztt. G., Olveston (A.), 30/7/22.

,, *dentipes* F. G. and S., common.

,, *irritans* Fln. G. and S., very common.

,, *meteorica* L. G., Cirencester (T.), 20/5/23. S., Tickenham (A.), 20/5/21: St Audries (A.), 24/8/29.

,, *occulta* Mg. G., Cirencester (T.), 22/5/23.

,, *palaestrica* Mg. G., Sheepscombe (St.), 18/6/27. S., Berrow (A.), 27/8/24.

,, *penicillata* Rnd. S., Clevedon (W.), 19/8/01.

Lasiops mutatus Fln. (*semipellucidus* Ztt.). G., Cirencester (T.).

,, *semicinereus* Wied. G. and S., fairly common.

Ophyra anthrax Mg. G., Wotton-under-Edge (P.).

,, *leucostoma* Wied. G. and S., fairly common.

Phaonia = Hyetodesia.

Phaonia basalis Ztt. G., Painswick (W.); Cirencester (T.); Sheepscombe (St.), 18/6/27. S., Clevedon (W.); Tickenham (A.), 19/7/24; Backwell (A.), 25/4/26.

,, *errans* Mg. G., Painswick (W.); Cirencester (T.), 22/6/23.

,, *erratica* Fln. G., Painswick (W.); Blaise Castle (A.), 8/21. S., Freshford (C.); Cheddar (G.); Leigh Woods (A.), 12/9/28; St Audries (A.), 30/8/29.

,, *goberti* Mik. S., Leigh Woods (H.).

,, *incana* Wied. G., Painswick (W.); Cirencester (T.), 1/7/24; Sheepscombe (St.), 18/6/27. S., Sharpham (A.), 28/4/24: Chew Magna (A.), 30/5/31.

,, *laeta* Fln. G., Bully (W.); Wotton-under-Edge (P.).

,, *mystica* Mg. S., Taunton (P.).

,, *pallida* F. G. and S., fairly common.

,, *palpata* Stein (*trigonalis* Mde.). G., Blaise Castle (A.), 28/5/27. S., Clevedon (A.), 14/5/27; Leigh Woods (H.), 19/5/19; Brockley (H.), 28/9/20.

,, *perdita* Mg. S., Leigh Woods (H.).

Phaonia rufipalpis Mcq. G., Olveston (C.); Cirencester (T.). S., Leigh Woods (H.), 3/7/18; Pensford (H.), 20/6/19; Sharpham (A.), 4/8/25.
,, *scutellaris* Fln. G., Painswick (W.); Kingsweston (A.), 30/5/25. S., Leigh Woods (H.); Keynsham (C.); Tickenham (A.), 28/4/25.
,, *scutellaris* Fln. var. *stolata* Rnd. S., Leigh Woods (A.), 18/10/24.
,, *serva* Mg. S., Leigh Woods (H.), 3/6/19.
,, *signata* Mg. G., Cirencester (T.), 14/10/23; Shepperdine (A.), 23/8/24. S., Leigh Woods (H.); Portishead (A.), 9/21; Brean Down (A.), 27/9/29.
,, *tinctipennis* Rnd. S., Sharpham (A.), 20/8/25.
,, *vagans* Fln. S., Taunton (A.), 6/6/31.
,, *variegata* Mg. G., Cirencester (T.); Kingsweston (A.), 8/4/25. S., Taunton (P.); Leigh Woods (G.); Shapwick (A.), 24/5/25.
Pogonomyia decolor Fln. (*cunctans* Stein). G., Cirencester (T.), 25/5/25.
Polietes albolineata Fln. G. and S., fairly common.
,, *lardaria* F. G. and S., very common.
Trichopticus pulcher Mde. G., Cirencester (T.), 16/6/24; Shepperdine (A.), 30/7/24. S., Shepton Mallet (C.).

Sub-family Mydaeinae.

Fifth longitudinal wing vein (discal) straight; seventh vein (anal) does not reach edge of wing; two pairs of praesutural dorsal bristles; no outer bristle on tibia of hind leg. All coprophagous.

Azelia aterrima Mg. S., Sharpham (A.), 7/9/25.
,, *cilipes* Hal. S., Sharpham (A.), 6/9/25; Tickenham (A.), 12/5/29.
,, *macquarti* Staeg. G. and S., fairly common.
,, *triquetra* Wied. G., Tortworth (A.), 27/4/27. S., Nailsea (A.), 21/4/27.
,, *zetterstedti* Rnd. G., Shepperdine (A.), 2/8/24.
Hebecnema and *Helina* are *Spilogaster, Mydaea, Hyetodesia* of old lists.
Hebecnema fumosa Mg. S., Sharpham (A.), 19/4/29.
,, *nigricolor* Fln. G., Blaise Castle (Wm.), 12/5/20. S., Banwell (Ch.), 31/5/25.
,, *umbratica* Mg. G. and S., fairly common.
,, *vespertina* Fln. G. and S., fairly common.
Helina abdominalis Ztt. G., Wotton-under-Edge (P.).
,, *anceps* Ztt. (*communis* R. D.). G., Wotton-under-Edge (P.); Bristol (C.).
,, *atripes* Mde. G., Painswick (W.); Cirencester (T.); Kingsweston (A.), 8/7/25. S., Berrow (A.), 13/8/30: Charterhouse-on-Mendip (A.), 20/6/23.
,, *calceata* Rnd. G., Shepperdine (A.), 13/8/24. S., Berrow (A.), 22/8/28.
,, *consimilis* Fln. G., Filton (A.), 1/6/32. S., Backwell (A.), 2/5/28.
,, *depuncta* Fln. G., Painswick (St.), 19/6/24; Kingsweston (A.), 8/7/29. S., Tickenham (A.), 8/20; Weston-s.-Mare (H.), 25/5/20; Ashcot (H.), 28/9/20.
,, *duplaris* Ztt. G., Cirencester (T.).
,, *duplicata* Mg. G. and S., fairly common.
,, *flagripes* Rnd. G., Painswick (St.), 26/7/22.
,, *impuncta* Fln. G., Painswick (W.); Cirencester (T.); Olveston (A.), 18/6/22. S., Tickenham (A.), 8/20.
,, *lasiophthalma* Mcq. G., Cirencester (T.), 26/5/24. S., Clevedon (W.), 29/8/02.
,, *latitarsis* Rgdh. S., Keynsham (A.), 19/7/26.
,, *lucorum* Fln. G. and S., common.
,, *marmorata* Ztt. S., Leigh Woods (H.), 19/6/19.
,, *obscurata* Mg. S., Tickenham (A.), 12/6/29.
,, *pertusa* Mg. G., Hallen (A.), 14/9/25.
,, *protuberans* Ztt. S., Berrow (A.), 8/21; Burnham (A.), 25/8/22.
,, *quadrimaculata* Fln. G., Cirencester (T.), 17/6/24; Tortworth (A.), 27/4/27.
,, *quadrum* F. G., Painswick (W.), 18/6/91; Cirencester (T.), 2/7/24; Olveston (Wm.), 13/6/28.
Limnophora (s.g. *Spilogona*) *denigrata* Mg. G., Sheepscombe (St.), 18/6/27. S., Taunton (P.); Holford Glen (A.), 28/8/29; St Audries (A.), 30/8/29.

Limnophora (s.g. *Gymnodia*) *humilis* Ztt. (*septemnotata* Stein). S., Sharpham (A.), 6/8/23.
,, (s.g. *Limnophora*) *maculosa* Mg. S., Tickenham (A.), 24/5/26.
,, (s.g. *Calliophrys* or *Melanochelia*) *riparia* Fln. G., Littledean (A.), 25/5/31.
,, (s.g. *Limnophora*) *setinerva* Schnbl. (*exsurda* Stein). G., Aust (A.), 6/9/23. S., St Audries (A.), 19/8/29.
,, (s.g. *Pseudolimnophora*) *triangula* Fln. S., Tickenham (A.), 11/5/29.
,, (s.g. *Spilogona*) *veterrima* Ztt. (*signata* Stein). S., Berrow (A.), 13/7/30.
Lispa crassiuscula Lw. (*caesia* Mg.). G., Shepperdine (A.), 6/8/24. S., Burnham (A.), 25/8/22.
,, *tentaculata* Deg. G., Olveston (A.), 31/8/23. S., Shepton Mallet (C.), Burnham (A.), 25/8/22.
,, *uliginosa* Fln. S., Sharpham (A.), 11/8/25.
Mydaea pagana F. G., Wotton-under-Edge (P.); Cirencester (T.); Olveston (C.). S., Hanham (A.), 19/6/22; Keynsham (A.), 1/6/29.
,, *tincta* Ztt. G., Cirencester (T.), 16/6/24.
,, *urbana* Mg. G., Wotton-under-Edge (P.); Cirencester (T.). S., Leigh Woods (A.), 29/9/24; Chewstoke (A.), 8/7/32.

Sub-family ANTHOMYINAE.

Discal vein of wing straight; anal vein reaching to edge of wing; two pairs of praesutural dorso-central bristles; bristles on sternopleura (lateral chitinous plate of thorax lying between front and middle coxae) not three in number or if three then not arranged in an equilateral triangle. Coprophagous or phytophagous unless otherwise stated.

Acroptena (*Hydrophoria*) *ambigua* Fln. S., St Audries (A.), 18/7/29.
,, ,, *divisa* Mg. S., Tickenham (A.), 11/7/31.
Anthomyia pluvialis L. G. and S., common.
Chirosia albitarsis Ztt. G., Filton (A.), 22/5/30.
Chortophila=*Chortophila*, *Phorbia* and part *Hylemyia* of old lists.
Chortophila (s.g. *Crinura*) *albula* Fln. (*arenosa* Ztt.). S., Berrow (A.), 22/7/22; Burnham (A.), 17/6/24.
,, (s.g. *Crinura*) *antiqua* Mg. (*cepetorum* Mde.). G., Painswick (W.): Bristol (C.). Bred from Onions.
,, (s.g. *Egeria*) *brassicae* Bché. (*floccosa* Mcq.). G. and S., common. Cabbage Fly.
,, (s.g. *Egeria*) *brunneilinea* Ztt. (*seticrura* Rnd.). G., Painswick (W.), 7/6/99. S., Sharpham (A.), 5/9/25; Chewstoke (A.), 8/8/32.
,, (s.g. *Delia*) *cardui* Mg. G., Painswick (W.), 7/7/89; Shepperdine (A.), 30/7/24. Carnation Fly.
,, (s.g. *Crinura*) *cilicrura* Rnd. (*florilega* Ztt.). G. and S., fairly common.
,, (s.g. *Flavena*) *criniventris* Ztt. G., Painswick (W.), 18/7/91.
,, (s.g. *Egeria*) *discreta* Mg. G., Shepperdine (A.), 8/8/24. S., Shapwick (A.), 16/7/27; Prior Park, Bath (A.), 30/5/29; Brockley Combe (A.), 6/21.
,, (s.g. *Nudaria*) *dissecta* Mg. G. and S., fairly common.
,, (s.g. *Thrixina*) *exigua* Mde. G., Painswick (W.), 17/9/05; Kingsweston (A.), 1/4/26. S., Clevedon (W.), 25/5/02.
,, (s.g. *Thrixina*) *fugax* Mg. (*pudica* Rnd., *striolata* Fln.). G. and S., fairly common.
,, (s.g. *Egeria*) *humerella* Ztt. S., Sharpham (A.), 18/4/24.
,, (s.g. *Nudaria*) *intersecta* Mg. (*neglecta* Mde.). G. and S., fairly common.
,, (s.g. *Egeria*) *pullula* Ztt. G., Cirencester (T.), 15/6/23; Kingsweston (A.), 17/5/24.

Chortophila (s.g. *Egeria*) *signata* Brischke. S., Banwell (Sl.), 30/5/18; Blackdown (Sl.), 21/6/21; Chalcombe Bay (Sl.), 22/8/18. On Ferns.
,, (s.g. *Tricharia*) *trichodactyla* Rnd. G., Painswick (W.), 3/7/97; Cirencester (T.), 24/5/23.
,, (s.g. *Egeria*) *varicolor* Mg. (*trapezina* Ztt.). G., Cirencester (T.), 16/5/24. S., Clevedon (W.), 25/8/02; Swinford (C.).
Egle (*Chortophila, Phorbia*) *muscaria* Mg. G., Painswick (W.), 23/4/91; Filton (A.), 18/6/26. S., Tickenham (A.), 24/4/22.
,, ,, ,, *parva* R. D. S., Clevedon (A.), 11/8/31.
Eustalomyia (*Phorbia*) *festiva* Ztt. G., Painswick (W.), 5/93. S., Sharpham (A.), 4/8/25.
,, ,, *histrio* Ztt. G., Cirencester (T.), 28/6/22; Hallen (A.), 19/6/26. S., Leigh Woods (H.).
Fucellia fucorum Fln. S., Burnham (A.), 28/8/22.
,, *maritima* Hal. G., Aust (A.), 6/9/23. S., Burnham (A.), 28/8/22; Dunster (A.), 8/6/24.
Hammomyia albiseta v. Ros. (*albescens* Ztt.). S., Swinford (C.). On *Halictus* spp.
,, *grisea* Fln. S., St Audries (A.), 20/8/29. On *Colletes* sp.
,, *sociata* Mg. G., Bitton (W.), 11/6/04; Shepperdine (A.), 22/8/24. On *Halictus*.
Heterostylus atomarius Deg. G., Dursley (A.), 30/3/30.
Hydrophoria conica Wied. G. and S., fairly common.
,, *linogrisea* Mg. G., Bristol (A.), 8/6/32.
,, *ruralis* Mg. (*anthomyica* Rnd.). S., Sharpham (A.), 4/9/25; Chewstoke (A.), 8/8/31.
Hylemyia coarctata Fln. G., Cirencester (T.), 21/8/24.
,, *lasciva* Ztt. G., Painswick (W.), 3/6/97; Cirencester (T.), 3/6/23. S., Taunton (A.), 9/6/24; Berrow (A.), 7/8/24; Backwell (A.), 17/8/26.
,, *nigrimana* Mg. G. and S., fairly common.
,, *strigosa* F. G. and S., common.
,, *variata* Fln. G. and S., very common.
Hylephila obtusa Ztt. G., Painswick (W.), 29/5/90. On Fossorial Hymenoptera.
,, *sponsa* Mg. G., Bitton (W.), 21/8/00. On Fossorial Hymenoptera.
Mycophaga fungorum Deg. G., Cirencester (T.), 4/6/23. S., Taunton (P.).
Opsolasia (*Lasiomma*) *adelpha* Kow. G., Kingsweston (A.), 17/4/29.
,, ,, *roederi* Kow. G., Painswick (W.), 5/94; Kingsweston (A.), 17/4/29.
Paregle (*Anthomyia*) *aestiva* Mg. G. and S., common.
,, ,, *cinerella* Fln. S., St Audries (A.), 29/8/29.
,, ,, *radicum* L. G. and S., very common.
Pegomyia bicolor Wied. G., Painswick (W.), 26/7/95; Cirencester (T.); Olveston (A.), 15/8/22. S., Sharpham (A.), 22/8/22; Rodney Stoke (A.), 16/4/29.
,, *flavipes* Fln. S., Tickenham (A.), 8/20; Leigh Woods (H.), 26/6/16.
,, *haemorrhoa* Ztt. G., Olveston (A.), 30/7/22.
,, *hyoscyami* Pz. (*betae* Curt.). G., Bristol (A.), 8/18; Blaise Castle (A.), 29/4/28. S., West Town (Wm.), 7/23.
,, *iniqua* Stein. G., Shepperdine (A.), 22/8/24.
,, *nigritarsis* Ztt. G. and S., fairly common.
,, *rufina* Fln. G., Olveston (A.), 24/3/23.
,, *silacea* Mg. G., Wotton-under-Edge (P.).
,, *transversa* Fln. G., Painswick (W.), 22/7/92.
,, *ulmaria* Rnd. S., Taunton (P.).
,, *univittata* v. Ros. S., Backwell (A.), 17/7/26; Leigh Woods (H.), 16/6/19.
,, *versicolor* Mg. G., Cheltenham (Wm.), 4/4/20. S., Nailsea (Wm.), 1/5/26; Moreton (A.), 17/5/22; Leigh Woods (H.), 1/7/18.
,, *winthemi* Mg. G., Painswick (W.), 22/7/92; Olveston (A.), 15/7/22. S., Sharpham (A.), 18/8/25.
Phorbia sepia Mg. G., Wotton-under-Edge (P.).
Pycnoglossa (*Pogonomyza*) *flavipennis* Fln. S., St Audries (A.), 24/8/29; Winscombe (A.), 5/7/30.

Sub-family Coenosiinae, Tribe Coenosiini.

Discal vein of wing straight; anal vein does not reach edge of wing; only one pair of praesutural dorso-central bristles, three hypopleural bristles forming an equilateral triangle. Small flies; larvae probably zoophagous.

Allognota agromyzina Fln. G., Cirencester (T.), 20/5/23. S., Leigh Woods (A.), 12/9/28.
Coenosia includes *Caricea*.
Coenosia decipiens Mg. (*pedella* Fln.). S., Berrow (A.), 29/9/24; St Audries (A.), 30/8/29.
,, *geniculata* Fln. S., Berrow (A.), 27/8/24.
,, *humilis* Mg. (*nana* Ztt.). G., Wotton-under-Edge (P.).
,, *intermedia* Fln. G., Painswick (W.), 16/7/92. S., Holford Glen (A.), 28/8/29.
,, *lineatipes* Ztt. G., Painswick (W.), 7/04; Olveston (A.), 28/6/25; Dursley (A.), 20/6/25. S., Leigh Woods (A.), 31/9/27; St Audries (A.), 23/8/29.
,, *means* Mg. G., Wotton-under-Edge (P.).
,, *pumila* Fln. G., Painswick (W.), 22/7/91. S., Clevedon (W.), 29/8/02.
,, *sexmaculata* Mg. G., Wotton-under-Edge (P.). S., Berrow (A.), 27/8/24.
,, *tigrina* F. G. and S., common.
,, *tricolor* Ztt. (*infantula* Rnd.). G., Painswick (W.), 27/7/89; Cirencester (T.), 3/6/24. S., Clevedon (W.), 6/9/02; St Audries (A.), 29/8/29; Leigh Woods (A.), 12/9/28.
Hoplogaster mollicula Fln. G. and S., fairly common.
Schoenomyza litorella Fln. S., Clevedon (W.), 25/8/02; Backwell (A.), 25/4/26.

Sub-family Gasterophilinae.

These form a link between the calyptrate and acalyptrate flies. Mouth organs rudimentary. Large, hairy, brownish flies with large wings and long curved abdomen. The larva of the British species lives in the stomach of the Horse (Horse Botfly).

Gasterophilus intestinalis Deg. (*equi* Clk.). G., Painswick (W.); Wotton-under-Edge (P.). S., Wellington (Bl.); Sharpham (A.), 28/8/22.

CORRECTIONS.

N.B.—Now that the use of the names in Meigen's "Nouvelle Classification," 1800, has been authorised by the International Entomological Congress (Paris, 1932) it is hoped that there will be no further changes in the nomenclature.

Part II, p. 125—*Flabellifera* for *Ctenophora*, and *Pales* for *Pachyrhina*.
Part III, p. 202—*Noeza* for *Hybos*.
Part III, p. 205—*Hercostomus fulvicauda* Wlk. for *H. flavicauda* Wlk.
Part III, p. 206—*Musidoridae* for *Lonchopteridae* and *Musidora* for *Lonchoptera*.
Part IV, p. 272-3—*Epistrophe* is feminine, so specific names ending in "us" must end in "a."
Part IV, p. 275—Sub-family Eristalinae. After "subcostal cell closed" insert "in first four genera, open in the others."
Part IV, p. 276—Substitute *Zelima* for *Milesia*.

ADDITIONS.

CERATOPOGONIDAE.

Sphaeromias (*Johannsenomyia*) *nitida* Mcq. G., Painswick (W.), 18/7/91.
Atrichopogon winnertzi Goet. G., Painswick (W.), 8/7/02.

CHIRONOMIDAE.

Chironomus (*Microdentipes*) *nitidus* Mg. S., Leigh Woods (A.), 7/5/32.

TIPULIDAE.

Limnophila fulvonervosa Schum. (*lineolella* Verr.). G., Littledean (A.), 5/6/32. S., Chewstoke (A.), 8/7/32.
,, *lineola* Mg. S., Leigh Woods (A.), 23/5/25; Sharpham (A.), 28/7/25; Tickenham (A.), 16/5/25; St Audries (A.), 21/8/29.
,, *phaeostigma* Schum. (*meigenii* Verr.). G., Littledean (A.), 5/6/32.
Tipula pabulina Mg. G., Cranham (Wm.), 27/8/28.

STRATIOMYIIDAE.

Beris morrisi Dale. S., Prior Park, Bath (A.), 25/6/32.

EMPIDIDAE.

Hilara beckeri Strbl. G., Painswick (W.), 16/5/24.
Rhamphomyia albosegmentata Ztt. (*stigmosa* Mg.). G., Littledean (A.), 5/6/32.
Trichopeza longicornis Mg. G., Littledean (A.), 5/6/32.

DOLICHOPODIDAE.

Sciopus (*Psilopus*) *wiedmanni* Fln. G., Painswick (W.), 17/7/95.
Porphyrops crassipes Mg. G., Littledean (A.), 5/6/32.
Hypophyllus discipes Ahr. G., Bristol (A.), 6/7/32.

MUSIDORIDAE.

Musidora (*Lonchoptera*) *furcata* Fln., var. *furcata* Fln. and var. *rivalis* Mg. S., Clevedon (W.), 29/8/02.

SYRPHIDAE.

Chilosia impressa Lw. G., Kingsweston (A.), 13/6/32.
Syrphus latilunulatus Col. S., Sharpham (A.), 11/8/23.
Ferdinandea ruficornis Fab. S., Backwell (A.), 25/4/26.

ADDITIONS TO BIBLIOGRAPHY.

A key to the British species of Asilidae. B. M. Hobby, "Trans. Ent. Soc. S. Eng," 1932.

British Tipulinae. H. Audcent, "Trans. Ent. Soc. S. Eng.," 1932.

Syrphidae, P. Sack, and Conopidae, O. Kröber, "Tierwelt Deutschlands," 1930.

Denny Isle.

By L. Harrison Matthews, M.A.

THE Denny, a small island off Portishead, in the Bristol Channel, is well known by sight to thousands, though comparatively few have landed upon it. These notes on the island, and the plants and animals that live there, are the outcome of visits to the Denny made in September, 1922, and June 1932.

The Denny is a limestone rock, 2¾ miles from the nearest part of the Monmouthshire coast, near Magor Pill, and 2¼ miles from the corresponding part of the Somersetshire coast at Battery Point. Its distance from Avonmouth is 3 miles, and from Portishead Pier 2½ miles. The shape of the island is long and narrow; it is about fifty yards wide and one hundred yards long. Its long axis lies nearly north by east and south by west, and its superficial area is about ¾ acre. The summit of the island is flat, with a slight slope towards the south-east, and lies about twenty-five feet above high water mark. From the high tide level to the summit the entire coast line consists of abrupt cliffs about twenty feet high, which at the north and south ends are less steep, and form easily-ascended rocky slopes. A conspicuous beacon stands near the centre of the island.

At low tide, when there is a fall in water level of 35 to 40 feet, the island stands in the midst of a waste of sandbanks, the Welsh Grounds, which are only a few feet above low tide level. The tidal foreshore of the island consists of a rock slope, strewn with *Fucus*-covered boulders and stones set in the familiar Bristol Channel mud. At the base of the cliff at the north end of the island is a small pebble beach, which is completely submerged at high tide. At low tide a lake of considerable extent is left between the base of the rocky slope and the level sands on the north-west side, and a smaller one on the south-east side.

The deep water channel of the Severn estuary runs on the Somersetshire side of the island, so that at low tide the uncovered sandbanks of the Welsh Grounds occupy all the area between the Denny and the Monmouthshire coast. The sands, which look so inviting from the Somersetshire shore, are nearly everywhere dangerous quicksands, on which it is impossible to land; though they look dry and firm enough, immediately one sets foot upon them water rises to the surface, and the surrounding area quakes and shivers, ready to engulf the unwary venturer. At the turn of the tide the returning waters rush over the sandbanks with a surprising, and even alarming, speed and roar.

Geologically, the Denny consists of a mass of limestone rock, which was believed by Buckland and Conybeare (3) to be a connection between the rocks of the Portishead Ridge and those of Monmouthshire, but Lloyd Morgan (5) regards the island as the continuation of the Kingsweston and Penpole axis.

Though so small in area and exposed in position, the Denny supports a flora and fauna which is perhaps more numerous in species than might be expected. A single plant association covers nearly all the island; a second, smaller one, being limited to one end. Of the vertebrate fauna, a few species of bird breed on the island, whilst the remainder find sanctuary on it at high tide, and seek their food on the surrounding shores at low tide. The invertebrates fall into two groups —those that feed on the vegetation, either living or decayed, and those that prey on the first.

BOTANY.

The summit of the Denny is clothed with a thick growth of long grass, never mown, grazed, nor subjected to trampling, so that a dense mat of vegetation resilient to the tread is formed. This vigorous growth consists nearly entirely of the grass *Festuca rubra*, with a less amount of *Triticum pungens* mixed with it, and forms the main plant association of the island. Amongst the grass grow scattered plants of the various species enumerated below. At the edge of the cliff at the south-west end of the island there is a small area of short turf, composed mainly of the grass *Festuca ovina*, in association with *Plantago maritima* and *Lotus corniculatus*, while a plentiful growth of Samphire obtains footing in the crannies of the cliffs all round the island.

1. *Lavatera arborea* L. Tree Mallow.

About twenty strong plants of the Tree Mallow were found growing at the cliff edge on the east side of the island. J. W. White, in the "Flora of Bristol" (9), states that this species is probably indigenous on the islands in the Bristol Channel, and quotes Parkinson ("Theatrum Botanicum," 1640), "Malva arborea marina nostras . . . . In an island called Dinnie, three miles from King's Roade and five miles from Bristow." Mr White adds: "I am assured by friends who have landed on the Denny in recent years that there is now no trace of the Tree Mallow on the island." It is therefore with great pleasure that I am able to report that the plant is still well established and in vigorous growth there.

Though not rare by the sea coast, this plant has few stations where it is indigenous in the Bristol district. This is its nearest locality to Bristol.

2. *Lotus corniculatus* L. Bird's-foot Trefoil.

A number of very luxuriant and long-stemmed plants were found amongst the long grass of the summit, while in the short turf of the south end the plant was abundant, and of typical dwarf habit.

3. *Vicia angustifolia* L. Wild Vetch.

4. *Potentilla reptans* L. Trailing Cinquefoil.

A few plants of both these species occur in the long grass.

5. *Crithmum maritimum* L. Samphire.

In plenty on the cliffs of the island. White (9) notes Samphire as decreasing on the Bristol Channel coast.

TREE MALLOW (*Lavatera arborea* L.) flowering on the Denny.
(East side, looking north.)

6. *Carduus tenuiflorus* Curt. Slender-flowered Thistle.

A few plants of this sea-coast thistle were found amongst the long grass of the summit of the island.

7. *Thrincia hirta* Roth. Hairy Hawk-bit.

8. *Taraxacum vulgare* Schrank. Dandelion.

9. *Crepis virens* L. Smooth Hawk's-beard.

A few plants of these three common species grow among the long grass.

10. *Plantago maritima* L. Sea Plantain.

A vigorous growth of large plants occurs on the cliffs, and in the short turf of the south end of the island.

11. *Rumex crispus* L. Curled Dock.

A few plants of the Curled Dock, not yet in flower, were noticed in the long grass in June, 1932.

12. *Festuca ovina* L. Sheep's Fescue-grass.

A small area of short turf is formed by this grass at the summit of the cliff at the south end of the island, in association with *Plantago maritima* and *Lotus corniculatus*.

13. *Festuca rubra* L. (=*F. duriuscula*). Hard Fescue-grass.

The commonest plant on the island, and the dominant species of the main plant association, forming a dense mat over most of the summit. Its slightly creeping, sub-caespitose mode of growth on the Denny exactly corresponds with the description given by Boswell Syme in Sowerby's "English Botany" (8).

14. *Triticum pungens* Pers. Erect Sea Couch-grass.

This grass occurs in considerable quantity in association with the dominant *Festuca rubra* on the summit of the island. Although its flowering season is July and August, a few flowering stems were found in June, 1932, and are assignable to the awned variety *aristatum* Warren = *T. littorale* Host.

ZOOLOGY.

Mammalia.

1. *Phoca vitulina* L. Common Seal.

In September, 1922, two seals were seen at low tide on the sand-banks near the Denny. In June, 1932, one was seen, and was kept under observation for some time. It showed great curiosity in our party, and approached close to the shore of the island and to our boat to examine us. Such curiosity is a well-known habit of seal. J. N. Duck (4) records that "in the spring of 1850 a seal was shot whilst basking on the rocks of the Denny." It is greatly to be hoped that the present day seals will not be molested, either by sportsmen or by the owners of salmon fisheries further up the Severn estuary, which latter are surely far enough away to escape damage. C. K. Rudge and H. J. Charbonnier (7) note the Common Seal as an accidental visitor to the

Bristol district, and record one shot at Clevedon in 1874. In view of the fact that seals were seen at the Denny on both my visits, separated by a period of ten years, it seems that the species can be regarded as a permanent resident in the district. I feel sure that all local naturalists will be gratified to know that these interesting and attractive animals are to be found within nine miles from our city (actually within the boundary of the City and County of Bristol). When I noticed the seals at the Denny in 1922, I was led to believe that they might have been animals released in the Channel from the Clifton Zoological Gardens during the war, when there was a shortage of food for animals in captivity. However, as that is more than fifteen years ago, I think that one is justified in regarding the present seals as true wild animals. The seals no doubt find an abundance of food at the Denny, as the Channel is well stocked with fish, though one would suppose that the turbidity of the water would make their capture difficult to animals hunting by sight.

Before visiting the Denny I had heard rumours of the existence on the island of a race of rats " as large as rabbits." These tales are certainly legendary; no trace of any land mammal was found, and I think that it can be safely said that there are no rats there. It is possible, though not probable, that there may be some of the smaller mammals, such as mice, voles or shrews, on the island.

Aves.

The Denny affords a secure and secluded retreat at high tide for the shore birds that feed on the surrounding sands at low water. It is, in addition, a favourite haunt of duck.

1. *Anthus spinoletta petrosus* Mont. Rock Pipit.

The Rock Pipit is common on the shores of the Bristol Channel; four pairs were observed on the Denny in June, 1932. One nest was found, placed on a rock ledge at the top of the cliff. It was completely overhung by a tuft of the grass *Festuca rubra*, and was built and lined with the dead leaves of the same grass.

2. *Falco peregrinus peregrinus* Tunst. Peregrine Falcon.

On April 18, 1927, a Portishead resident, who made a hobby of motor-boating, paid a visit to the Denny. He there found a nest containing four eggs, of which he took two, not knowing to what species of bird they belonged. On his return he brought the eggs to Mr C. Bartlett, who immediately recognised them as those of the Peregrine Falcon. The finder reported that the nest was on a ledge of the low cliff of the island, and that a number of bird bones were scattered around it. There is no doubt whatever that the eggs were taken on the Denny (they were about a week incubated when they were brought to Mr Bartlett), nor is the identification of them in question, as to make quite sure, they have been compared with the series of Peregrine Falcon eggs in the Bristol Museum, and Mr H. Tetley confirms the diagnosis. I have not been able to find that the Peregrines have bred on the Denny since 1927; there was certainly no sign of them in 1932. It is possible that they were the same birds that have nested in the Avon Gorge during the last few years, or they may be related to them.

3. *Tadorna tadorna* L. Sheld Duck.

The Sheld Duck breeds on the Denny; in June, 1932, two nests were found. One contained nine eggs, while the brood had hatched from the other, leaving only the down and an addled egg. Both nests were concealed in the long grass in a small depression of the surface, about two feet below the general level of the summit. The nests, built on the ground and not placed in burrows, were completely concealed by the overhanging tufts of grass.

4. *Anas platyrhynchus platyrhynchus* L. Wild Duck.

Large flocks of Wild Duck resort to the Denny in the autumn. In June, 1932, a flock of about twenty was seen on the rocks by the tide as we approached. Among the long grass of the summit, not far from the Sheld Ducks' nests, a nest of this species was found. It contained no eggs, but is identified by the down and fragments of eggshell.

5. *Sula bassana* L. Gannet.

In the list of Bristol Birds (2) published in these "Proceedings" some years ago, Dr. J. A. Norton notes that "a party of four or five was seen on Denny Isle on September 3rd, 1893," and this is the only record given for the Bristol district. Bad weather can only account for the occurrence of this species so far up the Bristol Channel, where the muddy water is entirely unsuited to its fishing habits.

6. *Charadrius hiaticula hiaticula* L. Ringed Plover.

7. *Tringa totanus totanus* L. Redshank.

Numbers of both these species were seen on the shores of the Denny in September, 1922. Doubtless many other species of waders and shore birds occur there in autumn and winter.

8. *Haematopus ostralegus occidentalis* Neumann. Oyster-catcher.

The list of Bristol Birds referred to above (2) gives the Oyster-catcher as "common on the Severn coast. Nests on Denny Isle." It appears to be doubtful if this species continues to nest on the island at the present time.

9. *Larus ridibundus ridibundus* L. Black-headed Gull.

10. *Larus argentatus argentatus* Pont. Herring Gull.

A number of Black-headed and Herring Gulls were seen on both my visits to the island. The gulls haunting the Denny during the spring and summer are either immature or non-breeding birds.

INVERTEBRATA.

Nearly all the invertebrate animals found on the Denny are small and inconspicuous forms that live in the herbage beneath the mat of long grass, the carnivorous species preying on those that feed on the plants and vegetable debris. Undoubtedly this list could be very much extended by careful search for minute and inconspicuous species. No particular rarities are recorded.

Mollusca.

1. *Lauria cylindracea* Da Costa.

2. *Helicella nitidula* Drap.

Both these small species of snail were found in some numbers on the summit.

Crustacea.

3. *Ligia oceanica* L.

Common at the base of the cliff, as in similar places everywhere on the shores of the Bristol Channel.

4. *Armadillidium vulgare* Latr.

Occurs in the greatest numbers all over the island. It is particularly numerous at the edge of the cliff, where the turf can be peeled off the rock, revealing great numbers of this woodlouse. About fifty per cent. of the specimens are of the usual leaden colour, whilst the remainder are variegated with dirty white markings on a brownish grey ground. The specimens are smaller than usual, none of them being over twelve millimetres in length, and few as long; the adult from other localities is about fifteen mm. long. The dark coloured examples are ten to eleven mm. in length, but the variegated ones are eight to nine mm., and therefore represent a sub-adult stage. This species probably feeds on the decaying grass stems and other vegetable debris on the Denny. It is, in point of numbers, the dominant species of the fauna.

Arachnida.

5. *Trochosa terricola* Thorell.

Several specimens of this spider were found amongst the long grass. It is a common species throughout England and Wales, and, according to Pickard-Cambridge (6), it is found under stones and other similar protection in meadows, and among moss and heather on heaths and moors.

6. *Dysdera cambridgii* Thorell. (=*erythrina* Walch.)

Two specimens were found amongst the long grass. Pickard-Cambridge states that under stones and detached portions of rock, as well as in cracks and crevices of the earth, it dwells and spins a silken tube. Pearcey (1) records this spider as moderately common under stones on Steep Holm.

7. *Harpactes hombergii* Scop.

One specimen of this small spider was found amongst herbage. It is a common species nearly everywhere.

8. *Trombidium holosericeum* L.

A few specimens of this mite were found amongst vegetable debris beneath the mat of grass.

Myriapoda.

9. *Lithobius forficatus* L.

One specimen was found amongst the roots of long grass.

10. *Cylindroiulus* sp.

One specimen in similar situation as the last. The specimen is a female, but a definite diagnosis of the species is impossible, as males are necessary for specific determinations in this genus. The species is probably either *C. britannicus* or *C. frisius*.

INSECTA.

Apterygota.

11. *Isotoma viridis* Bourl. (=*anglicana* Lubbock.)

A single specimen from the base of the long grass.

12. *Anurida maritima* Guer.

In abundance under stones and on the surface of rock pools below high-tide level.

Coleoptera.

13. *Harpalus aeneus* F.

14. *Lacon murinus* L.

Specimens of both these common beetles were taken, *H. aeneus* on the ground under dense herbage, and *L. murinus* sitting on grass stems.

Rhynchota.

15. *Deltocephalus* Burm. sp.

Two immature specimens amongst vegetable debris at the base of long grass.

Lepidoptera.

16. *Elachista cygnipenella* Hübn.

Several specimens of this little moth were found amongst herbage. It is a common species of which the larva feeds in the stems of various species of grass.

Hymenoptera.

17. *Myrmica ruginodes* Nyl.

18. *Donisthorpea flava* F.

Specimens of both these common species of ant were found amongst the short turf of the south end of the island, where two nests of *D. flava* were noticed.

In conclusion, I wish to thank the Rev. S. Graham Brade-Birks, D.Sc., of the South-Eastern Agricultural College, Wye, Kent, for kindly determining the Myriapoda, and Mr C. Bartlett for aid in identifying the Lepidoptera and Coleoptera, and for information regarding the nesting of the Peregrine Falcon.

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Interesting Fungi found in the Botanical Gardens of the University of Bristol.

By W. R. Ivimey Cook, B.Sc., Ph.D., F.L.S.

DESPITE their comparatively small size, and the fact that the ground is in constant cultivation, the University Botanical Gardens have yielded, during the last few years, a number of interesting and comparatively uncommon fungi. I am not concerned here with the numerous microscopic fungi responsible for plant diseases which invariably appear where a large and diverse collection of flowering plants are grown. Those about which I propose to speak are all of them macroscopic fungi, and ones which, with a few exceptions, are all, at any rate superficially, free-living.

The University Botanic Gardens consist of two plots of ground; the smaller adjoins the University buildings and the Department of Botany, and contains mostly foreign plants and those of special character, such as rock plants, bog and water plants. This garden, which I shall subsequently refer to as the Botanical garden, does not for one reason or another produce many higher fungi, though attempts have been made to induce them to grow in the fern bank near the buildings. The larger garden is situated at the corner of Woodland Road and Tyndalls Road, and is reserved for experimental work and for British plants. I shall speak of this plot as the Experimental garden, and it is here that the more remarkable species have occurred.

Commencing with the Agaricaceae, I have found a number of interesting species, some of which are common inhabitants of the woods around Bristol, while others are by no means so frequently found. An interesting succession of common species may be seen each autumn on the side lawn in the Experimental garden. Early in August there appears all over the grass the fruiting bodies of *Coprinus micaceus*, a common fungus which may be found widely distributed around Bristol. As soon as it dies down, which it does after quite a few days, another member of the Agaricaceae makes its appearance. This is *Lepiota cristata*, a small species not more than an inch and a half in height and an inch across the cap. It is a near relative of the Parasol Mushroom, and is characterised by the presence of a ring around the stem. This fungus persists for several weeks, and quite a number of fruiting bodies are produced. They finally disappear, and a third species grows up. This is *Armillaria mellea*, a common wood-destroying species, which spreads on to the lawn from some decaying elm stumps in the bed behind. Although it has not been proved, it seems likely that it is really growing on the dead and dying elm roots which run below the grass. This third fungus continues until the frosts, and may be found for several weeks. No other fungi have been found on this lawn, and these three species always appear in the same order, the one dying down before the appearance of the next.

Fruiting bodies of *Armillaria mellea* also develop freely among the stumps and roots of the trees, and large masses are sometimes formed. Fortunately the fungus does not seem to spread to other parts of the garden. Lower down, among a plantation of Conifers, another species, *Entoloma clypeatum*, made its appearance this year for the first time. Its fruiting bodies develop about April, and only continue for a few weeks, consequently, it is one of our earliest fungi.

Various species of *Coprinus* appear in the gardens during the year. In the spring *Coprinus stercorarius* develops in the greenhouse in the Experimental garden, growing on the richly manured soil. The life of the fruiting bodies is very brief. They generally appear about dusk, and the little bell-shaped heads push their way through the soil. Each is covered with a greyish meal. The stem elongates rapidly, and often reaches four or five inches. Dissolution or autodigestion of the gills soon sets in, and by next morning all that is left is the stem and a black liquid mass consisting of the remains of the gills and the black spores. This special mechanism for spore distribution is characteristic of the genus *Coprinus*, and is found in all the species. Another species, which sometimes makes its appearance in the Natural Order beds, in the Experimental grounds, is *Coprinus atramentarius*, which is a larger and more durable species, with a cap measuring about five inches in length, supported on a stem from six to seven inches long. It is greyish white in colour, and the top of the cap is very shaggy.

A beautiful violet fungus, *Cortinarius violaceus*, grows now and then in the Botanical garden, around the roots of *Gunnera manicata*. Its chief interest, apart from the colour, is the curious markings on the stem, which are the remains of a cobweb-like veil. *Nolanea icterina* has also been found on one occasion among the frames in this garden. It is a curious fungus with a yellowish cap and a reddish brown stem. The cap is convoluted and thrown into folds, and at first sight scarcely looks like an Agaric at all. The stem is very deeply ridged, giving the appearance of consisting of several fused parts. The spores of this fungus are pink.

In the Experimental garden, until the spring of 1932, a number of elm trees bounded the east side of the garden, but were then cut down. These trees were badly rotted, and during the latter part of their life had produced several fungi. In 1930 several fructifications of *Pleurotus ulmarius* appeared about twenty feet above the ground. These are large showy fungi, with a cap about nine inches long and six inches wide. The stem is lateral and very short. The gills radiate from the point of attachment, and are yellowish white in colour. A group of four fruiting bodies were developed at the same time, but no further specimens were collected. On the same trees the following year several fruiting bodies of a pore-bearing species, *Polyporus squamosus*, appeared. From the ground these looked very like those of *Pleurotus ulmarius*, but on being cut down were readily distinguishable. The upper surface, instead of being whitish yellow, was brownish, and covered with brown scales. The lower surface was yellow-brown, and covered with pores. The lateral stem also differed in having a black attachment.

In the fern bank in the Botanical garden the orange yellow *Stereum hirsutum* grows regularly, and a few can generally be found on the logs buried in the ferns. During the autumn the Candle-snuff fungus *Xylaria hypoxylon* may also be found on these logs, producing first conidia and later perithecia on curious stag horn-like fructifications. This latter is a very common fungus, and can be found almost everywhere where rotting wood is lying about in a wet place.

Probably the most interesting fungi occurring in the gardens belong to the Ascomycetes. The Common Morel, *Morchella esculenta*, comes up regularly each year in a cinder path in the Experimental garden, and, although most of the speciments are small and ill formed, one appeared in 1929 measuring six inches in height and nearly three inches across the cap. The Morel is now much less common about Bristol than it was formerly.

Both last autumn and again this year a beautiful mass of a little cup-shaped fungus, *Peziza aurantia*, made its appearance, and some forty fruiting bodies developed on a strawberry bed. This fungus is bright orange-yellow inside the cap, and whitish yellow outside; it measures up to three inches in diameter. A smaller species, closely related to *Peziza aurantia*, appears in the greenhouse each year during the summer months. Generally it grows on the brickwork, apparently deriving its food from the whitewash. It is *Plicaria repanda*, and, although sometimes cup-shaped, is more generally flat. This spring several more cup-shaped fruiting bodies were found growing among the bristles of a disused scrubbing brush which had been lying under the staging! Another species, *Peziza tectoria*, must be mentioned, although it does not actually grow in the gardens. It is found on the whitewash in a cellar under the Botanical Department, and a number of fruiting bodies develop regularly in the autumn of each year. They are watery-white in colour, and consist of a short stem about an inch in length, bearing a small cup about an inch in diameter. It is a delicate but very beautiful little fungus.

None of these fungi are new to the district, all of them having been recorded in Bucknall's list published many years ago in the Society's "Proceedings," though many of their names have been changed. It was thought, however, that the appearance of so many uncommon kinds within such a restricted area in the heart of Bristol might be of interest to some members of the Society, and worth putting on record.

Description of G.W.R. Cutting at Westbury, Wiltshire.

By P. M. Mathews.

In the latter part of 1930 the Great Western Railway, as part of a scheme for speeding up the west-bound expresses, commenced the construction of a new loopway to bypass Westbury station.

The construction of this new line necessitated the cutting through of a low ridge or escarpment about one mile from Westbury station.

Owing to the fact that material for the long embankments over the lower lying land was needed, the cutting was developed into a fair-sized quarry and thus ample scope was given for examination of the strata passed through.

The cutting runs almost due east and west and the general dip of the strata in it is about 12°-15° S.E. beneath the Cretaceous escarpment which rises in close proximity.

In the cutting three formations of the Jurassic were represented:—

1. The Kimmeridgian.
2. The Corallian.
3. The Oxfordian.

The following is a diagram of the section:—

The Kimmeridgian.

At the eastern end of the cutting beds of Kimmeridge clay were to be seen. The dip of the beds was 11° to 12° E.S.E.

The Kimmeridgian here consisted of a dense unstratified mass of blue clay containing much Selenite and a few small septarian nodules.

Great numbers of *Ostrea deltoidea*, mostly in a fragmentary condition, occurred in the deposit but no other fossils were recorded.

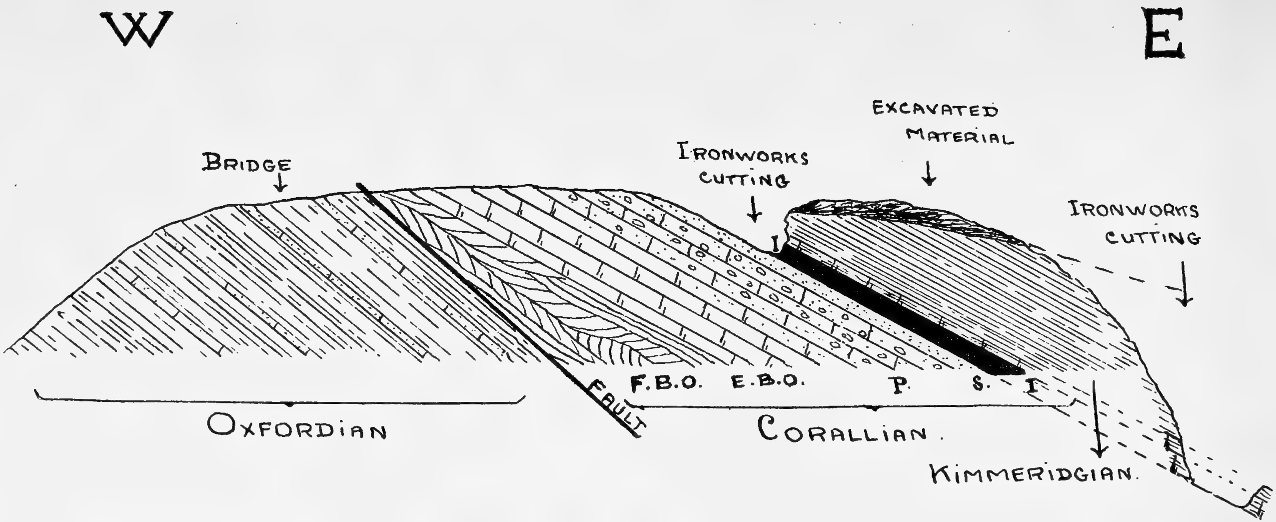
The Corallian.

The Kimmeridge clay beds rest upon a brownish-red rubbly mass of oolitic ironstone which constitutes the famous Westbury iron-ore.

The bed marks the top of the Corallian deposits as represented at Westbury and is certainly, both palaeontologically and stratigraphically the most conspicuous bed in the entire section.

It consists of several highly fossiliferous bands between which are four or five feet of valuable iron ore (Siderite) yielding from 40% to 45% of pure iron.

Examination of the matrix of the iron-ore shows that it consists of an oolitic limestone which has been highly oxidised—even the oolite



DIAGRAMMATIC SECTION OF G.W.R. CUTTING AT WESTBURY (WILTS.). Length of Section, about $\frac{1}{8}$ of mile. Vertical scale much exaggerated.

F.B.O.—False-bedded Oolite, E.B.O.—Even-bedded Oolite, P.—Pisolite, S.—Sands, I.—Ironstone.

granules have been converted into iron oxide, making them very well defined.

The whole stratum is extremely fossiliferous, but by far the greater number of the fossils occur in the "shell beds," as they are called, owing to the enormous number of *Ostrea deltoidea* present in them.

One of these beds occurs at the extreme top of the deposit and forms a pronounced ledge upon which the Kimmeridge clay rests. Ammonites of the Perisphinctes type occur in the ironstone. Lamellibranchs, especially *Ostrea deltoidea*, are very common and much lignite occurs.

Perhaps the most striking thing about the Kimmeridgian and the Corallian ironstone beds to be seen in the section was the fine junctions of the two deposits—the light blue of the Kimmeridge clay when first opened up in the excavations, resting upon the dark red brown layers of the Corallian ironstone was very remarkable.

The iron ore is underlain by a bed of blue green and brown sands. This deposit of ferruginous sand was soft, but isolated blocks of brown ochreous sandstone with numerous hollow casts were common. Many small Trigonia occur in them and *Exogyra* was very abundant in the blue layers.

The brown sands predominated, but at points the blue sands entirely replaced them. The sands did not exactly "wedge out" but were very inconsistent and patchy. This was probably due to the degree of oxidation which had taken place in the deposit.

This stratum rests upon a considerable thickness of very rubbly pisolite containing much argillaceous material. The pisolite is very coarse, some of the beds being almost suggestive of a conglomerate. The top portion of the beds is blue and is crowded with casts of Gasteropods and Lamellibranchs. The lower portion is yellow and more oolitic.

The pisolite passes gradually into even bedded oolitic limestone weathering very rubbly. The oolite granules vary in size and in places constitute a semi-pisolite. Towards the base of the deposit the limestone exhibits much false-bedding and becomes more massive. Throughout the whole of the false-bedded oolite a species of Echinoderm—*Echinobrissus scutatus*—is very abundant, a block in the section containing as many as 17 of this species on its surface. Practically all the specimens are crushed and flattened and were evidently entombed under turbulent conditions, as is also shown by the false-bedding of the limestone.

Except for a few scattered Lammellibranchs the bed is comparatively barren. At the base of the cutting the false-bedded oolite was seen to rest upon stiff shaly blue clay with several sandstone layers. Along the junction line the yellow oolitic limestone was stained blue.

The dips of the two beds were carefully measured, and it was found that the dip of the Corallian, including the false-bedded oolite, was 12°-13° E.S.E., whereas the dip of the Oxford clay beyond the bridge, which crosses the cutting about 30 yards further on, and the dip of the blue clay in question was 18°-19° E.S.E. approximately—a difference of 6° to 7° between the two beds. This evidently shows that the rocks are traversed by fault which brings the Corallian against Upper Oxford clay—from petrological reasons alone the blue clay upon which the false-bedded oolite rests is undoubtedly of Oxford clay age.

Unfortunately, this blue clay was entirely barren of fossils which would have been useful in determining the exact age of the deposit. In the sandstone bands, however, typical Oxfordian fossils were found, including *Perisphinctes* cf. *convolutus*, *Gryphaea dilatata*, *Modiola bipartita* and *Pholadomya paucicosta*.

To the end of the cutting the Oxford clay predominates. It contains numerous bands of hard yellow and blue sandstone, one band of which is four feet in thickness. These sandstone layers contain numerous fossils, especially casts of large Ammonites in a bad state of preservation.

Beyond the bridge, which here crosses the cutting, several more sandstone bands occur—these contain many of the typical Oxfordian fossils, including large *Gryphaea dilatata*. Many septarian nodules about 1½ feet in diameter occur in the clay.

Formation.	Description of Strata.	Ft.	Ins.
Soil and other deposits,	1. Yellow clay, succeeded by gravels full of pieces of flint, chalk and siliceous stones derived from the Greensand. These rest on all the other strata.	3 to 4	0
Kimmeridge Clay,	2. Blue clay, with faint stratification, and containing numerous *O. deltoidea*.	36	0
Corallian,	3. Brownish red oolitic ironstone with layers of bluish green clay, the whole being very fossiliferous.	11	0
	4. An irregular mass of blue, green, and brown ferruginous sands.	5	0
	5. Very coarse pisolite, blue at top, becoming yellow towards base, and containing numerous gasteropods, passing gradually into even bedded rubbly oolite.	31	0
	6. False bedded oolite.	7	0
Fault,	— — — — — — — — — — — — — —		
Oxfordian,	7. Blue clay, with blue sandy layers and *Gryphaea dilatata*.	6	5
	8. Very prominent band of hard yellow sandstone.	4	0
	9. Blue clay, with numerous layers of fossiliferous sandstone.	60	0

List of Fossils obtained from the Westbury Section.

	Oxford Clay	False Bedded Oolite	Even Bedded Oolite	Pisolite	Ferruginous Sands	Iron Ore	Kimmeridge Clay
Vertebrates—							
Plesiosaurus sp., ...	—	—	—	—	—	×	—
Cephalopoda (Ammonites)—							
Ringsteadia frequens Salfeld, ...	—	—	—	—	—	×	—
Pictonia, cf. *baylei* (Salfeld), ...	—	—	—	—	—	×	—
Aspidoceras peramatum Sowerby, ...	—	—	—	—	—	×	—
Perisphinctes, cf. *convolutus* (Quenstedt), ...	×	—	—	—	—	—	—
Cardioceras, cf. *excavatum* (Sowerby), ...	?	—	—	—	—	—	—
Cephalopoda (Belemnites)—							
Belemnites abbreviatus Miller, ...	—	—	—	×	×	×	—
Belemnites oweni Phillips, ...	×	—	—	—	—	—	—
Gasteropoda—							
Pleurotomaria reticulata Sowerby, ...	—	—	—	—	—	×	—
Pseudomelania heddingtonensis (Sowerby), ...	—	—	—	×	—	—	—
Natica sp., ...	—	—	—	×	—	—	—
Bourguetia striata (Sowerby), ...	—	—	—	×	—	—	—
Nerinaea sp , ...	—	—	—	×	—	—	—
Pelecypoda—							
Astarte ovata Smith, ...	—	—	—	—	—	×	—
Cyprina, cf. *tancrediformis* Blake, ...	—	—	—	—	—	×	—
Exogyra nana Sowerby, ...	—	—	—	—	×	—	—
Exogyra sp., ...	×	—	—	—	—	—	—
Gervillia, cf. *aviculoides* Sowerby, ...	—	—	—	×	—	—	—
Gryphaea dilatata Sowerby, ...	×	—	—	—	—	—	—
Isocardia tenera Sowerby, ...	×	—	×	×	—	—	—
Ctenostreon proboscidea (Sowerby), ...	—	—	—	—	—	×	—
Modiola bipartita Sowerby, ...	×	—	×	×	—	—	—
Ostrea deltoidea Sowerby, ...	—	—	—	—	—	×	×
Ostrea (Alectryonia) gregaria Sowerby, ...	×	—	—	×	—	—	—
Perna mytiloides Lam., ...	×	—	—	—	—	—	—
Pecten (Chlamys) midas d'Orbigny, ...	—	—	×	—		×	—
Pecten (Chlamys) fibrosus Sowerby, ...	×	—	—	—	—	—	—
Pholadomya paucicosta Roémer, ...	×	—	—	—	—	—	—
Pleuromya, cf. *tellina* Agassiz, ...	—	—	—	×	—	×	—
Pleuromya recurva Phillips, ...	×	—	—	—	—	—	—
Trigonia, cf. *perlata* Agassiz, ...	?	—	—	—	—	—	—
Unicardium aceste d'Orbigny, ...	—	—	—	—	—	×	—
Annelida (Serpula)—							
Serpula tricarinata Sowerby, ...	×	—	—	—	—	—	—
Serpula intestinalis Phillips, ...	—	—	—	—	—	×	—
Echinoidia—							
Echinobrissus scutatus (Lam.), ...	—	×	×	—	—	—	—
Echinobrissus dimidiatus (Phillips), ...	—	×	×	—	—	—	—

In conclusion of this brief note on the section it should be understood that nearly all the measurements of the various beds in the section are approximate owing to the sloping of the sides of the cutting rendering correct measurement very difficult. It is due to this fact that the angle of dip of the fault apparently coincides with the dip of the Oxfordian beds.

Lastly, my thanks are due to Mr J. W. Tutcher for his help in the identification of the various fossils from the section.

The Geological Structure of the Blackdown Pericline.

By F. B. A. Welch, B.Sc., Ph.D., F.G.S.

THE area to be described forms the eastern part of the Blackdown Pericline, the most northerly situated of the four echeloned periclines constituting the Mendip Hills. The western boundary of the area is formed by the railway running north to south from Sandford to Axbridge; the eastern boundary is a line drawn from near East Harptree to Cheddar along the line of axis of the Cheddar Syncline,[1] lying between the Blackdown and North Hill Periclines.

I. Previous Work.

The area to the west of the railway has been described by Miss A. E. Bamber, under the title of "Western Mendips,"[2] whilst that to east and south-east was described in my paper on "The Geological Structure of the Central Mendips."[3]

The area under discussion was included by Dr T. F. Sibly in his work on the Carboniferous Limestone of the Mendips,[4] in which he described many exposures and also fixed their zones.

The finest continuous section in the area, Burrington Combe, was exhaustively treated lithologically and palaeontologically by Prof. S. H. Reynolds and the late Arthur Vaughan,[5] and forms a type section for the area to which most others can be referred. Many of the quarries and sections are described in detail by Prof. S. H. Reynolds in his Geological Excursion Handbook for the Bristol District.

The present paper sets out the results of mapping the zones of the Carboniferous Limestone (Avonian) on the 6-inch scale with a view to working out the structure of the Blackdown Pericline. Except for collecting to determine the zones no detailed investigation of the lithology or fauna was made.

II. Physical Features and Geological Structure.

In the Blackdown Pericline the Mendip Hills rising steeply from the plain on the north and south reach their highest point at Beacon Batch, 1068 feet O.D.

Owing to the steep gradients roads, except for narrow lanes and bridle tracks, are few, and access to the relatively flat top of the peri-

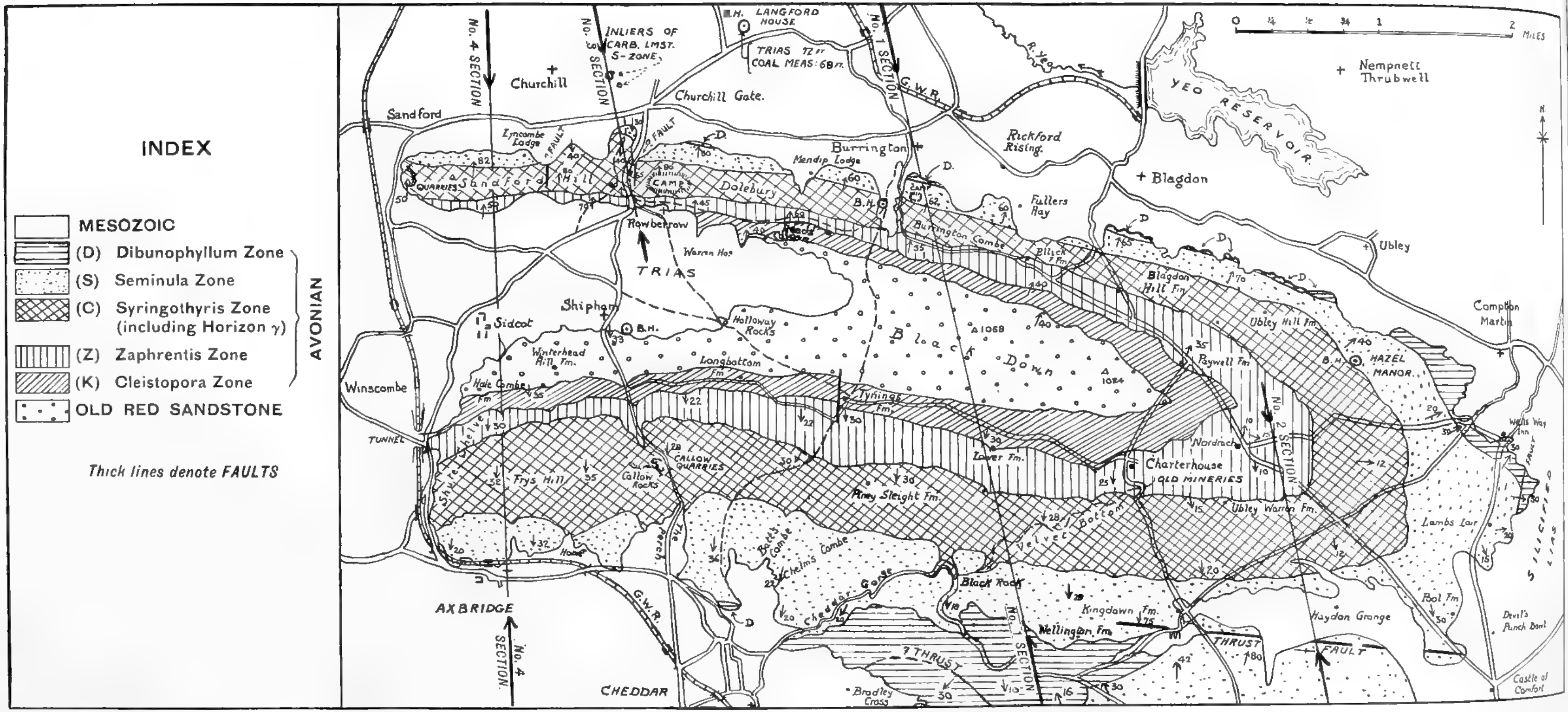
[1] *Q.J.G.S.*, vol. lxxxv (1929), p. 53.

[2] Bamber, A. E., "Western Mendips," *Proc. Bristol Nat. Soc.*, 4 Ser., vol. vi (1923), pp. 75-91.

[3] Welch, F. B. A., "The Geological Structure of the Central Mendips," *Q.J.G.S.*, vol. lxxxv (1929), pp. 45-76.

[4] Sibly, T. F., *Q.J.G.S.*, vol. lxii (1906), pp. 324-380.

[5] Reynolds, S. H., and Vaughan, A., *Q.J.G.S.*, vol. lxvii (1911), pp. 342-392.



GEOLOGICAL MAP OF PART OF THE BLACKDOWN PERICLINE.

cline is gained by the winding gorges of Cheddar and Burrington, or by roads leading from the western end where, owing to erosion, the ascent is more gradual.

The centre of the pericline is formed of Old Red Sandstone from which the Carboniferous Limestone dips away on either side. (Section 1). There is a steep rise from the Trias of the valleys at about 200 feet O.D. on to the plateau-like outcrop of the Carboniferous Limestone at a height of 500-600 feet O.D. From here the Old Red Sandstone rises again to form the highest ground of all consisting of a rounded flat topped ridge reaching 1000 feet O.D. Between the Old Red Sandstone and the Avonian limestones deep valleys are often developed along the outcrop of the Lower Limestone Shales (zone K) as, for example, between Rowberrow and Dolebury, and south of Shipham from Longbottom Farm to Hale Combe Farm.

West of Blackdown, however, the Old Red Sandstone core of the pericline has been eroded away and lies at the bottom of the broad Winscombe Valley buried by Trias. The limestone still survives to the north and south in the form of steep ridges—Sandford Hill and Fry's Hill above Axbridge (Section 4).

Thus in plan the outcrops of the limestone and sandstone resemble the shape of a molar tooth laid sideways with the crown pointing eastwards. The two separate masses of limestone point west like roots, joining eastwards in the main crown formed of limestone with sandstone at the core.

The limestone gives rise to bare thin soiled land with frequent outcrops of rocks (locally called sleights). Numerous overflow springs occur at the junction of the Old Red Sandstone and the Lower Limestone Shales, whilst over the limestone tract the drainage is subterranean. In consequence farms tend to collect close to the shale belt, for those situated elsewhere are dependent on rainwater for supplies.

Regarding the structure of the pericline Prof. S. H. Reynolds states[6]

> "While throughout the Central Mendip area the geological structure is very complicated, in the Blackdown uplift and westward to the end of the range the arrangement is simple. . . . A cross section from Cheddar to Burrington shows a simple anticlinal fold with the oldest rocks exposed (Old Red Sandstone) forming the core."

In spite of the general simplicity of structure there are parts of the area which show that even the Blackdown Pericline suffered a certain amount of deformation by earth movement along with the rest of the Mendips.

Section 1 shows the simplest cross section from Burrington to Cheddar; here it is seen that a shallow syncline (Cheddar Syncline) links the pericline of Blackdown to that of North Hill, immediately to the south-east. But a little north-east of this line of section the syncline is shattered along its axis by a thrust fault (Section 2) which extends from Kingdown Farm towards the Castle of Comfort

[6]Reynolds, S. H., "The Mendips," *Geography*, vol. xiii (1927), p. 172.

Inn, and along which the North Hill Pericline has been forced northwards against the Beacon Hill Pericline, with a consequent cutting out of the outcrop of the *Dibunophyllum*-zone.

Section 4 shows the structure of the western part of the Blackdown Pericline. Here an asymmetrical anticlinal fold has been developed in which the beds of the north limb are almost vertical, and a passage from vertical to complete inversion is seen in the part which lies between Dolebury Camp and Lyncombe Lodge (Section 3).

III. Delineation of Faunal Zones.

The lines of demarcation between the zones of the Carboniferous Limestone are the same as those employed in the Central Mendips.[7]

In the present area, unlike the East and Central Mendips, *Cyathaxonia* has not appeared in abundance at the top of Z_2. Hor. γ is well defined throughout, and owing to the remarkable degree of silicification can be easily recognised.

The dividing line between S and C, as stated in the Central Mendip paper, can be readily drawn at Black Rock, Cheddar, immediately below a band of crinoidal limestone full of *Lithostrotion martini* Ed. & Haime, *Carcinophyllum mendipense* Sibly, *C. welchi* Ryder, etc. This peculiar faunal development has also been found south of Piney Sleight Farm and south-east of Charterhouse. Elsewhere it has not been recognised and the incoming of *Lithostrotion martini* in abundance is taken as the base of S.

The junction of S and D is marked by the profusion of *Palaeosmilia murchisoni* Ed. & Haime, associated with bands of *Productus hemisphericus* McCoy, 1855, *non* Sowerby.

IV. Geological Description of the Area.

It will be convenient, starting in the north at Burrington, to give an account of the beds when traced clockwise round the pericline. The portion between Burrington and Sandford will be treated separately.

(1) *Northern Limb.*

In Burrington Combe an unbroken sequence of beds is seen ranging from Old Red Sandstone to D_1. This succession was fully described by Prof. S. H. Reynolds and the late Arthur Vaughan[8] and need not be discussed here. The dips here range from 55°-62°. East of the Combe the beds strike W.N.W.-E.S.E. towards the periclinal axis accompanied by a gradual decrease in angle of dip.

Old Red Sandstone.—Apart from the sections in the Burrington Twin Streams exposures of Old Red Sandstone are rare. In the stream banks 3/8 mile S.S.E. of Ellick Farm are seen red-yellow fine-grained sandstones associated with olive-coloured shales dipping north-north-east at 40°.

[7] *Q.J.G.S.*, vol. lxxxv (1929), pp. 47-49.

[8] *Q.J.G.S.*, vol. lxvii (1911), pp. 342-392.

K Beds.—From the top of Burrington Combe the *Cleistopora*-zone is marked by a low swampy belt which extends to the old mining area between Nordrach and Charterhouse. No exposures of these beds have been observed.

Z Beds.—Numerous old quarries occur by the side of the Burrington-Nordrach main road showing typical Z beds. In the quarries around Nordrach the change of dip on approaching the periclinal axis is well seen.

C and S Beds.—Except for natural outcrops there are comparatively few good sections of these beds. In a quarry close to the western fork of the road leading south from Blagdon the junction of S and C is well exposed. Here white C_2 oolites are overlain by china-stones containing *Seminula* and *Lithostrotion*. The C-S junction is also well seen in a series of old mining trenches situated one mile east-south-east of Nordrach. Here the white oolite is overlain by silicified crinoidal limestone full of *Lithostrotion* and *Carcinophyllum* as in the section at Black Rock, Cheddar.

D Beds.—East of Burrington Combe the outcrop of D is cut out by the Dolomitic Conglomerate which, south-east of Fullers Hay, rises from the level of the plain to 600 feet O.D. The conglomerate, even close to the limestone, is of great thickness as can be seen in the quarries and deep ravine south of Blagdon. East of Blagdon Hill Farm the D beds are but intermittently exposed and not until south of Compton Martin is reached is there a fairly wide outcrop of this zone. Exposures, however, are limited owing to the dense woods south of Ubley and Compton Martin. Half-a-mile south-west of Ubley is a large quarry in the hillside, in which the D beds are seen to be light grey, unfossiliferous oolites associated with subordinate shaly and rubbly bands. In places the limestone is decalcified and strongly veined with calcite and haematite.

South-west of Compton Martin, Compton Combe affords a discontinuous section terminating in a newly-opened quarry at the northern end. Many bands of *Productus hemisphericus* and *P. giganteus* occur throughout.

The junction of S and D is well exposed south-south-west of Compton Martin in the angle of the Nordrach-Kingdown roads.

Further east D beds are exposed in the old quarries around the Wells Way Inn, and in the series of old mining trenches south-east of this point. Close to the periclinal axis a small north-south fault throws D beds against those of the S zone.

(2) *Southern Limb.*

South of the periclinal axis throughout the south limb the dips are low ranging from 10°-36°. In consequence the outcrops are wider than in the north limb.

Old Red Sandstone.—Exposures of this formation are infrequent but Old Red Sandstone with a southerly dip can be seen at the top of the hill south of Shipham village; in the south side of Hale Combe near the farm, and beneath the Trias at Holloway Rocks.

K-Beds.—Exposures of the *Cleistopora*-beds are infrequent, though the outcrop of this zone is clearly defined by the belt of swampy ground extending westwards from Charterhouse to Tyning's Farm. Beyond this point the beds are deeply excavated to form the Longbottom valley and its westerly continuation towards Hale Combe.

Several strong springs rise at or near the junction of the shales with the Old Red Sandstone as for example those between Tyning's Farm and Charterhouse. Around Lower Farm, Charterhouse, there are numerous small exposures of upper K shales and associated limestones. Similar beds are exposed in the side of the road leading up from Longbottom Farm to Trots Corner (west of Tyning's Farm).

About 500 yards east of Longbottom Farm, close to the base of K, there is a low cliff in which some 25 feet of poorly bedded, fissured and dolomitised oolite occur. This oolite has not been detected elsewhere, a fact which suggests that it is a locally developed limestone lenticle.

On the hillside approximately one-quarter of a mile south-west of Winterhead Farm is an old quarry in K, in which is seen 5 feet of massive red crinoidal limestone with thin shale partings, above and below which there is thin bedded grey crinoidal limestone. The red limestone is probably the equivalent of the Bryozoa Bed of the Western Twin Stream at Burrington.

There is a curious and interesting fact recorded by F. A. Knight in his " Heart of Mendip,"[9] in which he states that formerly coal was dug in Longbottom Valley and that the coal was actually burnt in the inn at Rowberrow.

At the present day there is considerable belief locally that coal exists in the valley. The locality at which it is said to have been dug is on the north side of the valley about half-a-mile west of Longbottom Farm close to the junction of the Old Red Sandstone and K beds. No trace of mining exists at the present. Unless there is a local carbonaceous seam within the K or Old Red Sandstone it is hard to account for Knight's statement.

It is possible, however, that when the lead mines at Charterhouse were working coal was carried to the mines via the Longbottom Valley. From the west the track, though rough, would have no severe gradients, but after Longbottom a very steep rise would occur near Tyning's Farm.

It may have been that the coal was dumped from waggons at this point to be later transported by lighter carts or pack horses to the mines, and it was the discovery of one of these forgotten and buried dumps that has given rise to the belief that coal seams occur in Longbottom valley. This idea is not based on any facts, but is merely stated as a possibility.

Z Beds.—Around Charterhouse in the network of old mining trenches and " gruffy-grounds " Z beds are excellently displayed, but call for no special comment. Westwards exposures consist of natural outcrops, particularly fine sections being seen in the high cliffs bordering the south side of Longbottom and Hale Combe Valleys. At the junction of

[9]Knight, F. A., " Heart of Mendip " (1915), pp. 141-2.

the limestone and underlying K shales streams which have been surface flowing disappear underground through swallow-holes.

C Beds.—C and Hor. γ can also be well seen around Charterhouse, and Velvet Bottom affords a discontinuous section of the beds. At the Cheddar end of Velvet Bottom, near Black Rock, the strong vertical jointing of the C_2 beds formed a very fine and striking cliff. Unfortunately a quarry has been opened at this point and the cliff has been totally destroyed. C beds take part in the formation of Cheddar Gorge occupying an irregular tongue-shaped area at the bend below Black Rock. Between the top of Cheddar Gorge and Fry's Hill, above Axbridge, the highest ground is occupied by C beds, but these are not well exposed except in the neighbourhood of the road leading from Shipham to Cheddar where the beds are extensively quarried. Callow Rocks show fine-grained oolitic and foraminiferal C in which specimens of "*Cyathophyllum ø*" are not uncommon.

Just before the point is reached at the top of The Perch at which the C beds are covered by Dolomitic Conglomerate, there is a quarry on the east side of the road excavated in massive dark crystalline C beds, which at the north end of the quarry are traversed by a thick belt of shatter-breccia.

S Beds.—The finest section of S beds in the southern limb of the pericline is afforded by Cheddar Gorge, which has been fully described by Prof. S. H. Reynolds.[10] Except for a little of the D zone at the south end and the tongue of C beds at the north end, previously mentioned, the entire gorge is cut in S beds. The junction of S and C showing the crinoidal development at the base of S is seen in an old quarry half a mile south-west of Piney Sleight Farm. It was again well seen at the first scar east of Black Rock, where the crinoidal limestone was full of *Lithostrotion martini* Ed. & Haime, *Carcinophyllum mendipense* Sibly, etc., but the quarrying at Black Rock, mentioned above, has now destroyed this exposure.

West of Cheddar S beds are well exposed in Chelm's and Batt's Coombe. They form the great south slopes of the Mendips extending to Fry's Hill above Axbridge. At this point the beds are dolomitised, so that all fossil structure is obliterated. The change is gradual and can be traced from dark fine-grained limestones with corals to dull purple rocks weathering yellow. The C beds are effected in like manner, but to a less degree.

D Beds.—Except in the Cheddar Syncline and south of Cheddar Gorge the only exposure of D occurs south of Warrens Hill, north of Cheddar. At Cheddar low D_1 beds are seen south of Pavey's Hotel. The junction of S and D gradually rises from the level of the plain and runs above the crags above the caves to Wind Rock. At this point it turns in an east-south-easterly direction to the south corner of Grey Pits Plantation (locally called Cheddar Firs) and runs south-east below the prominent scars, rich in *Palaeosmilia murchisoni* to the level of the

[10]Reynolds, S. H., "A Geological Excursion Handbook for the Bristol District" (2nd ed., 1921), pp. 113-115.

Priddy road. East of the road it rises to the 800 foot contour and passing close to Wellington Farm runs towards Kingdown Farm. At this point the thrust fault (shown in Section 3) cuts across and faults out the D outcrop.

(3) *Area between Burrington and Sandford.*

The high ridge of Dolebury Warren, running west from Burrington Combe is formed almost entirely of Z, C. and S beds. The outcrop of K is marked by a deep valley extending west from Read's Cavern to the ravine west of Rowberrow Church. Except at the head of the valley north-north-east of Warren House these beds are not exposed. At this point, however, the following section is seen in the hillside.

Series of thin bedded mainly crinoidal limestones, in which the crinoids weather white in deep red iron-stained matrix. Certain beds oolitic, others fine-grained	about 20 feet.
Thin flaggy splintery grey crinoidal limestone, underlying the above	6 feet.

This sequence may be compared with that seen on Winterhead Hill (p. 392).

Further west at Rowberrow the Dolomitic Conglomerate cuts out further exposures of this zone.

The steep south scarp of Dolebury affords a magnificent strike section of Z and Hor. γ. In the cliff outside Read's Cavern are signs of disturbance in the Z beds which, in the cave, are bent into sharp folds. At one point a part of the roof, bent into an acute fold, has broken away along a bedding plane and now lies on the floor of the cave like a tent. A photograph of this rock, known as the "Angle Stone," is preserved in the collection of the Bristol University Spelaeological Society.

C and S beds are exposed mainly in natural outcrops. A small outcrop of D_1 emerges from beneath the Trias at one point on the north side of the ridge.

Throughout the series there is a gradual increase in the dip angles when traced westwards from Burrington, until west of Dolebury Camp the beds dip northwards at 80°.

Between Dolebury Bottom (west of Dolebury Camp) and Lyncombe Lodge the beds are inverted. This area will be described separately.

From Lyncombe Lodge to the west end of Sandford Hill, steeply dipping Z, C and S beds form the high ground. C beds are riddled with old mining trenches on the top of the hill and are well exposed in the large quarries at Sandford, which also include S beds.

In both Dolebury Warren and the western part of Sandford Hill the beds, though steeply inclined, dip normally northwards. In the area between Lyncombe Lodge and Dolebury Bottom, however, the lower beds dip northwards whilst the upper beds dip southwards in an inverted succession.

This can be well studied in the quarries on the west side of the main Bridgwater road at Dolebury Bottom, Starting at the road bend close to the junction of the main road with the lane to Rowberrow, Trias with a dip of 18° S. is seen banked against and overlying Z_2 limestones dipping at 60° N.

A little further north in the old quarry, through which the waterworks adit has been driven, Z_2 and Hor. γ beds dip northwards at 80°. About 200 yards north of this point the overlying C beds have become vertical and beyond this an inverted succession is seen. At first the beds dip steeply southwards, but traversing northwards successive dips of 52°, 40° and 20° are seen in the quarries.

At a higher level on Churchill Batch old quarries by the side of the old track show similar inversion of the beds, but in all cases the dips here are higher than the dips of the beds in the quarries immediately below by the side of the Bridgwater road.

Thus a complete and inverted succession of C beds is seen, underlain near Churchill Gate by S.

Similar inverted strata are seen east of Lyncombe Lodge.

The change between the normally northwards dipping beds on either side of this block and the inverted series within it seems abrupt. To account for this the two faults shown on the map have been tentatively drawn.

About half a mile north-west of Churchill Gate is a low hill known as Windmill Hill. Though mainly covered by Trias two small outcrops of shattered S beds are seen at the summit, and these appear to be intimately related to the inverted S beds of the main mass.

It seems probable, therefore, that between Dolebury Bottom and Lyncombe Lodge there is a small northwardly directed overfold, similar to that at Vobster,[11] of which the limestone at Windmill Hill forms part of the apex (Section 3). It is not known, however, whether or not the Windmill Hill limestone is actually a residual part of an overthrust mass as at Vobster, since there is no record of any deep boring close to the hill to determine the underlying rocks. It is significant, however, that a boring at Langford House, nearby, after penetrating 72 feet of Trias proved 68 feet of Coal Measures.[12] It would not, therefore, be surprising to find Coal Measures beneath the Carboniferous Limestone of Windmill Hill.

V. Triassic Deposits.

No account of the geology of the Blackdown Pericline would be complete without some mention of the Triassic deposits that surround and in places cover the limestone uplift, frequently up to 800 feet O.D.

Many of the valleys seen at the present time are pre-Triassic features that have been subsequently uncovered by the removal of the Triassic material filling them.

Burrington Combe was a narrow gulf in Trias times and nearly as deep as the present combe, for north of the Western Twin Stream, the whole of the western side of the gorge is formed of Dolomitic Con-

[11] Welch, F. B. A., "The Geological Structure of the Eastern Mendips," *Q.J.G.S.*, vol. lxxxix (1933), pp. 14-52.

[12] "Wells and Springs of Somerset," *Mem. Geol. Survey* (1928), p. 44.

glomerate, with the exception of the bottom third. The plane on which the conglomerate was laid down is seen to be very irregular, for small peaks of limestone jut up and form buried ridges. One of these limestone peaks is seen at the Rock of Ages over which the Dolomitic Conglomerate rises to fall again northwards.

This feature can best be seen in winter when the vegetation is dead.

On the sides of Velvet Bottom near Charterhouse, patches of Dolomitic Conglomerate still adhere, showing that the Cheddar drainage valley had been started in pre-Triassic times.

But perhaps the most remarkable case of pre-Triassic erosion of the pericline is seen at its western end. Here erosion carved through the limestone to the sandstone core and formed a great bay in which Trias material accumulated. To-day Trias covers the Palaeozoic rocks lying beneath Winscombe Valley and rests on the Old Red Sandstone of Blackdown up to a height of 800 feet O.D.

At this level on Blackdown the Dolomitic Conglomerate frequently resembles Carboniferous Limestone for the enclosed boulders of limestone are large, numerous and subangular and have very little Triassic material cementing them together.

It was undoubtedly such a deposit that was encountered in borings for water at Shipham Village and near the top of Blackdown.[13]

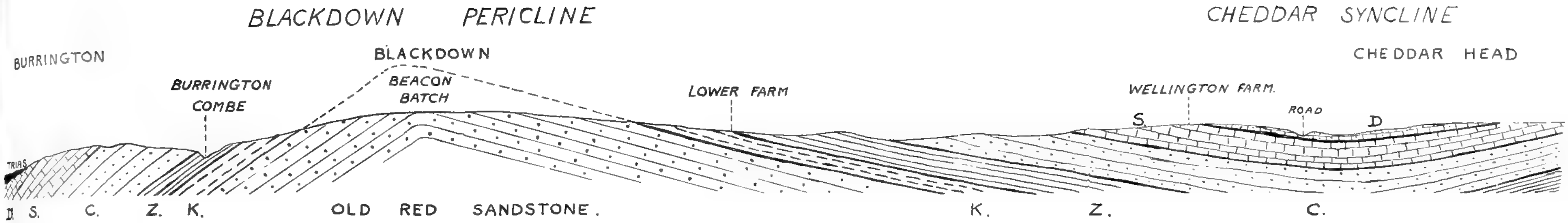
West of Blackdown Holloway Rocks affords a fine section of Dolomitic Conglomerate resting upon Old Red Sandstone.

It is probably from the Trias that the red and yellow ochre found in fissures in the Carboniferous Limestone has been derived. At the present time yellow ochre is worked on Fry's Hill above Axbridge, and south of Tyning's Farm. Red ochre was formerly quarried from the east side of Compton Combe near Compton Martin.

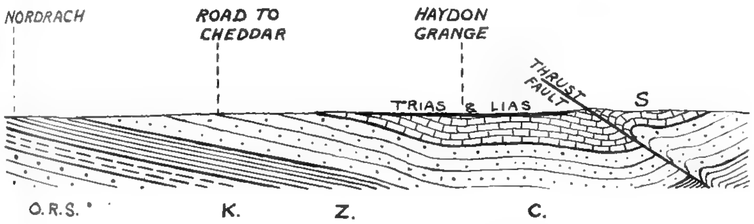
At Tyning's Farm the ochre occurs in vertical waterworn pipes in the limestone, suggesting the filling of pre-Triassic potholes.

The underground drainage system, and formation of caves and dry valleys in the Blackdown Pericline have not been dealt with as the subject would be too lengthy to be included in the present paper. I hope, however, to make these the subject of a separate paper at a later date.

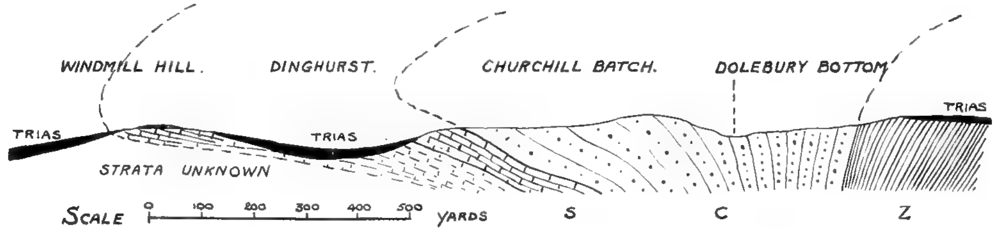
[13] "Wells and Springs of Somerset," *op. cit.*, p. 46.



Section 1. Section from north to south through the simplest part of the Blackdown Pericline. SCALE. 0 100 300 500 1000 YARDS.

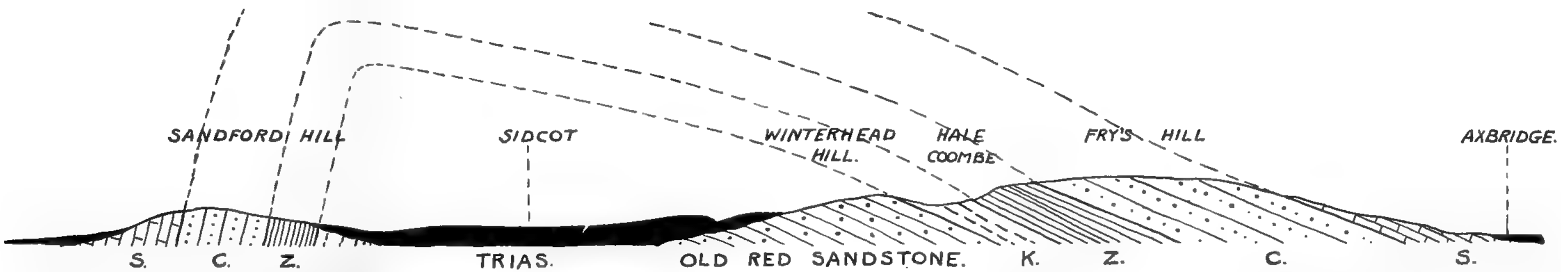


Section 2. Showing thrusting along axis of Cheddar Syncline.
Scale. 0 100 300 500 1000 YARDS.



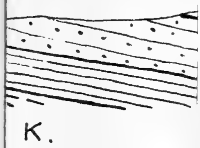
SCALE 0 100 200 300 400 500 YARDS

Section 3. Section from near Churchill to Dolebury Bottom.



Section 4. Section from Sandford Hill to Axbridge showing asymmetric folding in the western part of the Blackdown Pericline. Scale. 0 100 300 500 1000 YARDS

Note. In all these sections the NORTH is on the left of the figure.



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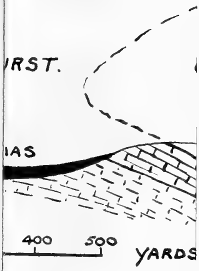

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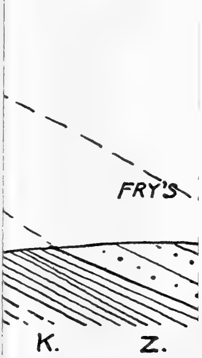

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FOURTH SERIES, VOLUME VII. PART VI.

PRICE FOUR SHILLINGS.

1933.

ANNUAL REPORT

AND

PROCEEDINGS

OF THE

Bristol Naturalists' Society

"Rerum cognoscere causas."—Virgil.

ARBROATH: PRINTED FOR THE SOCIETY.

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TABLE OF CONTENTS.

FOURTH SERIES, VOL. VII, PART VI, 1933.

N.B.—A List of Members will be prepared and circulated to every member with the Autumn Syllabus.

For information concerning the Bristol Naturalists' Society generally, or concerning its meetings, please apply to the present Hon. Secretary and Editor:—

Miss Ida M. Roper,

176 Chessel Street,

Ashton Gate, Bristol, 3.

All Books, Pamphlets, Reports of Proceedings sent by way of exchange, gift or otherwise, and all correspondence relating thereto should be addressed to:—

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REPORT OF COUNCIL,
TO DECEMBER 31st, 1933.

THE year opened with a new President in succession to Mr J. W. Tutcher, M.Sc., who wished to be relieved from the office which he had held so ably for the past two years.

The Society is to be congratulated that Dr F. S. Wallis, D.Sc., F.G.S., another distinguished geologist, was willing to succeed him, and his great interest in the Geological Section and the Field Section, of which he is President, has done much to stimulate the activities of these two important organisations. Under his Presidency, the Society has had a year of steady progress, and it is a matter of regret that stress of other work will not allow his term of office to be further extended. Dr Wallis realised, however, from the beginning that if the activities and usefulness of the Society were to be maintained the finances needed re-adjustment, because for several years the expenditure has exceeded income. This is due in great part to the continued excellence of the "Proceedings," and the decrease in the number of ordinary members. He was instrumental in appointing a Committee early in the year to make recommendations regarding a campaign to bring about greater co-operation with the Sectional members who are content to pay a low subscription, and do not, therefore, materially help the Society to maintain its valuable Library and publications. Various schemes have been brought forward and discussed until finally it has been decided to appeal to the members at the Annual Meeting to sanction an alteration in the Laws whereby Sectional members must become Associates on payment of 5s, and persons under 21 years of age may join the Society as Junior members by paying 2s 6d to the Parent and 1s to any Section.

In this way it is hoped to strengthen the finance and membership, and bring the present large percentage of Sectional members into closer fellowship with the Parent Society, and also to encourage the younger generation to take an interest in Natural History.

The response to the 6th Annual Dinner in February shows that this opportunity of friendly intercourse amongst the members is appreciated. A record attendance encouraged the guest of the evening, Dr T. Loveday, Vice-Chancellor of the University of Bristol, in proposing the toast of "The Society," to advocate some type of organisation to persuade young recruits to join its ranks. This should not be very difficult, as Natural History was now part of the curriculum of most schools. A programme of music and conjuring tricks added to the enjoyment of the evening.

The Summer Field meeting to Minchinhampton and Rodborough Commons was also well supported by the members, who appreciated the excellent arrangements carried out for their enjoyment by the officers of the Field Section. Several local naturalists joined the party and pointed out the natural beauties of this upland spur of the Cotteswolds.

The programme of meetings has been carried out on the same lines as in past years. The lecturer for the Open Night was Mr John Kearton, of Surrey, the well-known authority on Wild Life, and his vivid descriptions of the habits of our common songsters and his coloured slides taken from his own photographs delighted an exceptionally large audience. At another meeting the members welcomed Mr C. W. Bracken, F.R.M.S., F.E.S., of Plymouth, the President of the S.W. Naturalists' Union, to which we are affiliated, and listened with interest to his observations on the Grasshopper and its relatives.

The Exhibition Night was again well represented by the work of the Sections. The Botanists showed great enthusiasm and energy in the arrangement of over 150 living flowers and fruits, and a collection of all the British poisonous plants, whilst two members of the Ornithological Section were responsible for a complete series of the mammals of the district.

The Society has again participated in the doings of kindred Societies. The Hon. Secretary and Mr J. V. Pearman, F.E.S., attended as delegates the Centenary celebrations of the Entomological Society of London, held in S. Kensington from May 3-6, and presented on behalf of our Society a congratulatory address. They report on the cordiality and hospitality shown to them, and of the pleasant intercourse with the distinguished visitors from other parts of the Empire.

Early in the year the Society lost by death two of its most loyal supporters. Mr W. H. V. Wickes was elected a member in 1900, and served on Council for 13 years. His work and enthusiasm were chiefly concerned with the Geological Section, where his knowledge of local geology was always at the service of younger members until failing health prevented his attendance at the meetings. Mrs E. M. Vaughan was another industrious geologist, whose death has left a gap in the Society not easy to fill. She was ever ready to help in the organisation of excursion and exhibition meetings, and as Reporting Secretary, a post she had held since 1925, did much to bring to the notice of the public the activities of the Society. Obituary notices of these two members will be found elsewhere in the "Proceedings."

Thanks are given to the authors for defraying the cost of the blocks that illustrated their papers in the "Proceedings" for 1932, published early in the year and distributed to the British and Foreign societies with whom exchanges are effected. The volume retains its high standard and has papers of special local interest.

IDA M. ROPER, *Hon. Secretary.*

The Hon. Treasurer in Account with the Bristol Naturalists' Society.

Dr. GENERAL ACCOUNT FOR THE YEAR 1933. *Cr.*

	£	s.	d.		£	s.	d.
To Members' Subscriptions :—				By Subscriptions :—			
Ordinary, ...	47	10	0	Ray Society, ...	1	1	0
Associate, ...	1	5	0	Zoological Society, ...	2	10	0
Arrears, ...	4	0	0	S.W. Naturalists' Union, 1932, 1933, ...	1	2	0
In advance, ...	2	10	0	,, Cost of *Proceedings*, 1932, ...	52	4	6
,, Field Section Capitation Fee, ...	4	12	0	,, Printing, Postage, etc., ...	10	9	6
,, Donations to Publishing Fund, ...	9	12	6	,, Lecture Expenses, ...	9	14	0
,, Grant from Geological Section, ...	1	0	0	,, Rent and Fire Insurance, ...	1	11	0
,, Sale of Publications, ...	2	17	6	,, Dinner Expenses, ...	16	16	6
,, Sale of Dinner Tickets, ...	18	19	6	,, "Geological Magazine," 2 Vols., ...	2	12	0
,, Interest on Deposit, ...	1	18	11	,, Bookbinding, ...	1	10	6
,, Balance from last Account, ...	119	9	8	,, Cash in hand, ...	114	4	1
	£213	15	1		£213	15	1

December 31st, 1933.

Audited and found correct.

ERNEST H. COOK,
CHARLES BARTLETT, F.C.A. } *Auditors.*

LIBRARIAN'S REPORT,

FOR THE YEAR 1933.

MEMBERS are at last awakening to the fact that the Library contains many volumes of reference that may help them in their studies and research, or may stimulate them to gain a deeper insight into the mysteries of Natural Science.

The number of books taken out during the year for home reading has shown a decided increase on past years, although at the same time only a small percentage of the members take advantage of this privilege offered by the Society.

The pamphlets and magazines issued by kindred Societies are displayed on the table and changed frequently. They arouse some interest, but unfortunately the book binding fund is exhausted, and in the present state of the Society's finances it is not possible to bind and put on the shelves more than the current numbers of the long series of periodicals presented by the Sections. The same applies to the purchase of up-to-date text books, but it is hoped that a special fund will be started shortly for the acquisition of new books and thus add to the usefulness of the Library. Two volumes, however, of the "Geological Magazine," 1908 and 1909, which had been missing for some years have been replaced by purchase.

The demand for back numbers of the "Proceedings" continues, especially for those containing papers of geological value. The stock of early parts of the "Proceedings" has been increased by a gift of duplicates from the Geological department of the University.

The following books have been added from the Library of Miss Roper, and cordial thanks are given to her and other donors :—

Sowerby's "Cryptogamic Botany," 9 Vols., 1790-1814, and MS. Index.
Miles, G. G. "Bog-Trotting for Orchids," 1904.
Gordon, Seton. "The Charm of the Hills," 1912.
Babington, C. C. "British Botany," 9th edit., 1904.
Plowright, C. B. "British Uredineae and Ustilagineae," 1889.
Kew, H. W., and Powell, H. E. "Thomas Johnson, Botanist and Royalist," 1932.
Crawford, F. C. "Anatomy of the British Carices," 1910.
Victor, Hehn. "Wanderings of Plants and Animals from their first Home," 1888.
Woods, Joseph. "The Tourists' Flora," 1850.
Step, E. "Wild Flowers Month by Month," 2 Vols., 1905.
Macgillivray, W. "Manual of British Birds," 2nd edit., 1846.
Leighton, W. A. "Lichen Flora of Great Britain," 1879.
Boistel, A. "Nouvelle Flore des Lichens."
"Journal of Botany," 4 Vols., 1928-31.
Womersley, H. "Collembola-Symphyleona of Australia," presented by the author.
Bickerston, W. "The Baby Bird and its Problems," 1927, presented by Miss A. Morley.
"Nature Printed Varieties of the British Ferns," 1876, presented by Miss T. Shaw.
Sandwith, C. I. "The Adventive Flora of the Port of Bristol," 1932, presented by the author.
"Palaeontographical Society," Vol. lxxxv, 1931, from the Geological Section.

IDA M. ROPER, *Hon. Librarian.*

BOTANICAL SECTION, 1933.

THE innovation made at the last meeting of 1932 was continued during the early part of the year, when Buds formed the special section of exhibits. Specimens of buds of trees and shrubs in varying stages of development were examined. Those of cloves, figs and potato were also exhibited. The origin and development of the " eye " of the potato gave rise to a certain amount of discussion, and Miss Bowen therefore prepared and exhibited sections of the eye showing the origin of its members.

In July, Prof. Darbishire invited the Section to hold its meeting in the University Botanical Gardens, and this being accepted, he acted as guide and explained many interesting points concerning the growth and habit of plants. A visit was also paid to the gardens in Woodland Road to see the Natural Order beds and the collection of medicinal plants.

The number of exhibits brought during the summer months for discussion has been greater, and, as might be expected, has included a number of comparatively rare plants. Examples of fasciation and other unusual growths have again been fairly plentiful.

During the winter months, the exhibits gradually diminish and it has therefore been decided to have short papers on subjects which are being studied by members. It is hoped that in this way members will, in addition to the systematic work carried out by the Section, undertake some special branch and later make known the results of their investigations.

The alien plants of Bristol and the district have been dealt with very thoroughly by Mrs Sandwith in her paper :—" The Adventive Flora of the Port of Bristol," published in the Report of the Botanical Exchange Club of the British Isles. There is a brief history of the Port of Bristol together with the habitats where plants have been found, but which are now gradually disappearing with the increased demand for building sites. Many new species, hitherto unknown here, were introduced during the Great War, when the volume of trade was increased. The total number of Bristol Adventive species has been found to be 717, in 52 families, of which 111 belong to the Compositae and 93 each to the Gramineae and Leguminosae. The majority of species have come from the Mediterranean Region; other sources being N. and S. America, Africa and Temperate Asia.

Mrs Sandwith's observations extend over a period of twenty-two years. In recent years she has been assisted by other members of the section—Miss Roper and Messrs H. J. Gibbons and Ivor W. Evans.

F. F. GLASSPOOL, *Hon. Secretary and Treasurer.*

ORNITHOLOGICAL SECTION,

1933.

At the beginning of the year and to the regret of all members Dr A. L. Flemming found it necessary, owing to his professional duties, to resign the Presidency of the Ornithological Section, an office he had held since the revival of the Section in 1922. He had done a great deal towards increasing the popularity of the Section and now hands over to an excellent successor in Mr J. H. Savory.

During the year six meetings have been held. Dr O. H. Wild, of Cheltenham, kindly came down to the Annual Meeting in January and gave a paper on British Wild Geese; in February Mr L. H. Matthews gave a detailed account of "British Waders;" at the March meeting the Section had the privilege of seeing the Wiglesworth bequest of Bird books in the Bristol University Library. This is a large and valuable series of books on Birds, bequeathed by the late Dr J. Wiglesworth, of Winscombe, and forming probably one of the best Ornithological Libraries outside London. The Section is very much indebted to the authorities for permission to hold this meeting in the Library and particularly to Mr J. S. Cox who, in the unavoidable absence of Mr W. L. Cooper, the Librarian, took great pains to make the meeting a success.

In October Mr Tetley gave an account of "Bird-life on the Scillies," and in November Mr H. H. Davis one of "Birds of Little Stoke." The year concluded with the December meeting in which Mr F. R. Willcox gave a paper, followed by lantern slides, on "Birds of the Pembrokeshire Coast."

It will thus be seen that members have had the opportunity of gaining information on certain groups of British Birds such as the Geese and Waders, as well as on Bird-life in more distant parts of the British Isles, while the paper by Mr Davis is a good example of a detailed report on a comparatively small local area and is of real value.

Field work has, as usual, been carried out by members as opportunity offers. And 1933 will be of particular interest owing to the continued presence of an Iceland Gull in the Bristol area, as well as the sight of uncommon birds such as Spotted Redshank, Black-tailed Godwit, Greenshank, Ruff and Black Tern, all of which occurred on the Barrow Gurney or Blagdon reservoirs in September. Notes on all these occurrences have been published in "British Birds."

Mr A. C. Leach contributes elsewhere in the "Proceedings" a paper on "Birds of the Barrow Gurney Reservoirs," a very useful summary which needed doing in view of the many detailed notes taken in recent years by Mr Leach as well as other members of the Section.

The membership is now 40, and it is hoped that members of the Ornithological Section will feel able to support the re-organisation scheme of the Society and that those who are now only Sectional members will join the Society and continue their membership of the Section. In this way they will gain the use of the Library and will have in the "Proceedings," an excellent medium for publishing observations made by them.

H. TETLEY, *Hon. Secretary and Treasurer.*

ENTOMOLOGICAL SECTION,

1933.

THERE has been a slight decline in membership, and we are back to the 1931 figures of 16 ordinary and 2 honorary members. The year's accounts are closed with a small balance in hand, with a few subscriptions in arrears.

Six meetings have been held. At the end of 1932, a discussion on mimetic colouring led to a suggestion for a survey of comparisons and contrasts in colour and pattern of related and unrelated insects. This was considered at the January meeting, when most members had to admit inability to deal adequately with the subject, but, with his customary thoroughness, Mr H. Audcent tackled it so far as the Diptera were concerned. He exhibited sets of compared insects, each set consisting of two or more species belonging to different families (in one case, different orders) and with dissimilar biological histories, yet closely alike in form and colour. Only a few related insects showed marked contrasts. After referring to, and criticising, reasons that might be advanced to account for the facts, Mr Audcent was of opinion that no satisfactory explanation was yet available.

Two meetings were mainly concerned with proposals for assisting the Museum to improve its collections of local insects. Specimens accompanied by particulars of (at least) place and date of capture were wanted to supplement the numerous undocumented examples. Ultimately it was arranged to try to build up a Sectional collection of local Lepidoptera for presentation to the Museum. Members will contribute specimens as opportunities arise, and from the beginning the collection will be housed in the Museum. If the plan succeeds, similar procedure may be adopted in the case of other orders.

Some attention has been paid to the insect inhabitants of warehouses. A very full account of the Lepidoptera whose larvae cause damage to various food substances in local warehouses was given by Mr A. Kromler, who showed specimens of the imagines, sketched the life histories, and described experiments that have been made to exterminate the pests. Later, Mr C. Bartlett dealt with the depredations of Coleoptera, and exhibited a large collection of harmful species.

It has become a settled practice for the chief business of the October meeting to be the exhibition of members' captures during the summer. Although many interesting insects were brought forward this year, few were of particular local importance. Perhaps the most noteworthy was a specimen of *Agrotis simulans* Hufn. taken by Mrs Barton White at Fishponds; this is new to the Bristol list.

Probably as a consequence of the long spell of fine weather, the Bristol district, in common with other parts of the kingdom, received a large influx of migrant species of Lepidoptera, among which *Acherontia atropos* L. (Death's Head Moth) was unusually plentiful.

J. V. PEARMAN, *Hon. Secretary and Treasurer.*

FIELD SECTION,

1933.

A SMALL campaign to increase public interest in the work of the Section—admirably helped by some clever posters designed by Mr Ivor Evans—has resulted in the election of 13 members. With a nett membership of 101, the average attendance at field meetings of over 45 is satisfactory. The Section has evidently found its niche in the common weal and definitely serves some of the citizens who wish to combine walks in the countryside with natural history observations.

During the year the Section has suffered an almost irreparable loss in the death of Mrs E. M. Vaughan. Her energetic and dependable character will always be an inspiration to those who were associated with her. We recall her service on the Committee and willingness at all times, often at no little personal inconvenience, to further the study of Natural History in Bristol.

At the Annual General Meeting in January, Dr F. S. Wallis and Mr G. H. Beacham were re-elected President and Vice-President respectively. Miss T. Shaw continued to serve as Hon. Treasurer and Miss M. D. Hiley as Hon. Secretary. Some interesting exhibits were shown. The president spoke on some of the ways in which members can try to influence public opinion, and suggested that much could be done to influence public thought by more careful attention to speech and real causes. He said that the recognition of the lower animals as distant cousins should make a difference in one's attitude towards them and pointed out that no real Naturalist could whole-heartedly subscribe to blood sports.

It was decided to adopt a broad form of Regional Survey for the field meetings, Dundry Hill being the selected area. This district provided members with observational work of a more intensive type than they had previously experienced. The Section takes this opportunity of placing on record its indebtedness to Miss Ida M. Roper and Messrs J. V. Pearman, H. Stuart Thompson, Coldstream Tuckett, and J. W. Tutcher for generalised descriptions of the area.

The visit to Hartcliff Rocks, arranged by Mr and Mrs H. F. Barke, provided an opportunity of inspecting the Carboniferous Limestone—the foundation rock of Dundry—and a practical demonstration on Felton Common showed the value of simple field experiments in differentiating soil types. Botanists obtained numerous specimens. A visit to Dial Quarry completed the itinerary.

In July Mr Ivor Evans conducted the members over the central part of the Dundry range. The botanists were there able to contrast the vegetation of a clay soil with that of an oolitic limestone. Inspection of a badger sett discovered by Mr Coldstream Tuckett afforded unusual interest.

Mr G. E. J. McMurtrie was the general leader in September. Leaving Pensford he directed a course along the valley of the river Chew which afforded an excellent opportunity for collecting water plants. Ancient bridges, the problematical Bishop's Palace and the Stanton Drew Circles were visited and proved an interesting addition to more strictly natural history pursuits.

Finally, in October, Mr G. H. Beacham planned a route from Whitchurch over the eastern slopes of Dundry to Maes Knoll. He visualised in a concise and imaginative narrative the succession of races who had inhabited Dundry. Mr H. F. Barke dealt with the geology of the area and under his guidance an exposure of Upper Lias rocks was examined. Mr and Mrs Lawrence Ogilvie kindly entertained their fellow members to tea.

According to recent custom, the Annual Field Meeting of the parent Society was held under the auspices of this Section. Minchinhampton and Rodborough Commons were excellent centres and the Section is indebted to Rev. Rex. V. Hodson, Drs H. Eltringham, F.R.S. and H. W. Hills, and Messrs F. L. Daniels, C. I. Gardiner, F. C. Humpidge and H. C. Playne, all of whom either supplied notes or proved inspiring guides. The importance of friendships with local naturalists formed in this manner cannot be too strongly stressed. The botanists were particularly enthusiastic concerning orchidaceous plants, the geologists examined some rich Inferior Oolite exposures, and all enjoyed the ever-changing panorama of Cotteswold scenery. A brief examination of the local character of exhibits in the Stroud Museum formed a fitting termination.

Mr H. Vicars Webb again kindly conducted the meetings devoted to Ornithological studies and contributes the following notes:—

Wednesday, April 26th. Leigh Woods. Party of 14. A gloomy evening affected songsters, except Blackbirds, a number of which were in good voice. Others heard include Willow and Common Wrens, Robin, Thrush and Chaffinch. From an open space in the newly-added portion of the woods, an excellent view was obtained of the Peregrines' nesting site on Portway.

Monday, May 15th. Party of 12 to the Hanham Woods. Several Nightingales, Blackcaps and Willow Warblers heard and identified. Ramble extended to Hanham Abbots Church, Tithe Barn and Fish Pool. A lovely evening added to the charm of river and waterfall, rocks and woods, and to the avenue of huge lime trees.

Saturday, May 27th. A party of eight to Stapleton via Fishponds. Many songsters heard near the Old Mill. At the Duchess Pond a scene of much animation provided by Swifts, House and Sand Martins, and Swallows taking insects on the wing. On the pond Water Hens, Grebes and Mallard observed. Wickham Glen included in the ramble.

Wednesday, June 7th. An evening ramble to Flax Bourton. Nine members present. Bird-life observed in the quarry, and on the stream, where a Moorhen's nest with four eggs was found. While the party rested from the view point on Belmont Hill, the leader gave an informal talk on the season's observations.

Mr Ivor Evans was again responsible for meetings conducted for botanical observations and reports that on April 29th, Hanham and Brislington were visited. Twelve members present. The route to Brislington was taken along the riverside and amongst the vegetation the following were noted:—Hairy Rock Cress, White and Red Dead Nettles, Broom, Yellow Fumitory, Barberry, Alder, Black Mustard, Great Hairy Wood Rush, Crosswort, etc.

Saturday, May 20th. Charfield to Nibley. Twenty-two members present. The following plants were observed:—Bee, Frog and Marsh Orchis, Tway Blade, Lady's Smock (double), 14 species of Sedges and many types of Grasses.

Saturday, June 10th. Ursleigh Hill and Keynsham. Twelve members. After leaving Ursleigh Hill the hedges and fields gave opportunity for the following plants to be seen:—Bryony, Hop, Snowberry, Bee Orchis, Adder's Tongue Fern, Marsh and Butterfly Orchis, fruit of Meadow Saffron, etc.

M. DORIS HILEY, *Hon. Secretary.*

GEOLOGICAL SECTION,

1933.

NEITHER innovations nor experiments in organisation have marked the past year and the period may be summed up as successful but uneventful. The membership at the close of the year totalled 66 members, and a credit balance is recorded.

At the Annual Meeting held in January, Professor S. H. Reynolds, M.A., Sc.D., Mr H. F. Barke, and Dr F. S. Wallis were re-elected President, Vice-President and Secretary respectively. Mrs E. M. Vaughan was re-elected Treasurer but at her death in March the duties were undertaken by Mrs H. F. Barke for the remainder of the year. The following were elected to serve on the Committee—Mesdames Barke and Marsden, Dr Stanley Smith and Messrs G. A. Kellaway, A. Selly and J. W. Tutcher. Before adjoining to the Geological Museum of the University the President exhibited a series of lantern slides from the British Association Geological photographs. Members were especially interested in a series of Cambrian fossils from the shaft at Breadstone and a model illustrating the crystal systems both exhibited by Dr Stanley Smith.

In February Dr A. Heard (Cardiff) gave a lecture on "The earliest known land plants." He pointed out that the oldest known representatives of land vegetation are found in the Old Red Sandstone rocks and the lecture was made additionally interesting by the fact that Dr Heard is himself responsible for the elaborate technique found necessary to study these simple plants.

The popular feature of short papers by members was revived in March when Major A. Gorham described the work and memorials of William Smith with special reference to a stone at Tucking Mill. The re-erection of this stone had been personally supervised by the lecturer on behalf of the Geological Society of London and the Royal Literary and Scientific Institution, Bath. Mr P. M. Mathews gave an account of the G.W.R. cutting at Westbury, Wiltshire, which has been published in the "Proceedings" of the Society for 1932.

The President gave a lecture in October on the British Coasts illustrated by a wealth of lantern slides. He contrasted the deeply indented western coast of Scotland with the more smooth and even coasts of England and pointed out that the formation of a coastline involves at least three factors. Many points of interest regarding the shore-lines of the Bristol Channel were also dealt with.

In November Professor A. E. Trueman—at short notice in place of Mr C. I. Gardiner—spoke on the rivers of South Wales. He said that they fall naturally into two groups. An eastern group with a general N.W.-S.E. trend, superbly illustrating superimposed drainage with valleys unrelated to the structure of the rocks. In the western portion of the area the rivers have a decided strength in a N.E.-S.W. direction and though again the original lines of drainage were laid down on a surface of Upper Cretaceous rocks the present valleys are eroded in belts of weakness or along complicated fault lines.

The April Field Meeting arranged by Mr G. A. Kellaway gave members the opportunity of visiting exposures of Lower Lias in the Radstock district and especially the Charmouthian of Broadway Lane. In July Prof. Reynolds and Dr Smith led a party to Tortworth and Tite's Point. After visiting the trap quarries at Cullimore's and Damery, recent work on the Cambrian rocks at Breadstone was illustrated. The Silurian and Lower Lias were examined at Tite's Point and the Wenlockian at Brinkmarsh was seen on the return journey. Mr H. C. Baker led a party in September to the old lead and celestite workings in the neighbourhood of Abbots Leigh and Leigh Woods.

Under the general leadership of Mr J. W. Tutcher, M.Sc., the discussion class has been held regularly accomplishing much useful work amongst members. The informal nature of this class is still maintained and its popularity amongst members is undoubtedly due to the effective control of Mr Tutcher.

During the year the Section has lost by death two valued members. Mr W. H. Wickes joined the Section in 1900 and by his original and often provocative remarks did much to stimulate thought. Mrs E. M. Vaughan, who joined in 1917 and held the post of Treasurer from 1932 until her death in March 1933, was an earnest student especially of local exposures. She was a most capable organiser and the Section owes much to her quiet methods.

The Section still continues to subscribe to the "Geological Magazine" and the Palaeontographical Society, the volumes being placed in the Library of the Society.

F. S. WALLIS, *Hon. Secretary.*

Account of the Annual and General Meetings.

THE 70TH ANNUAL MEETING.

January 19th, 1933.

Dr F. S. Wallis, F.G.S., was elected President, and Mr H. Tetley, B.Sc., F.Z.S., a Vice-President, with minor alterations in Council. The retiring President, Mr J. W. Tutcher, M.Sc., delivered his second Annual Address, entitled " Historical Sketch of the Society, 1862-1932 " (see p. 334).

THE 564TH GENERAL MEETING.

February 2nd, 1933.

THE 6TH ANNUAL DINNER.

The President, Dr F. S. Wallis, F.G.S., presided over a gathering of upwards of 70 members and friends and an enjoyable evening was spent. When the loyal toast had been honoured Dr T. Loveday, the Vice-Chancellor of the University of Bristol and the guest of the evening, proposed the health of " The Society," and congratulated it on attaining the age assigned to the human being—three score years and ten. He emphasised how fully he recognised the value of the Society to the University, but stressed the fact that if it were to continue healthy and prosperous in the future it must persuade the younger generation to join its ranks. The Council must provide some type of organisation for the recruitment of new members. This should not be a difficult task as biology is now studied at the schools and every possible endeavour should be made to follow up that early instruction.

He thought that there was no more democratic institution in existence than a natural history society. In the pursuit of natural history persons of all stations in life, whether wealthy or in poverty, succeeded in mixing in the most friendly way.

In reply, Dr Wallis paid a tribute to the valuable assistance given by the University to the Society. He suggested that one reason for the continued vitality of the Society was to be found in the close and friendly co-operation of two groups of folk—the specialist and the amateur. There was no rigid line of demarcation between the two groups and each was the complement of the other. Although the specialist work of the community is now carried out with ever increasing exactitude, the generalised direction is without power and lacks vision. In conclusion he made an urgent appeal for an increase in the membership roll of the Society.

An excellent programme of music and recitations was contributed by Mrs H. W. Turner, Miss Jeffcoat, Mr T. A. Ryder, and Dr Stanley Smith, whilst Prof. O. V. Darbishire delighted the members with some clever conjuring tricks.

THE 565TH GENERAL MEETING.

March 2nd, 1933.

"British Orthoptera—The Grasshopper and its Relatives," by C. W. Bracken, B.A., F.R.E.S., President, S.W. Nat. Union.

The Grasshopper belongs to the group of insects known as *Orthoptera*—straight-winged insects. Others having the same characteristics are therefore grouped with it and may be considered under the popular term of "relatives." They are the Earwigs, Cockroaches, Leaf and Stick Insects, Grasshoppers—long- and short-horned, and Crickets.

There are no marked larval and pupal stages as with the butterfly; the tiny insect emerges from the egg a miniature of its adult stage, developing gradually its wings and other organs.

We have only about 40 species in Britain of a world total of probably 10,000. Europe numbers about 500.

Contrary to popular ideas the garden earwig is but one of nine British species. Its imbricated abdomen enables it to bear great pressure, while its wings have a complicated system of folding. The callipers vary in male and female, and may assist in wing-packing, or even offence and defence. The female earwig is one of the few insects which cares for its young. The lecturer proceeded to give interesting details of the so-called Giant Earwig of the Bournemouth district, now nearly extinct, and the "Tavistock" (Devon) species, also no longer found.

Cockroaches include the common black beetle—a misnomer, since it is neither black nor a beetle. The differences between the House and Ship Cockroach were explained and the history of their introduction to England given. The presence of the latter in Welsh coal mines was attributed to the use of imported pit-props. Certain cockroaches are indigenous to this country and may be termed "wild" cockroaches. The only common one, *Ectobius panzeri*, is less than half an inch long and may be beaten from gorse bushes and undergrowth near the sea coast.

The *Mantidae* and *Phasmidae*, which include the Praying Mantis, Leaf and Stick insects, are foreign insects. They provide excellent examples of protective mimicry.

Our common grasshoppers are either short-horned or long-horned. The former, abroad, include the locust tribe. Here, they are the green, chirping, leaping insects of our fields and hedgerows. They vary in size from the *Tetrix* of $\frac{1}{3}$ inch to the handsome red and gold Marsh Grasshopper, some two inches long. The long-horned species include the Great Green and the Great Gray Grasshoppers, the former being the largest British species, whose wing-span may be three to four inches. All this group are not uncommon in their special habitats, but are rarely seen away from the herbage among which they live. The lecturer dealt exhaustively here with the habit of stridulation or chirping in this group and with the organs of hearing, which were situated either in the abdomen or the knee!

Among the Crickets, *Gryllus domesticus*, the "Cricket on the Hearth," is, of course, the commonest and still survives in farm houses.

The Field Cricket, of which Gilbert White wrote so charmingly in his "Natural History of Selborne," is much rarer than in his day and is now seldom seen. The curious Mole Cricket with its fossorial forelegs is also rare now-a-days, although its subterranean habits have always protected it from capture and observation.

Reference was made to the migratory habits of the true locust and to the occurrence of odd specimens in this country. Cockroaches of various kinds were frequently found in imported bananas, especially the rather pretty green *Panchlora*. The lecturer stated that Orthoptera records from the Bristol area appeared to be very limited, obviously because of a paucity of observers rather than from a lack of material. He commended this family to the attention of naturalists who desired a small compact group of insects for observation, collection and study.

THE 566TH GENERAL MEETING.

April 6th, 1933.

I.—" Plant or Animal," by Miss D. H. Marshall.

The Slime Fungi (*Myxomycetes*) are remarkably interesting organisms, partaking of the nature of both plants and animals, but being, strictly speaking, neither! In their active state, they consist of a mass of slimy material (the plasmodium) capable of slow movement and of engulfing and digesting solid particles of food; but they form fructifications which bear fungal spores, and the various species exhibit great variety in the forms of these sporangia. The spores, when germinated, give rise to "swarm cells," resembling the low form of animal life known as an amoeba, which multiply repeatedly by division into twos, and from numbers of these cells a new plasmodium is built up, thus completing the life cycle. Slime Fungi are usually to be found on dead leaves, rotting wood and tan: and there are about 450 species.

II.—" The Oldest Rocks in the Neighbourhood of Bristol," by Dr Stanley Smith, M.A., F.G.S.

The lecturer described how he was asked in 1932 to examine an old shaft which had been constructed in the early 18th century near Breadstone, in Gloucestershire. The fossils which he found proved conclusively that the strata were of Cambrian age. Further search showed that the beds were of Upper Cambrian or Tremadoc age.

These rocks have now been shown to cover an area from Berkeley to Purton and consist of uncleaved but much jointed shales, contrasting markedly with the strong arenaceous Llandovery rocks to the south. The shales are micaceous and for the most part soft and fissile, breaking with a conchoidal to platy fracture. They are generally of a grey or bluish-grey colour, weathering buff.

The fossils were described and the importance of this discovery, by which the early history of the Bristol area is pushed back some millions of years, was stressed.

SUMMER FIELD MEETING.

June 17th, 1933.

Minchinhampton and Rodborough Commons on the Cotswolds were chosen for the Summer Field Meeting, under the leadership of Dr F. S. Wallis and Miss M. D. Hiley, the President and Secretary of the Field Section. Leaving Bristol via Downend and proceeding through Old Sodbury and the picturesque Nailsworth valley, the upland village of Minchinhampton was reached. Here the party was met by the Rector, Rev. Rex. V. Hodson, M.A., who gave an interesting account of the present church and the only remaining portions of the 14th century structure.

After tea at the Bear Inn, Mr C. I. Gardiner, M.A., past president of the Cotswold Field Club and curator of the Stroud Museum, heartily welcomed the Bristol visitors to the district. He and other local naturalists accompanied the geologists to the Inferior Oolite rocks near Rodborough Fort, whilst the botanists, under the energetic leadership of Mr H. C. Humpidge, explored the Commons and were very successful in finding Orchidaceous plants.

Finally, the members gathered in the Stroud Museum, where the energy of the curator has in three years built up a fine institution. The essential local character of the exhibits was commented upon, and members were acquainted with many interesting facts concerning the cloth industry.

THE 567TH GENERAL MEETING.

October 5th, 1933.

Exhibits of Natural History by the Members.

The exhibits laid out by the Botanical Section included a collection of over 150 freshly gathered flowers and fruits of trees, shrubs and herbaceous wild plants of the district. About 30 of these represented all the British poisonous plants, supplemented by pressed specimens specially gathered and arranged by Mrs Bell. The University lent tropical plants, among which were a growing pine-apple, and the *Sansevieria zeylanica*, from the fibres of whose leaves the ancient Hindoos prepared bow-strings. Dwarf trees of Ash, Yew and Horse-Chestnut, 12½ years old but scarcely a foot in height were also lent. Mr H. S. Thompson showed plants found during the drought in the Blagdon and Chew Magna reservoirs and growing in mud normally covered by several feet of water.

The Ornithological Section provided a living Hawk, wearing hood and jesses, and marvellous photographs of birds with their nests and young, and also water colour sketches of birds by Mr F. Carey Coombs. Mr H. Tetley and Mr L. H. Matthews, who have been enquiring into the distribution of local mammals, showed skins and notes concerning them, together with the dreaded Musk Rat, of American origin, which, though already in the upper reaches of the Severn, has not yet been found in Gloucestershire.

In Geology, Mr J. W. Tutcher displayed the original fossils illustrated in Dr Arkell's newly-issued work on the Jurassic system, while Mr H. F. Barke had fine Rhætic specimens from Aust, and Mr G. A. Kellaway exhibits from the Charmouthian at Welton, near Radstock, beds rarely exposed in this area.

Microscopy was represented by Mr D. F. Shrimpton's botanical slides and photographs.

Visitors from the Ornithological Section of the Somerset Archaeological and Natural History Society, who had been entertained earlier in the day by our Section, were accorded a hearty welcome.

THE 568TH GENERAL MEETING.

November 2nd, 1933.

"The Fascinations of Field Photography," by John Kearton, of Surrey.

The lecturer showed by a fascinating series of lantern slides, most of them in colour, examples of the unnatural pictures of birds which were common in earlier books. His father, the late Richard Kearton, the well-known lecturer on Natural History, had produced a work at the end of last century which was the first natural history book to be illustrated with photographs taken of creatures in their natural surroundings. The difficulties experienced in obtaining such photographs were described, as well as how the curious concealments, such as a stuffed ox, artificial sheep, hollow tree trunks and camera "hides," were gradually constructed and then left for birds to become accustomed to them. Disappointments were inevitable, but the triumph of a successful picture, even after days of failure and much expense of travel and other costs, seemed well worth all the labour taken. Mr Kearton often surprised his hearers by the clever reproduction of the calls of several well-known birds. He showed slides of birds, beasts and reptiles in their natural haunts, and a number of them dealt with the wild life of Lundy Island. Some of these showing nests and young birds on the face of steep cliffs had been secured with great difficulty and at considerable risk.

The lecture was suited to the large mixed audience, and was able to give interest and pleasure alike to those skilled and to those as yet unversed in Nature lore.

THE 569TH GENERAL MEETING.

December 7th, 1933.

"Ecological Studies in the Bristol District," by Dr Rose Bracher, M.Sc.

Students in the Botany Department of the University of Bristol have been encouraged to study vegetation in the open.

Field classes are held every week that the weather is suitable. The principles of plant ecology are at first considered. An accurate map is made of the area under investigation and by a systematic study of the vegetation, the area is divided up into natural plant communities.

The studies are then extended to an examination of the ecological factors, or the environmental conditions which operate over the area. The reason for the existence of the plant community in question may then be ascertained.

Finally, the vegetation in any one place is compared from year to year; changes are noted and the reasons for these changes are sought.

Besides the regular course work, certain advanced students undertake ecological research. The places which have been specially studied are the Avon banks, Portishead Mud Flats, Berrow Sand-dunes and the peat vegetation of the Mendips. The Woodlands of the Failand House estate have also been studied with regard to the various types of wood and plantation now found there.

PRESIDENTIAL ADDRESS, 1933.

By F. S. Wallis, D.Sc., Ph.D., F.G.S.

BEFORE delivering his address the President referred briefly to the three losses which the Society had suffered during the year.

WILLIAM HENRI VALENTINE WICKES

Died February 2nd, 1933, in his 86th year.

Mr Wickes was born in London but came west in middle life and lived for some time at Freshford, near Bath. After this, for more than forty years, he resided in Bristol. Mr Wickes joined our society in 1900 and remained a member until his death thirty-three years later. He was also a member of the Geological Section during the same period. Mr Wickes served on the Council of the Naturalists' Society for eleven years, 1906-17, and contributed four important papers to the "Proceedings." He also contributed to the "Proceedings of the Geological Association of London" of which he was a member.

Mr Wickes was well informed in most natural history subjects, but his attention was chiefly directed to Geology. He made an extensive collection of specimens relating to that science, the greater portion of which was placed at the disposal of our Society. Mr Wickes was not, however, mainly a collector of specimens: he was a keen observer with original views, and many suggestive explanations of geological phenomena appear in his contributions to the Society's "Proceedings."

Until advancing years prevented, he regularly attended the ordinary and sectional meetings and excursions of the Society, and on all occasions his genial personality and pertinent observations were much appreciated by the members. For many years Mr Wickes was a valued member of the Royal Orpheus Glee Society and was well known and much respected in local musical circles.

J.W.T.

EDITH MARY VAUGHAN

In the death of Mrs Vaughan on March 10th, 1933, the Society, together with its Geological and Field Sections, sustained a severe loss. Joining the parent Society and its Geological Section in 1917, Mrs Vaughan, despite many other duties and a natural unobtrusiveness, soon proved ability and readiness to render valuable service. In 1921 she was elected to the Society's Council and in 1925 became its Reporting Secretary, ably filling that position until her death. On the Annual Dinner Committee, she was always Miss Roper's right-hand helper.

Mrs Vaughan was a keen geologist and took especial interest in the Trias and Lias rocks of her own locality. No chance exposure of these, during road or building operations in the Redland and Cotham areas, escaped her notice and her records of such are in the Geological Note-book now in the custody of the Geological Section. Mrs Vaughan was also active in making the subject and author card-index of the Q.J.G.S. now in our library. In 1932, elected Treasurer for the Geological Section, she again gave excellent service. After her death her collected geological specimens were distributed among members of the Section.

On Field excursions and at the annual meetings of the South-Western Naturalists' Union, Mrs Vaughan was always keen in observation and thoughtful to aid others. She will be remembered by all who knew her as a typical Naturalist, eager alike to learn and to impart knowledge and winning an outstanding individuality by her very effort to lose it in the welfare of the body she served.

The Society was represented at the funeral, and with its Sections, sent a wreath.

T.S.

WILLIAM ALEXANDER SMITH, M.A., M.B., M.R.C.S., F.C.S.

Dr William Alexander Smith died in Cambridge in August 1933, in his eighty-second year. His distinction in and out of his own profession has been widely acknowledged, and a portraiture of him from the pen of Dr George Parker appears in the latest number of the Bristol Medico-Chirurgical Journal.

From Christ Church, Oxford, and from St Mary's Hospital, London, he carried his attainments into country practice. One of his family can describe rural rounds diversified by the pursuit of bird, flower, fossil or flint. He would return to late hours in an ever-expanding library and its world of thought. He surrounded himself with a knot of cultivated men: he travelled abroad, and his situation near Saffron Walden gave him Athens and Thebes—Oxford, which lay behind him, and new associations with Cambridge.

When he came back to Clifton he gave full scope to his bent. Of many Societies which he joined, the Naturalists' was one, and for several years he acted as Treasurer. He has left to Bristol Museum and Art Gallery a geological collection in which his haunts may be traced.

His friends could wish that he had left more original work, knowing, as they do, the charm of his familiar letters, the style of an occasional paper, and the ample range of his conversation. But he was a good man to whom to bring a speculation for a verdict. He gave a scholar's attention to Dr Charles Singer of Oxford dealing with the Aesclepiads of Greece in an age when one mind might cover the whole field of knowledge.

If he had a zeal for Science and defended research, he loved the jots and tittles of literature too. A book he favoured was "Guesses at Truth;" he liked too, he said, its *clipt spelling*. He had the unique little traits of a large and lovable nature.

D.A.A.

Science and the Community.

When Societies and individuals pass the three-score-years-and-ten mark, it is perhaps pardonable for them to depart from the strict interpretation of their title or profession, exercise the privilege of old age and browse in a somewhat philosophical spirit amongst matters of wide import, provided that the theme is cognate with the general flavour of their existence.

Manifestly, this is a Society which exists for the advancement of the study of the natural history of the Bristol district. The wider realm of science however includes the parochial investigation of nature, and the present time appears opportune to discuss briefly a few ideas connected with science and its relationships to the social and ethical problems of our day and generation. We are students of natural history, but we are also members of a community. We admit the science-for-its-own-sake slogan, but feel that we cannot ignore the social implications of our studies. Increasingly, public attention is being focussed on these relationships, and there is a growing recognition amongst workers in science that the broader and wider questions must receive more attention. This Society is always represented officially at the meetings of the British Association, and hence to a certain extent we are involved in the utterances of Sir Alfred Ewing at York in 1932 and the still more recent words of Sir Frederick Hopkins at Leicester, when the relationships of science and the common weal were strongly stressed.

It is a truism to say that we live in an age of science; it is admitted that science is the dominant intellectual interest of mankind at the present day, and yet it is only in the minority of folk that we discover the real scientific outlook. Even we fear, it must be confessed, that the essential spirit of science is lacking in some members of natural history societies. We are so keen on species new to science, that oft-time cant word " research," first records, and the collection of hosts of facts, that our vision is narrow and the real meaning of science is lost.

Obviously, at the outset it is important to visualise the exact significance of science. We glibly use the term and numerous definitions immediately present themselves. The difficulty of definition is partly due to the abstract nature of some of its conceptions, and even scientific workers differ regarding the why and wherefore of their activities. Science has been defined as the accumulation of facts, organised commonsense, systematised knowledge, or more expressively just " stinks," and although no one can disagree with either of these definitions, the resultant impression on the mind is vague. Perhaps a simile may help. That much-discussed and much-maligned individual, the man-in-the-street, has knowledge of a certain kind; he knows that the grass is green, that coal is black, and a host of other facts of even more practical import to himself. But the botanist will tell us of green chloroplastids, or chlorophyll corpuscles in the cells of the leaf, and will also tell us that leaves only appear green in white light. The chemist will explain the blackness of coal in like manner. The first type of knowledge is that of isolated facts regarding the grass and the coal; the other type is of facts and their relationships. In brief, the first is unscientific and the second scientific. The difference is the same as that between the heterogeneous collection of articles in a schoolboy's pocket and the labelled, inter-related specimens exhibited in a systematic museum. Attention to order and method is characteristic of our craft. The scientist aims at building out of the vast mass of human experience an orderly whole.

The foundation of all scientific knowledge is facts—facts ascertained by the myriad of devices known to twentieth century man. These facts are the bricks with which the Temple of Science is being built. It was T. H. Huxley who said that " the great benefit which a scientific education bestows is dependent on the extent to which the mind of the student is brought into immediate contact with facts." But these facts must be critically inspected, and if their nature and limits are in doubt the man of science will refuse to use them. Then, these ascertained, verified, and re-verified facts must be brought into a system. Science is systematised knowledge in which the personal factor has been eliminated. Scientific judgments are unbiased by personal feeling.

The slow accumulation of data, the long and sometimes tedious studies of the specialist, are all conducted in the hope that they will lead to the formulation of a new theory or provisional hypothesis. Where the old method of deduction failed to discover new truths, the modern method of experiment and inference, of inductive thought followed by deductive reasoning, has been fruitful in the understanding of natural history problems. Moreover, the method is simple although it appears complex.

But, in addition to this intense logic, the scientist sometimes finds it advisable to cultivate the controlled use of the imagination. This is a powerful and dangerous drug and should be taken in small doses. When he has marshalled all his facts, then to discover the hypothesis which binds them together, it is absolutely necessary for him to give the imagination free-play. Let him take a care-free holiday and then, having had his vision, return to the true scientific method and see if romance accords with the facts.

The difference between scientific and unscientific is not so much a question of reality as of method. The man-in-the-street picks up facts as he finds them; the man of science subjects his facts to critical examination and logically works them into a system. Science, then, is ordered, tested, and organised knowledge.

In science, the worker acquires a definiteness of grasp, a clearness of view of the relationship between cause and effect not attainable in any other branch of knowledge. He understands what is meant by rigid proof and his thoughts are clean cut and sharply demarcated in a way that is unknown to those not acquainted with the methods of science. Admittedly, the too exclusive use of this methodical faculty tends to warp other faculties and would quickly develop a nation of conceited prigs. Natural history societies provide the humanistic element and gracefully counterbalance any such tendencies.

Scientists may appear to be rash in their conclusions and shameless in the way they hop from one view to another. But it is a growing movement, not a set of hard and fast rules. The world of science is in a constant state of renewal. It has been said that the saddest sight in the world is a theory slain by a single fact. The backyards of science are littered with discarded hypotheses all destroyed by facts.

In a nutshell, science is a disinterested search for truth. The quest for truth is the basic platform of science. We must admit that man, even though normally honest in speech, is not by nature a lover of the truth. Rather, we wish to believe the thing as it seems in the imagination. We are lovers of fancies and our own cherished prejudices. Science provides an antidote for these human tendencies; it forces us to the truth and helps us to discriminate the false from the real and the doubtful from the well-established.

Science has placed within the reach of the nation methods of thought which could be used to banish human misery and commence a reign of material and cultural prosperity. But such an Utopia is not yet, for civilisation is definitely lagging behind scientific conclusions. In some quarters it has even been suggested that scientists should cease investigations for a period of ten years and allow civilisation and science to equalise themselves. But apart from such ideas of perfection, there are perhaps a few lines of thought concerning the reactions between science and the community that may be profitably pursued.

At the outset, it is a self-evident fact that science for a long time past, and more especially during the last twenty years, has substantially aided our material life. Much is expected of science at the present day, and no matter what miracle is performed no surprise would be experienced. It has become part of the creative element in modern life and the present must be considered as a mere foretaste of the future, for it is only just beginning to show its power. To realise the value of the materialistic advantages bestowed by science, we only have to compare our present life with that of 17th century man. Meditating in a haphazard manner we can enumerate flight, X-rays, plant genetics and surgery, all made available by the patient researches of the scientist. With the majority of these inventions chance has had little scope; they are nearly all the result of the intensive gathering together of facts, the processes of inductive and deductive thought, and the application of hypotheses to the needs of everyday life. It is a characteristic of our times that the investigation of principles is quickly followed by practical inventions.

Though the effect of science on our material life is so obvious, the contribution of science to our cultural life is perhaps not quite so apparent. Science, as an instrument of mind training, has a far higher value than is usually conceded to it by our experts in education. As naturalists, we believe that to direct the imagination to the infinitely great and to the infinitely small to aeons of time beyond comprehension, is work of supreme national importance. Such studies can and must elevate the mind, and even a casual but intelligent interest in them can but help us to live in the best sense.

We want to impress our fellow-citizens with the fact that the scientific method gives a critical faculty by which fact is distinguished from fable and on account of which one is cautious in arriving at conclusions. Further, the study of science promotes a respect for truth and fact, order, and method which of necessity is coupled with a wholesome distaste for rhetoric and loose thinking. We must admit that scientific accuracy is in some degree unnatural to man and that the majority of our opinions, often given so pompously, are really wishes. But even members of a natural history society may perhaps admit that a certain latitude is pleasant and even desirable in our so-called small talk, so long as we rigorously pursue the true scientific method on more solemn and official occasions. We have no desire that everyone should know the differences between the edible and non-edible fungi, or the names of the genera of Liassic ammonites, but we have every desire that the methods which enabled us to tabulate such facts should be part of the cultural equipment of every citizen. The method is the experimental one, and it should result in sound logical thought and the basing of our actions on that thought. We want to see the scientific temper of mind developed in all.

The influence of science on modern civilisation also includes the tendency to overthrow any over-respect for authority or tradition. It teaches us to refuse to accept, unless accompanied by proof, the words of any master, no matter how eminent his name. Evidence of such a critical faculty may be found in many walks of life and would appear to be a direct result of the scientific atmosphere.

As naturalists, we may also take legitimate pride in the way that the idea of evolution has influenced nearly all knowledge. Originally conceived as a theory to explain the diverse forms of life, the word has been incorporated into common parlance. It forces us to visualise all abstract ideas and concrete things as possessing a past; it brings the historical aspect well to the front. In fact, it might be said with truth that the study of all subjects is permeated to a greater or lesser extent by the evolutionary theme.

It might perhaps be argued that one is unduly stressing the effect of science on our lives and entirely ignoring the twin branch of culture usually termed art. The presence in this city of an institution called the Museum and Art Gallery sufficiently emphasises the close relationships between the two cultures. If science is a disinterested search for truth, then art is the complementary search for beauty. Keats realised this closeness of interest when he wrote that

> "Beauty is truth, truth beauty—that is all
> Ye know on earth and all ye need to know."

But if science and art are the complementary elements of culture, there are important distinctions. To the student of art, a work such as a picture, cathedral, or novel is accepted as a completed piece and the process that led to its production is not a prominent part of that acceptance; that is a mere matter of technique. But a scientific hypothesis is immediately scrutinised and the sequence of thought or experiments which produced it as well as the result are subjected to enquiry. And so also with scientists and artists. A result in science rejected by the experts in that line is generally thrown aside by all, but in art the cheers of one school balance the scowls of another. Art is more personal than science. Appreciation of the methods of art and science are not by any means as mutually exclusive as they are popularly supposed to be.

But to return to the main theme. It would appear that due regard for veracity, patience, logical thought, responsibility, discipline, and original work may all be impressed on the community by a study of scientific method, a study which can be greatly influenced and accelerated by natural history societies. We desire a more complete application of the methods of science in all departments of national and industrial activity. It is a platitude to say that the world is in a state of chaos at the present moment. We believe that its salvation must be based on knowledge permeated with the spirit and temper of science. It therefore follows that bodies such as the Bristol Naturalists' Society must conduct *pari-passu* with their detailed and often involved themes a campaign of publicity and education more ambitious than has ever been attempted in the past. We must seek to popularise scientific method, and, even although some of our organisation is evolved with the direct intention of securing new members, we must also remember that as a Society we have a larger and wider mission to fulfil in this City and County. The public are little interested in our scientific jargon, but they are keen to hear the general results of our work and then to fit these results into the general and philosophical problems of the day. Anyone who has had the privilege of lecturing to such bodies as the Workers' Educational Association will corroborate this statement.

The quests for truth, for beauty, and for goodness, known respectively as science, art, and religion, should form the essence of our cultural lives. A balanced judgment, which is of such inestimable value to-day, can only be attained when science is not merely regarded as a mass of facts, but is ranked with art and religion as an essential part of our mental outlook. This outlook can never receive full recognition until naturalists individually and societies collectively do all in their power to stress the scientific method in every sphere of human activity and conduct.

The British Coasts.

By Sidney H. Reynolds, M.A., Sc.D.,
Emeritus Professor of Geology in the University of Bristol.

Anyone who refers to a map of the British Isles can scarcely fail to be impressed by the great variety of the coastal types. At one extreme are the long, gently-curving and nearly unbroken shore lines which characterise so much of the East coast and are perhaps best seen in Northumberland, Lincoln, and Norfolk. At the other extreme is the highly indented coast of western Scotland, with its peninsulas, innumerable islands, large and small, and deep sea lochs.

These differences depend on three main processes:—(1) Change in the relative level of land and sea; (2) the erosion or wearing away of the land, which in its turn is influenced by (a) the nature of the rocks and (b) their disposition; (3) the redeposition of the material worn from the land by erosion.

It may further be claimed that, while the minor variations in the coast line depend chiefly on erosion and deposition, the major ones are more concerned with the changes in the relative level of land and sea.

It will be convenient to deal firstly with this latter subject. Definite evidence of the rise of the land relatively to the sea is conspicuous at numerous places, particularly on the West and South West coasts. The commonest kind of evidence is afforded by "raised beaches." These are deposits of shingle and sand often mingled with marine shells which once formed the shore line but are now raised to varying heights above high water mark. Excellent examples occur at Hope's Nose, Torquay (Pl. I, A), at Portland Bill, at many points in Cornwall, on the southern shore of the Gower peninsula, and in many other places. In the Bristol district small patches of raised beach material adhere to the cliff at a height of about 30 feet above high water mark at Spring Cove and Woodspring, near Weston-super-Mare (Pl. IV, B). At both these places the beach consists of blocks and pebbles of local origin mingled with shells of species found in the adjacent sea, the whole somewhat firmly cemented together.

Round many parts of the coast the sea, by the cutting back of the cliffs, has given rise to a nearly level tract extending between high and low water and known as a shore platform. Such shore platforms, more or less covered with shingle and sand, have often been raised above sea level, and particularly where the country is rugged (Pl. I, B) they may form the most valuable land available for cultivation. Many of the Scottish islands, such as Arran and Bute, have much of their coast bordered by a raised platform of this character. The Scottish carses, such as the Carse of Gowrie north of the Firth of Tay, are further examples. In parts of Scotland several such raised platforms occur at various levels, the chief being at approximately 25, 50, and 100 feet above high water mark. The 25 foot terrace is specially important, many towns, such as Arbroath, Dundee, Leith, Greenock, and Ayr, being partly built on it. Other features characteristic of a rocky coast such as caves and sea stacks may often, as near Oban, accompany a raised shore platform.

Evidence of the lowering of the land relatively to the sea is not so conspicuous as evidence of elevation partly because the sea, as it spreads

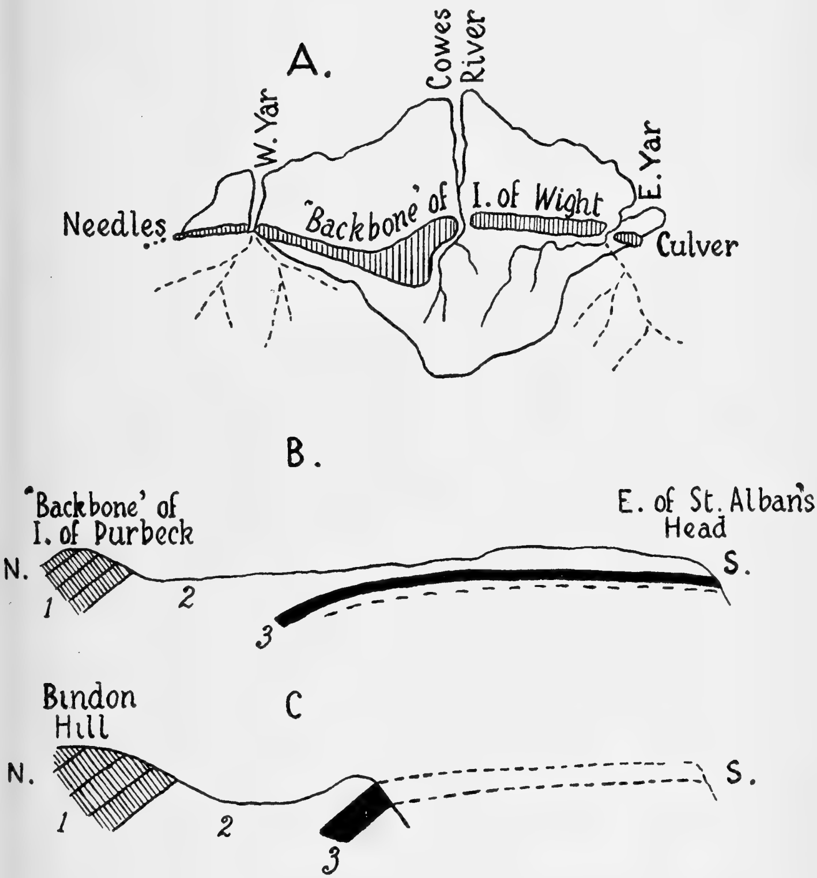


FIG. I.

A.—The Isle of Wight. Scale 1 inch = 8½ miles.
B.—Section across the Isle of Purbeck east of St Alban's Head.
C.—Section at the Fossil Forest, Lulworth.

1. Chalk. 2. Pre-Chalk Cretaceous and Purbeck beds. 3. Portland Stone.

In A. the possible courses of the vanished branches of the East and West Yar are shown by dots. In C. the cutting back of the coast in the western part of the Isle of Purbeck near Lulworth as compared with that in the eastern part near St Alban's Head is indicated by dots. Length of B. rather over 4 miles, of C. under 1 mile.

over the sinking land, obliterates the evidence of its former margin. But at numerous places, particularly on the South and West coasts of England and Wales, there occur "submerged forests" consisting of peaty deposits with the stumps of trees still in the position of growth, exposed at low water but submerged at high. Excellent examples occur in Swansea and Cardigan bays, on the coast of the Wirral peninsula, Cheshire, and in the estuaries of various rivers.

Many of the major features of our coast line are also essentially the effect of submergence, the result depending on the prior configuration of the ground. The effect of submergence on a mountainous region with high land formed of hard rocks rising steeply from the sea is admirably seen in the Western Highlands of Scotland. In such a region the valleys tend to be deep and narrow and when the sea enters them by submergence they form long narrow sea-lochs such as Lochs Linnhe, Fyne, and Long. When submergence has completely cut off a portion of the old land by entering a valley this will become a "sound," such as those of Jura, Mull, and Sleat. Many of the numerous small islands off the Scottish coast are the tops of nearly submerged mountains.

A very different result has followed the partial submergence of the low-lying coast of Suffolk and Essex formed of soft rocks. A comparatively slight depression has admitted the sea to the broad and shallow valleys and an irregular coast-line has resulted, though, as will be pointed out in the sequel, subsequent changes have to some extent restored the regularity of outline.

The long branching inlets on the south-west coast of England and Wales, such as the mouth of the Dart, Kingsbridge Harbour, Plymouth Sound, Falmouth Harbour, the Helford river, and Milford Haven, are also river valleys drowned by the advance of the sea through submergence.

It will be noted that evidence has been cited from the west of Scotland for movements both of elevation (emergence) as afforded by raised-beaches and of depression (submergence) as afforded by sea-lochs. The whole of the West of Scotland is a submerged area, but partial re-emergence has taken place, of which evidence is afforded by the raised beaches.

We may now pass to a consideration of the erosion or wearing away of the coast, which depends, as already stated, partly on the nature of the rocks, partly on their disposition.

To take the former point first—it is obvious that the wearing away of the rocks is determined by their capacity for resistance, and this in its turn depends partly on the hardness, partly on the divisional planes which traverse them. The chief hard rocks are the igneous rocks such as granite and basalt and the harder varieties of limestone and sandstone. The chief soft rocks are clays and sands. Other things being equal, the hard rocks will form promontories, the soft will be worn into bays. This is well shown on a large scale by the south coast of Devon and Cornwall, the projecting masses of the Start and the Lizard being due to the occurrence of areas of very hard and ancient rocks and that

A.—RAISED BEACH RESTING ON DEVONIAN LIMESTONE. HOPE'S NOSE, TORQUAY. The base of the beach is at about 25 ft. above high water mark.

B.—THE 100 FOOT RAISED BEACH, CATACOL, ARRAN.

PLATE I.

A.—LOOKING N. FROM NEAR DURLSTON HEAD, SWANAGE.

The resistent rocks form promontories—the Chalk of Handfast Point in the distance and the Purbeck limestone of Peveril Point in the middle. The softer rocks are worn into bays—Durlston Bay in the foreground and Swanage Bay beyond Peveril Point.

B.—NEAR ARBROATH—THE SEAWARD END OF A BLOW-HOLE IN THE OLD RED SANDSTONE.

PLATE II.

of Land's End to granite, while the wide bays between these masses are due to erosion of a varied series of, in the main, relatively soft rocks. The same feature is well illustrated by the Pembrokeshire coast in the neighbourhood of St Bride's Bay, which is worn in relatively soft sediments while the promontories to the north and south are chiefly formed of hard igneous rocks. Near Swanage (Pl. II, A), too, the promontories of Handfast Point and Peveril Point are formed by resistent rocks, while the occurrence of softer rocks explains the erosion of Swanage Bay and Durlston Bay.

The long narrow inlets which form such a remarkable feature of the coast of county Kerry depend partly on the varying resistance offered to marine erosion by the constituent rocks. The peninsulas are formed of hard Old Red Sandstone, the intervening inlets are worn in a more varied series of limestones and other rocks of Carboniferous age. But these inlets may in part be due to the drowning of river valleys.

The same features may sometimes be well seen on a small scale, hard bands forming promontories, less resistent bands being worn into narrow inlets.

A particularly rugged coast line with a fringe of reefs and rocky islets is often found in granite regions. Rarely is this better seen than in the case of the Channel Islands, which are the greatly eroded remnant of a tract of very ancient land. Inspection of a map will show with what a formidable mass of rocks and reefs parts of the coast, particularly the south coast of Jersey, are fringed. Certain groups of rocks such as the Casquets rise from a worn-down platform and must represent the remnant of what was once a fair-sized island. In other cases the land has completely disappeared and is represented by a submerged shelf.

Sea Cliffs. Though cliffs are commoner in hard rocks than in soft, there are a number of other features, such as uniformity of grain and the presence or absence of marked divisional planes, which determine their height and steepness. While some of the highest and most precipitous cliffs in the British Isles are formed by hard well-jointed and horizontally-lying limestones, as in parts of the west coast of Ireland, particularly Co. Clare, or by sandstone as in Caithness and the Orkneys, soft rocks such as the red marls and sandstone of the Trias and Permian may give rise to steep and lofty cliffs as in part of the South Devon coast between Exmouth and Sidmouth. The finest cliff in the Bristol district, that of Aust, is also chiefly composed of red Triassic marls. The rock which perhaps above all others is noted for its cliffs, Chalk, can scarcely be regarded as a hard rock, though it is extremely resistent. Its tendency to form cliffs probably depends chiefly on its well-jointed character and uniformity of grain.

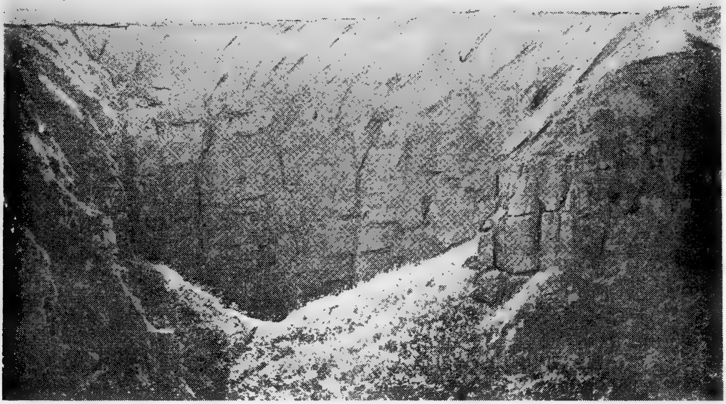
The shape of the Isle of Wight, something like that of an ace of diamonds, is due to the resistent character of the Chalk ridge forming the "backbone" of the island (Fig. I, A). The rapid erosion of the soft Lower Cretaceous strata south of the ridge, and of the, in the main, still softer Tertiary strata on the north side, has caused the Chalk ridge to project prominently at each end of the island. The resistent character of the Chalk is further well shown at the western end of the Isle of Wight from Freshwater to the Needles, at the head of Lulworth Cove and westward from Durdle Door. In each of these cases the sea has swept away the whole of the Lower Cretaceous rocks which by comparison with adjacent areas clearly once lay to the south of the Chalk ridge, but the Chalk checks its further progress.

Although the erosion effected by the sea is so much more conspicuous than that of the subaerial erosive agents, such as rain, the fact that the great majority of cliffs do not overhang but slope back from the top shows that the subaerial agents are really more efficient than the sea. Overhanging cliffs may occur when strata with conspicuous bedding and jointing slope seawards and in cases where the rocks at the base of a cliff are softer than those above.

Soft clays may not infrequently give rise to vertical cliffs as on the Dorset coast near Lyme Regis and Kimmeridge. But if a thick mass of clay forms the base only of a cliff, another factor is introduced by its impermeability. The clay prevents the downward passage of the water which has percolated through the overlying strata, with the result that these tend to slip over the surface of the clay, producing an irregular undercliff which may be difficult to traverse. Excellent examples of this are afforded by the Folkestone Warren, by part of the Undercliff of the Isle of Wight, by parts of the Dorset coast near St Alban's Head and White Nothe, and by the landslip area west of Lyme Regis. Cliffs chiefly composed of clay but with thin limestone bands are commonly characterised by much irregular slipping on a small scale, as is well seen on the north-west coast of the Isle of Wight.

Sea-caves, which are a feature of any coast formed of hard rocks, are due to the sea working along any conspicuous plane of weakness, such as a joint. Such a cave (Pl. II, B) may be gradually lengthened and may in time come to open to the air a considerable distance inland forming a blowhole (Pl. III, A).

We may now consider how the disposition of rocks may affect their erosion. It would be difficult to find any area where this is better shown than in the Isle of Purbeck. A considerable succession of sediments varying much in character forms the coast, but for the present purpose it is only necessary to allude to three members of the series—(a) the Chalk, (b) a varied series of strata little resistent to erosion—the Cretaceous rocks underlying the Chalk and the Purbeck, (c) the massive resistent Portland Stone. In the eastern part of the area between Durlston Head and St Alban's Head the Portland Stone forms the cliff, and as the rocks lie horizontally (Fig. I, B) the sea as it cuts them back has still to attack the same strata. Further west, however, the horizontally-disposed rocks have all been eroded away and the sea is attacking the same series tilted at an angle of some 30 to 40 degrees. Under these altered circumstances the Portland Stone still for a long distance forms a resistent barrier to the waves. But as its thickness is only about 100 feet, its inclined position has enabled the sea to break



A.—THE INNER OPENING OF THE BLOW-HOLE SHOWN IN PL. II, B. This is about 40 yards in diameter and 100 yards from the shore.

B.—GROYNE AT OVERSTRAND, NORFOLK. The shingle tends to move southwards and so is heaped on the northern (left) side of the groyne.

PLATE III.

A.—RECULVERS, THANET, KENT. Shows the wall and groynes protecting the coast.

B.—RAISED BEACH RESTING ON CARBONIFEROUS AT MIDDLE HOPE (WOODSPRING), near Weston-Super-Mare. The base of the beach is at about 30 feet above high water mark.

PLATE IV.

through it in places and rapidly erode the softer strata to the north. Hence arose the well-known Dorset coves of which the most remarkable is Lulworth Cove. Lulworth Cove has been cut back till the sea's further progress is checked by the Chalk; the erosion of the adjacent Stair Cove has not progressed nearly so far. All these inclined strata slope (dip) landwards, a fact which checks their erosion. When strata dip seawards, they all, hard and soft, tend to slip seawards and rapidly break up.

Hitherto the erosion of the British coasts has been described in general terms. Allusion may now be made to areas where this has gone on with special rapidity. The East and South-East coasts of England are mainly formed of relatively soft rocks, the remainder of the British coasts of relatively hard rocks. Hence marine erosion is as a rule more active on the east and south-east coasts of England than elsewhere.

Perhaps the coast most remarkable for rapid erosion is that of Holderness in Yorkshire, between Bridlington and Spurn Point—a tract 36 miles long. The cliffs here consist of glacial drift—an irregular mixture of clay, sand, gravel, and chalk rubble. Such a deposit offers comparatively little resistance to the waves and the numerous springs which are thrown out cause the cliffs to crumble away all the more readily. The subject is fully described in Sheppard's "The Lost Towns of the Yorkshire Coast," in which will be found a map showing the position of many places such as Auburn, Hartburn, and Ravenspur, the sites of which are now mudbanks dry only at low water. Mr Sheppard's illustrations further show how hard put to it some of the remaining places are to retain their position.

The coast of Norfolk is also one where recession has been rapid. It is recorded that during the 23 years between the Ordnance Surveys of 1838 and 1861 the part of the cliff between Cromer and Mundesley—composed, like the Holderness coast, of glacial drift or boulder-clay—has receded 330 feet, a mean annual loss of 14 feet. These cliffs are from 200 to 250 feet high, so that the amount of material carried away annually must be enormous. At present the average annual loss is said to be about 9 feet. The waste is largely the work of rain and springs, for as is the case with other coasts formed of soft rocks the cliffs tend to founder down in a series of small landslips. On the same coast villages such as Eccles have been washed away. For many years the last trace of the village of Eccles was the church tower, which stood among the sandhills; in turn these shifted inland, leaving the tower on the foreshore, and it finally fell in a storm in 1905. The coasts of Suffolk, of Sheppey and Thanet in Kent, and of Sussex between Hastings and Pevensey, have all suffered from encroachment by the sea. At Reculvers in the Isle of Thanet the church in Henry VIII's time was about a mile from the shore but by the beginning of the 19th century the sea was encroaching on the churchyard. The wall and groynes which now check its further advance are seen in Pl. IV, A. At Beachy Head great falls of the Chalk cliffs take place periodically. At Bexhill a peculiar "wave of erosion" proved very destructive. By this expression is meant a marked increase in the local intensity of the erosion, which, becoming manifest on a particular part of the coast, tended to move along it laterally. The promontory of Selsey, which is formed of soft rocks, has suffered much.

The Isle of Wight is clearly the reduced remnant of a once far larger land. Of the three rivers which flow northwards through the Chalk "backbone," the only one which retains its whole catchment basin is the Cowes river. The marshy tract and gap in the rocks north of Sandown mark the site of a branch of the Eastern Yar, which drained a tract now washed away, while the Western Yar has lost its whole catchment basin and is now represented only by the marshy valley extending from Freshwater Gap to Yarmouth.

The account given of the erosive action of the sea might lead to the supposition that the story of the British coasts was entirely one of destruction. This is far from being the case. All the material which is worn from the land by the action of the sea or conveyed thither by rivers becomes deposited, and much is laid down so close to the shore as to cause the land gradually to spread seawards. The material thus deposited is chiefly that of coarser grain, the shingle or beach material, but sand is often laid down near land and under certain conditions fine mud.

Shingle beaches commonly show a tendency to move laterally along the coast owing to the direction of the prevalent winds or currents. On the East coast the material tends to move southwards and on the South coast eastwards, as is shown by the side on which the shingle accumulates when a groyne or pier is erected (Pl. III, B). The direction of movement is also shown by the deflection of rivers owing to the throwing up of a bar or spit across the mouth. Thus, on the East coast the mouth of the Alde is deflected nearly 10 miles to the south and on the South coast the mouth of the Adur at Shoreham is deflected nearly two miles to the east. Other well-known examples of bars and spits are Spurn Point, which extends southwards across part of the mouth of the Humber; the Hurst Castle beach, which stretches part of the way across the Solent; the Chesil beach, which connects Portland Island with the mainland; and Slapton bar at Torcross, Devon. In some respects the most remarkable beach deposit of the British Isles is that of Dungeness, by which the large tract of Romney Marsh is shut off from the sea.

The important part played by beach material in protecting the coast against wave action has often been insufficiently realised. It has frequently happened that the carting away of shingle has been followed by serious local erosion.

Deposits of sand are formed either in the sea in the form of sand banks and sand bars or on land in the form of sand flats and sand

NOTE.—The photographs, with descriptions, published by the British Association Geological Photographs Committee afford excellent illustrations of the erosion of the British coasts. The subjects illustrated include several of those mentioned in this paper, such as Eccles Tower and the Bexhill "wave of erosion."

dunes. Many British harbours and estuaries are more or less blocked by sank banks and bars or by sand dunes, *e.g.*, that of the Exe. These deposits all check the drainage and tend to the production of marshes which may be drained and eventually form valuable land. Examples of marshy tracts shut off from the sea by sandhills are well seen on the south coast of Wales as at Briton Ferry, at several points in the Gower peninsula, and at Tenby. Sand banks and bars tend in association with erosion to do away with the irregularities of the coast line. Thus, while the southern part of the coast of Suffolk is deeply indented by drowned river valleys, further north the irregularities of outline have been much obliterated and the estuaries of the Bure, Yare, and Waveney have been shut off from the sea and gradually converted into marshy flats and backwaters. The present smooth outline of Cardigan Bay is also in large measure the result of local adjustment of erosion and deposition.

Sand dunes which tend to form on low shelving shores exposed to on-shore winds play an important part on the British coasts and may be very destructive, spreading inland and covering up fertile tracts with barren sand. Perhaps the most remarkable example of this is at Culbin, on the south shore of the Moray Firth, where the onward movement of the sand has disclosed many trees which had been smothered and killed. In the Bristol district, too, much of the low-lying Somerset coast between Bridgwater and Clevedon is bordered by sandhills and at Berrow they nearly surround the church.

At many places the spread of sandhills has been successfully checked by the planting of certain kinds of grass and other plants. On the other hand, at Southport a case occurred where, after the movement of sand had been checked by the natural growth of trees, these were cut down to extend the esplanade, with the result that the sand again began to move and covered the new esplanade. While in many cases blown sand plays a destructive part, in perhaps an equal number its presence is most valuable as it protects low-lying land from the sea.

While these accumulations of shingle and sand are important as affording protection for the land, they do not as a rule give rise to deposits valuable in themselves. It is different with alluvial flats, which are formed of the finest mud derived from the land. This may be deposited along the shores of estuaries and in sheltered bays, as is so well seen in the Bristol district, on the coasts of Gloucestershire, Somerset, and Monmouth. Oher regions of extensive alluvial flats are the marsh lands of East Lincoln and the shore of the Wash and of Morecombe Bay. In all of these districts large areas have been reclaimed.

In 1906 a Royal Commission was appointed to enquire into the erosion of the British coasts, and this paper may be concluded with some extracts from the report, which was published in 1911. Most of the statistics quoted below refer to a period of 35 years between two Ordnance surveys, but some are concerned with longer, others with shorter periods. They are based on a comparison of maps.

In England and Wales—4,600 acres lost, 35,400 acres gained; net gain, 30,700 acres.

In Scotland—815 acres lost, 4,700 acres gained; net gain, 3,800 acres.

In Ireland—1,100 acres lost, 7,800 acres gained; net gain, 6,700 acres.

In England the chief losses have been on the Yorkshire coast between Bridlington and Spurn Point, where 774 acres have been lost between 1848 and 1893; in Lincoln, where 400 acres were lost between 1883 and 1905; in Norfolk, Suffolk, and Essex, where 1,025 acres were lost; in Kent, Sussex, and Hampshire, where 1,100 acres were lost; and in Cheshire and Cumberland, where 926 acres were lost.

In all these counties except Suffolk, Kent, and Cheshire, there has been a net again, amounting to 2,000 acres in Yorkshire, 9,000 acres in Lincoln, 9,000 acres in Lancashire, 3,400 acres in Suffolk.

In Scotland and Ireland there has been a net gain in almost every county, over 3,000 acres having been gained in Londonderry and 1,300 acres in Clare.

Bristol Insect Fauna.

DIPTERA (Part VI).

By H. Audcent.

SCATOPHAGIDAE (CORDYLURIDAE).

THIS family occupies an intermediate position between the calyptrate and acalyptrate flies. The split second antennal segment and the chitinous bag at the base of the proboscis place it in the Thecostomata with the *Larvaevoridae* and *Muscidae*; there are, however, no hypopleural bristles, the calyptra (squamae) are small or the under one much reduced, the eyes are far apart in both sexes and always bare, the third longitudinal wing vein (R 2 + 3) turns up a little at the apex and there is no costal spine.

The tables in Wingate's "Diptera of Durham," 1906, are taken from Becker's *Scatomyzidae* ("Berl. Ent. Journ.," 1894). Mr J. Collin published a list of British species in "E.M.M.," 1910, p. 47.

The larvae usually live in decaying matter, but some are stem or leaf-miners. The imagines prey on other insects ("Trans. Ent. Soc. S. Eng.," Vol. 7, Part 1, 1931).

Dr B. M. Hobby, Hope Museum, Oxford, would be grateful for further records of captor and prey, and for the gift to the Museum of the specimens when they can be spared.

Amaurosoma fasciatum Mg. S., Keynsham (A.), 15/5/22; Clevedon (A.), 14/5/27; Nailsea (Wm.), 21/4/27.

,, *flavipes* Fall. S., Shepton Mallet (C.), bred from Dock leaves.

,, *inerme* Beck. S., Sharpham (A.), 17/8/25.

Ceratinostoma ostiorum Hal. (*oceana* Mcq.). G., Aust (A.), 12/8/33. S., Brean (A.), 27/8/24; St Audries (A.), 20/8/29; Weston-super-Mare (J.).

Cordylura ciliata Mg. G., Awkley (A.), 5/9/23. S., Shapwick (A.), 3/9/22; Sharpham (A.), 7/8/23.

,, *pubera* Fab. G., Wotton-under-Edge (P.). S., Taunton (Pa.); Chew Stoke (A.), 19/5/33.

,, *umbrosa* Mg. G., Olveston (C.), 5/18. S., Tickenham (A.), 12/5/29.

Norellisoma (*Norellia*) *armipes* Mg. (*flavicauda* Mg.). G., Hallen (A.), 13/6/25. S., Prior Park, Bath (A.), 8/5/26; Moreton (A.), 20/7/33.

,, ,, *spinimana* Fall. G. and S., common.

Parallelomma albipes Fall. G. and S., fairly common.

Scatomyza (*Scatophaga*) *litorea* Fall. G., Shepperdine (A.), 26/8/24. G. and S., Bank of Avon (A.), 22/6/25. S., Berrow (A.), 19/7/25.

Scatophaga decipiens Hal. G., Painswick (W.), 21/4/95; Olveston (A.), 2/5/22. S., Ham Green (A.), 10/20; Sharpham (A.), 24/4/24.

,, *squalida* Mg. G., Wotton-under-Edge (P.); Kingsweston (A.), 20/4/25. S., Shapwick (A.), 26/8/25; Bitton (A.), 8/4/27; Chew Magna (A.), 30/5/31.

Scopeuma (*Scatophaga*) *analis* Mg. G., Wotton-under-Edge (P.); Olveston (A.), 29/4/27.

,, ,, *inquinata* Mg. G., Wotton-under-Edge (P.); Shepperdine (A.), 4/8/24; Kingsweston (A.), 26/12/24. S., Cannington (Sl.); Shapwick (J.); Leigh Woods (A.), 12/1/22; Tickenham (A.), 22/4/25.

,, ,, *lutaria* Fab. G. and S., fairly common.

Scopeuma (*Scatophaga*) *maculipes* Zett. G., Cirencester (T.), 4/6/23. S., Shepton Mallet (C.); Tickenham (A.), 22/4/25; Keynsham (A.), 14/5/32.
,, ,, *ordinata* Beck. G., Blaise Castle (A.), 28/5/27. S., Shepton Mallet (C.).
,, ,, *stercoraria* L. (incl. var. *merdaria* Fab.). G. and S., the common Dung Fly.
,, ,, *suilla* Fab. G., Olveston (A.), 29/4/27; Littledean (A.), 25/5/31. S., Shepton Mallet (C.); Weston-super-Mare (J.); Tickenham (A.), 27/5/22; Keynsham (A.), 14/5/22.
,, ,, *taeniopa* Rnd. S., Taunton (A.), 6/6/21.

The second group of the Brachycera Cyclorrapha is known as the Acalyptratae. This name is misleading because some do have small upper calyptra (squamae), though in these the fifth longitudinal wing vein (discal, MA_2) does not bend towards the fourth (cubital, MA_1) [cp. *Larvaevoridae*], or there are no fronto-orbital bristles or no costal spine on the wing [cp. *Muscidae*]. A better name for the group is Haplostomata, which refers to the lack of a chitinous sac at the base of the proboscis. There are 40 families in this group.

I. PLATYSTOMIDAE (ORTALIDIDAE part).

Small dark flies, with spotted or striped wings. Head large; mouth large; first and second longitudinal veins of wing separate, fifth longitudinal vein ending at apex of wing, costa unbroken; propleural (prothoracic) bristles absent. Flies found in damp places, usually on leaves; larvae live in detritus.

Platystoma seminationis L. G., Wotton-under-Edge (P.). S., Taunton (H.); Nailsea (C.); Hanham (A.), 19/6/22; Tickenham (A.), 6/21.
Rivellia syngenesiae Fab. S., Shapwick (A.), 10/7/23.

II. ORTALIDIDAE.

Medium or small flies with clear or spotted wings. First and second longitudinal wing veins separate, fifth longitudinal vein ending below apex of wing, costa unbroken; propleural bristles present; third antennal segment pointed. Flies found in damp places, usually on leaves; life-history not well known. J. Collin, "E.M.M.," 1910, p. 173.

Dorycera graminum Fab. G., Bristol (C.); Wotton-under-Edge (P.). S., Withycombe (Sl.).
Herina (*Pteropaectria*) *afflicta* Mg. G., Hallen (B.), 11/7/29. S., Shepton Mallet (C.); Pensford (H.); Wells (L.); Tickenham (A.), 23/7/22; St Audries (A.), 1/9/27.
,, ,, *frondescentiae* L. G., Bristol (C.). S., Shapwick (A.), 17/6/23; Sharpham (St.), 4/6/27.
,, ,, *germinationis* Ross. (*nigrina* Mg.). G., Hallen (A.), 1/8/29. S., Taunton (Pa.); Leigh Woods (H.); Wells (L.); Tickenham (A.), 20/7/23.
,, ,, *oscillans* Mg. G., Tormarton (A.), 13/7/29.
,, ,, *palustris* Mg. G., Tormarton (A.), 13/7/29. S., Shapwick (A.), 10/5/26.
Loxodesma lacustris Mg. G., Wotton-under-Edge (P.). S., Cheddar (W.).
Melieria (*Ceroxys*) *crassipennis* Fab. S., Shapwick (A.), 6/21.
,, ,, *omissa* Mg. G., Hallen (A.), 1/8/29. S., Weston-super-Mare (J.).
,, ,, *picta* Mg. G., Wotton-under-Edge (P.); St Vincent's Rocks, Clifton (Curtis).

Ptilonota centralis Fab. S., Leigh Woods (H.).
,, *guttata* Mg. G. and S., fairly common.

III. PALLOPTERIDAE (LONCHAEIDAE part).

Small yellow flies. Wing with a break in the costa where the first longitudinal vein (subcostal) meets it, wing usually spotted or banded; tibiae without a preapical bristle. Usually caught by "sweeping" low vegetation; larvae feed on dead or living plants.

Ocneros pulchella Ross. (*Toxoneura muliebris* Harr.). G., Olveston (C.); Bristol (B.), 9/6/25; Stone (A.), 27/6/28. S., Shepton Mallet (C.); Leigh Woods (H.); West Town (Wm.), 9/22. Fly sometimes found on window-panes.

Palloptera arcuata Fall. G., Wotton-under-Edge (P.); Olveston (C.); Dursley (A.), 9/6/25; Tockington (A.), 19/4/27. S., Leigh Woods (H.); Chew Stoke (A.), 24/5/33.

,, *gangraenosa* Panz. (*umbellatarum* auct. nec Fab.). G., Wotton-under-Edge (P.). S., Nailsea (C.); Pensford (H.). Larvae in inflorescence of *Carlina vulgaris* L.

,, *saltuum* L. G., Wotton-under-Edge (P.).

,, *ustulata* Fall. G., Wotton-under-Edge (P.); Kingsweston (A.), 7/20; Stone (A.), 27/6/28. S., Shepton Mallet (C.); Wells (L.).

IV. PIOPHILIDAE.

Small black shiny flies. Wing usually clear; costa broken at apex of subcostal vein; long bristles (vibrissae) present, one on either side of the mouth. Flies usually caught by "sweeping." Larvae feed on decomposing animal matter. J. Collin in "E.M.M.," 1910, p. 177.

Piophila casei L. G., Painswick (W.); Bristol (C.); Bristol (B.), 3/8/26, bred from cheese. S., St Audries (A.), 26/8/29.

,, *luteata* Hal. S., Shapwick (A.), 14/8/25.

,, *nigriceps* Mg. S., Taunton (Pa.); Berrow (A.), 27/8/24; Shapwick (A.), 31/8/24.

,, *nigricornis* Mg. S., Clevedon (W.), 27/8/02.

,, *varipes* Mg. G., Blaise Castle (A.), 15/5/26. S., Taunton (Pa.); Sharpham (A.), 7/9/25.

V. ULIDIIDAE (ORTALIDIDAE part).

Small black flies. Wing clear or with one spot; costa unbroken; no vibrissae. Flies usually caught by "sweeping." Larvae feed on detritus. J. Collin in "E.M.M.," 1910, p. 73.

Seoptera vibrans L. G. and S., fairly common.

Ulidia erythrophthalma Mg. G., Bristol (C.); Cirencester (T.), 17/8/23.

VI. DRYOMYZIDAE (SCIOMYZIDAE part).

Large, yellow, shining flies, with wide, long wings. Wing clear; costa unbroken; basal cells of wing large; preapical bristle on tibiae. Larvae live in detritus. Czerny in "Fliegen der Palaearktischen Region," 1930.

Dryomyza flaveola Fab. G. and S., common. There are two generations, spring and autumn, which differ slightly in colour. Second longitudinal wing vein (R_1) bare.

Neuroctena anilis Rond. G., Ruscombe (W.); Sheepscombe (St.); Blaise Castle (A.), 9/21. S., Shepton Mallet (C.); Leigh Woods (H.); Sharpham (A.), 7/8/23. Second longitudinal wing vein bristly.

VII. NEOTTIOPHILIDAE (SCIOMYZIDAE part).

Like a *Neuroctena*, but longitudinal veins of wing clouded towards apex; transverse veins clouded; costa broken at apex of subcostal vein; no preapical bristle on tibiae. Larvae live in birds' nests, where they suck the blood of the young. Czerny in "Fliegen der Palaearktischen Region," 1930; Séguy in "Travaux des Naturalistes de la Vallée du Loing," 1932, p. 97.

Neottiophilum praeustum Mg. G., Painswick (W.); Wotton-under-Edge (P.). S., Flax Burton (H.).

VIII. TRYPETIDAE (TRYPANEIDAE).

Medium to small flies, mostly with banded or latticed wings. Costa with two breaks, one at apex of humeral cross-vein, the other further from base about where subcostal should end; second longitudinal vein (R_1) often turned up suddenly at apex; two basal cells, the lower one often prolonged in a point along the anal vein; a row of fronto-orbital bristles close to the eye; no preapical bristle on tibiae. Female ovipositor long. Larvae live in plants in which they mine tunnels or form galls, from which the flies can be bred. Loew in "Europaeischen Bohr-Fliegen," 1862; Bradley in "E.M.M.," 1901, p. 9; Collin in "E.M.M.," 1910; Hamm in "E.M.M.," 1918, p. 87; Hendel in "Fliegen der Palaearktischen Region," 1927; Saunt in "Proc. Coventry Nat. Hist. Soc.," 1932.

Acidia cognata Wied. S., Dunster (A.), 7/16. In *Tussilago farfara* L. and *Petasites ovatus* Hill.

Ceriocera ceratocera Hend. (*Trypeta cornuta* Fab.). G., Wotton-under-Edge (P.); Bristol (C.). S., Tickenham (K.), 22/7/23. In *Centaurea scabiosa* L.

Ditricha (*Carphotricha*) *gutturalis* Mg. G., Painswick (W.); Sheepscombe (St.), 29/6/24; Hallen (A.), 1/8/29. S., Shapwick (A.), 6/21. In *Achillea millefolium* L.

Ensina sonchi L. G. and S., fairly common. In *Sonchus arvensis* L., *S. oleraceus* L., *Tragopogon pratense* L.

Euribia (*Urophora*) *aprica* Fall. G., Wotton-under-Edge (P.); Olveston (C.). S., Minehead (Bl.). In *Centaurea scabiosa* L.

„ „ *cardui* L. G., Wotton-under-Edge (P.). S., Long Ashton (R.), 6/9/03. In *Cnicus arvensis* Hoff.

„ „ *cuspidata* Mg. (N.B. Records of *E. solstitialis* L. were probably this species). G., Hallen (B.), 11/7/29. In *Centaurea scabiosa* L.

„ „ *stylata* Fab. G., Hallen (B.), 23/7/27; Dursley (A.), 15/7/31. S., Crook's Peak (Rd.); Sharpham (A.), 28/6/23; Tickenham (A.), 1/7/33. In *Cnicus lanceolatus* Willd. and *Cnicus eriophorus* Roth.

Myolia caesio Harr. (*Acidia lychnidis* Fab.). G., Painswick (W.); Wotton-under-Edge (P.); Stone (A.), 28/7/28. S., Leigh Woods (H.); Sharpham (A.), 28/8/25. Probably in *Lychnis diurna* Sibth.

Noeëta pupillata Fall. G., Painswick (W.), 3/6/90. In *Hieracium umbellatum* L.

Orellia (*Trypeta*) *cylindrica* R.D. (*Chaetostromella onotrophes* Lw.). G., Wotton-under-Edge (P.); Selsley (Wt.); Hallen (A.), 24/7/28. S., Shepton Mallet (C.); Sharpham (A.), 3/8/23. In *Arctium majus* Bernh. and *Centaurea nigra* L.

„ „ *lappae* Cedj. G., Painswick (W.); Wotton-under-Edge (P.); Olveston (A.), 30/7/22. S., Weston-super-Mare (A.), 21/8/22. In *Arctium majus* Bernh. and *Centaurea nigra* L.

Orellia (Trypeta) ruficauda Fab. (*florescentiae* L.). S., Weston-super-Mare (J.); Wells (L.); Shapwick (B.), 22/6/24. In *Cnicus palustris* Willd. and *Cnicus arvensis* Hoff.

„ „ *tussilaginis* Fab. G., Olveston (A.), 30/8/22; Hallen (B.), 23/8/27. S., Sharpham (A.), 3/8/23; Prior Park, Bath (A.), 8/7/25. In *Arctium majus* Bernh. and *Centaurea nigra* L.

Oxyna (Tephritis) flavipennis Lw. G., Hallen (B.), 11/6/29. S., Moreton (A.), 20/7/33. In *Achillea millefolium* L.

„ „ *nebulosa* Wied. (*proboscidea* Lw.). S., Wells (L.). In *Chrysanthemum leucanthemum* L. and *Achillea millefolium* L.

„ „ *parietina* L. S., Brockley Combe (A.), 6/21; Berrow (A.), 27/8/24. In *Artemisia vulgaris* L. and *Artemisia absinthium* L.

Philophylla (Acidia) heraclei L. Celery Fly. G. and S., fairly common. In *Heracleum sphondylium* L., *Apium graveolens* L., *Peucedanum sativum* B. & H., and *Anthriscus sylvestris* Hoff.

„ „ „ var. *onopordonis* Fab. G., Wotton-under-Edge (P.).

Rhacochlaena toxoneura Lw. S., Leigh Woods (H.). Food plant unknown.

Rhagoletis (Spilographa, Zonosema) alternata Fall. G., Olveston (C.), 8/18. In hips of *Rosa canina* L.

„ *cerasi* L. G., Bristol (C.), 7/12. Probably imported. In fruits of *Prunus cerasus* L., *Berberis vulgaris* L. and *Lycium chinense* Mill.

Sphenella marginata Fall. G., Wotton-under-Edge (P.); Shirehampton (A.), 30/8/33. S., Clevedon (W.). In *Senecio jacobaea* L. and other species.

Tephritis bardanae Schrk. G., Painswick (W.); Sheepscombe (St.); Cirencester (T.), 19/7/24; Olveston (A.), 10/9/23; Hallen (A.), 26/6/26. S., Taunton (P.); Nailsea (C.); Tickenham (A.), 11/7/31. In *Arctium majus* Bernh.

„ (*Urellia*) *cometa* Lw. G., Painswick (W.). Food plant unknown.

„ *leontodontis* D.G. G., Wotton-under-Edge (P.). In *Leontodon autumnale* L.

„ *vespertina* Lw. G. and S., common. In *Hypochaeris radicata* L.

Terellia serratulae L. G., Shepperdine (A.), 2/8/24. S., Sharpham (A.), 6/8/23. In *Carduus nutans* L. and *Cnicus lanceolatus* Willd.

Trypanea (Urellia) amoena Frfld. G., Cirencester (T.). In *Lactuca virosa* L. and *Picris hieracioides* L.

Trypeta (Spilographa) zoë Mg. G. and S., fairly common. In *Cnicus lanceolatus* Willd., *Eupatorium cannabinum* L. and *Senecio jacobaea* L.

Xyphosia (Acinia) corniculata Zett. S., Brockley Combe (H.); Leigh Woods (H.); Pensford (H.). In *Centaurea jacea* L. and *Tanacetum vulgare* L.

„ *miliaria* Schrk. (*Oxyphora flava* Geoff.). G. and S., common. In *Carduus nutans* L.

IX. LONCHAEIDAE.

Small blue-black flies. Like *Trypetidae*, but wings never banded, only one break in costa, R_1 gradually reaching costa, only one fronto-orbital bristle. Larvae are found on dead or living plants. Becker in "Ent. Zeit.," 1895; Collin in "E.M.M.," 1910, p. 173.

Lonchaea chorea Fab. (*flavidipennis* Zett., *vaginalis* Fall.). G. and S., common.

„ *laticornis* Mg. G., Kingsweston (A.), 6/5/24.

„ *pusilla* Mg. S., Pensford (Ch.), 7/6/25.

„ *tarsata* Fall. S., Wells (L.).

X. LAUXANIIDAE (SAPROMYZIDAE).

Small black or yellow flies. Like *Lonchaeidae*, but two fronto-orbital bristles, preapical bristle on tibiae, and costa unbroken. Larvae and bibliography—as above.

Halidayella (*Lauxania*) *aenea* Fall. G., Wotton-under-Edge (P.); Olveston (A.), 5/9/25. S., Portishead (H.); Shapwick (J.); Tickenham (A.), 24/6/24. In Clover and Wild Pansy.

Lauxania amica Hal. (" Ent. Mag.," Vol. 1, p. 171). S., Leigh Woods (H.).

,, *cylindricornis* Fab. G., Wotton-under-Edge (P.).

Peplomyza litura Mg. (*wiedmanni* Lw.). G., Kingsweston (Wm.), 16/6/22; Cirencester (T.), 4/7/23. S., Nailsea (C.); Taunton (Pa.); Wells (L.); Leigh Woods (H.); St Audries (A.), 22/8/29.

Sapromyza affinis Zett. S., Burnham (A.), 6/8/23.

,, *apicalis* Lw. G., Awkley (A.), 8/9/22.

,, *biumbrata* Lw. G., Cirencester (T.), 25/6/23. S., Weston-super-Mare (J.).

,, (*Lycia*) *decempunctata* Fall. G., Bristol (C.); Shepperdine (A.), 11/8/24; Stone (A.), 21/5/27. S., Shepton Mallet (C.); Leigh Woods (H.); St Audries (A.), 28/8/29.

,, (*Meiosimyza*) *difformis* Lw. (*platycephala* Lw.). S., Portishead (A.), 9/24.

,, (*Minettia*) *fasciata* Fall. G. and S., fairly common.

,, (,, *Prorhaphochaeta*) *flaviventris* Costa. S., Berrow (A.), 19/7/25.

,, (,, ,,) *inusta* Mg. (*spectabilis* Lw.). G., Kingsweston (A.), 9/6/23; Sheepscombe (St.), 29/6/24. S., Taunton (Pa.); Wells (L.); Leigh Woods (H.); St Audries (A.), 22/8/29.

,, ,, *longipennis* Fab. G. and S., fairly common.

,, ,, *lupulina* Fab. G., Wotton-under-Edge (P.); Painswick (W.).

,, *obsoleta* Fall. G., Cirencester (T.); Bristol (A.), 7/26. S., Charterhouse-on-Mendip (A.), 30/6/23.

,, (*Lycia*) *pallidiventris* Fall. G., Wotton-under-Edge (P.); Cirencester (T.); Hallen (A.), 1/8/29; Kingsweston (A.), 17/9/32. S., Taunton (Pa.); Wells (L.); Leigh Woods (H.).

,, *quadripunctata* L. G., Shepperdine (A.), 8/8/24. S., Clevedon (W.), 27/8/02; Berrow (A.), 13/7/30.

,, (*Lycia*) *rorida* Fall. G. and S., common.

,, *sordida* Hal. (*decipiens* Lw.). G., Awkley (A.), 8/9/22; Winterbourne (B.), 7/7/23. S., Wells (L.); Pensford (H.); Tickenham (A.), 20/7/23.

Tricholauxania (*Sapromyza*) *praeusta* Fall. G. and S., common.

XI. TYLIDAE (MICROPEZIDAE).

Medium size flies with long, narrow body and very long, slender legs. No break in costa; the two median longitudinal veins (MA_1 and MA_2) converging as they approach the apex of the wing; the first basal transverse vein absent; the anal lobe of the wing very small. These flies are predaceous. Life-history unknown. Collin in " E.M.M.," 1911, p. 145; Czerny in " Fliegen der Palaearktischen Region," 1930.

Calobata (*Compsobata*) *cibaria* L. G. and S., fairly common.

,, (*Trepidaria*) *petronella* L. G., Wotton-under-Edge (P.); Painswick (W.); Selsley (Wt.).

Tylos (*Micropeza*) *corrigiolatus* L. G., Painswick (W.); Bristol (C.); Cirencester (T.), 13/6/24. S., Batheaston (Bl.).

XII. PSILIDAE.

Medium size flies, usually black with long, narrow body and long, but not particularly slender, legs. One break in costa; MA_1 and MA_2 parallel up to apex of wing; both basal transverse veins present. Larvae live in tissues of plants. Collin in " E.M.M.," 1904, p. 60.

Chamaepsila (*Psila*) *atra* Mg. S., Shepton Mallet (C.).
,, ,, *bicolor* Mg. G., Painswick (W.), 7/95.
,, ,, *nigra* Fall. G., Painswick (W.), 18/5/95.
,, ,, *rosae* Fab. (*nigricornis* Mg.). G. and S., fairly common. In roots of Carrot and Turnip.
Chyliza annulipes Mcq. G., Dursley (A.), 9/6/25.
,, *permixta* Rnd. (*leptogaster* Mg.). G., Selsley (W.); Hallen (A.), 19/6/26; Stone (A.), 21/5/27. S., Wells (L.); Tickenham (A.), 7/7/23. In Spiraea.
Loxocera (*Imantimyia*) *albiseta* Schrk. (*ichneumonea* auct. nec L.). G. and S., fairly common.
,, *ichneumonea* L. (*aristata* Pz.). G., Awkley (A.), 5/9/23. S., Batheaston (Bl.); Sharpham (A.), 22/8/22; Tickenham (A.), 16/9/22.
Megachaetum (*Chyliza*) *atriseta* Mg. G., Sheepscombe (St.), 18/6/27. In underground stem of Broomrape (*Orobanche*).
Psila fimetaria L. G. and S., fairly common.

XIII. MEGAMERINIDAE (PSILIDAE part).

Like *Psilidae*, but no break in costa and first longitudinal wing vein (Sc) more distinct.

Megamerina (*Lissa*) *loxocerina* Fall. (*dolium* Fab.). S., Taunton (Pa.).

XIV. SEPSIDAE.

Small black flies with globular head and often one black spot at tip of wing, which is iridescent. Costa unbroken. Femora of first legs of male, sometimes also the tibiae, modified in shape and bearing spines; only the males of this family can be determined with certainty. Flies found on leaves, sometimes in great numbers; larvae live in detritus. Collin in "E.M.M.," 1910, p. 175, and Goetghebuer and Bastin in "Ann. Soc. Ent. Belg., 1925, p. 124.

Enicita (*Henicita*) *annulipes* Mg. G., Awkley (A.), 8/9/22; Hallen (A.), 11/9/28. S., Leigh Woods (H.); Sharpham (A.), 10/8/23.
Meroplius (*Nemopoda*) *stercorarius* R.D. G. and S., common.
Nemopoda cylindrica Fab. G. and S., common.
Pandora (*Saltella*) *scutellaris* Fall. S., Langport (Dale); Tickenham (A.), 19/7/24.
Sepsis cynipsea L. (*incisa* Strobl.). S., St Audries (A.), 29/8/29.
,, *flavimana* Mg. (*ruficornis* Mg.). G., Shepperdine (A.), 2/8/24.
,, *fulgens* Hgg. apud Mg. (*cynipsea* Winn. et auct. non L.). This is the fly usually known as *S. cynipsea* L. G. and S., very common.
,, *melanopoda* Duda. (*nigripes* auct. nec Mg.). G., Cirencester (T.), 6/7/23; Awkley (A.), 8/9/23. S., Wells (L.); Tickenham (A.), 19/7/24; Shapwick (A.), 3/9/22.
,, *punctum* Fab. G., Wotton-under-Edge (P.); Olveston (C.); Shepperdine (A.), 5/8/24. S., Leigh Woods (H.); Shapwick (J.).
,, *violacea* Mg. G., Blaise Castle (A.), 4/21. S., Shapwick (J.); Backwell (A.), 16/6/27; Nailsea (A.), 21/4/27.
Themira (*Henicita*) *leachi* Mg. S., Shepton Mallet (C.); Sharpham (A.), 18/8/25.
,, *putris* L. G. and S., common.

XV. TETANOCERIDAE (SCIOMYZIDAE).

Medium size flies. Costa unbroken; no vibrissae; postocellar bristle divergent; preapical bristle present on hind tibiae. Larvae semiaquatic, live on detritus, sometimes carnivorous. Collin in "E.M.M.," 1910, p. 127.

Bischofia (*Sciomyza*) *simplex* Fall. S., Sharpham (A.), 5/9/25; Berrow (B.), 27/7/30.

Coremacera (*Limnia*) *marginata* Fab. G., Cirencester (T.), 9/7/24; Aust (C.), 7/18. S., Weston-super-Mare (H.); Brean Down (B.), 25/8/24.

Dichaetophora (*Limnia*) *obliterata* Fab. G. and S., fairly common.

Ditaenia (*Sciomyza*) *cinerella* Fall. G. and S., fairly common.

,, (,, *Melina*) *schoenherri* Fall. G., Dursley (A.), 11/10/30. S., Weston-super-Mare (J.); Wells (L.); Nailsea (A.), 22/4/27; Sharpham (A.), 1/9/25.

Elgiva albiseta Scop. G., Shepperdine (A.), 30/7/24; Awkley (A.), 8/9/22; Tormarton (A.), 13/7/29. S., Freshford (C.); Tickenham (A.), 23/7/22; Sharpham (A.), 7/8/23; Moreton (A.), 20/7/33.

,, *lineata* Fall. S., Cheddar (G.); Shapwick (A.), 3/9/22.

Euthycera (*Limnia*) *fumigata* Scop. (*rufifrons* Fab.). G. and S., common.

Hedroneura (*Elgiva, Ilione*) *cucularia* L. G. and S., fairly common.

,, ,, ,, *rufa* Panz. G. and S., fairly common.

Hemitelopteryx (*Heteropteryx, Sciomyza*) *brevipennis* Lw. S., Shapwick (B.), 17/8/27.

Hydromyia (*Elgiva*) *dorsalis* Fab. S., Tickenham (Wm.), 23/7/22.

Limnia unguicornis Scop. G. and S., fairly common.

Pherbina (*Tetanocera*) *coryleti* Scop. G., Wotton-under-Edge (P.); Olveston (A.), 18/6/21. S., Shepton Mallet (C.); Shapwick (A.), 5/9/22; Berrow (B.), 14/7/26.

,, ,, *punctata* Fab. G., Painswick (St.), 29/6/24; Cleve Hill (St.), 29/6/24. S., Taunton (Pa.); Clevedon (W.); Leigh Woods (H.).

Renocera (*Sciomyza*) *pallida* Fall. G., Littledean (A.), 25/5/31. S., Portbury (H.); Sharpham (A.), 22/8/22; Moreton (A.), 19/5/33.

Sciomyza (*Melina*) *albocostata* Fall. G. and S., fairly common.

,, *annulipes* Zett. S. Wells (L.).

,, *dubia* Fall. G., Cirencester (T.); Blaise Castle (A.), 22/5/27. S., Brockley Combe (H.); Wells (L.); Prior Park, Bath (A.), 20/5/29; Backwell (A.), 6/6/25.

,, *fuscipes* Mcq. (*dorsata* Zett.). S., West Town (Wm.), 27/7/28; Chew Stoke (A.), 8/7/32.

,, (*Melina*) *griseola* Fall. S., Wells (L.); Leigh Woods (H.); Sharpham (A.), 8/8/23.

,, (*Melina*) *obtusa* Fall. S., Sharpham (A.), 22/8/22.

,, *pallidiventris* Fall. S., Leigh Woods (H.).

,, (*Melina*) *ventralis* Fall. S., Wells (L.); Leigh Woods (A.), 19/3/27; Berrow (B.), 27/7/30.

Sepedon sphegeus Fab. G., Wotton-under-Edge (P.). S., fairly common.

,, *spinipes* Scop. (*hoeffneri* Fall.). G., Wotton-under-Edge (P.); Selsley (Wt.); Dursley (A.), 26/4/30. S., Minehead (Bl.); Cheddar (G.); Wells (L.); Banwell (J.), 26/3/23; Nailsea (Wm.).

Tetanocera arrogans Mg. S., Clevedon (W.).

,, *elata* Fab. G. and S., common.

,, *ferruginea* Fall. G., Painswick (W.); Kingsweston (A.), 6/5/32. S., Shapwick (Wm.), 3/6/22; Keynsham (A.), 14/5/22; Chew Stoke (A.), 8/7/32; Minehead (Bl.).

,, *hyalipennis* v. Ros. (*laevifrons* Lw.). G., Olveston (A.), 28/6/25; Shepperdine (A.), 30/7/24. S., Tickenham (A.), 16/9/22; St Audries (A.), 20/8/29.

,, *marginella* R.D. (*robusta* auct. Lw. sec. Schiner). G., Kingsweston (A.), 9/8/33; Shepperdine (A.), 20/8/24. S., Tickenham (A.), 16/5/25; Sharpham (A.), 3/8/25.

,, *silvatica* Mg. G., Wotton-under-Edge (P.); Selsley (Wt.); Sheepscombe (St.), 21/6/25. S., Weston-super-Mare (J.).

Trypetoptera (*Tetanocera*) *punctulata* Scop. (*hieracei* Mcq.). G. and S., fairly common.

CORRECTIONS.

Part IV, p. 269. Under *Clythia consobrina* Zett. delete G., Bristol (Wm.), bred 7/10/22.

Part V, p. 363. Under *Lucilia illustris* Mg. delete *sylvarum* Mg.

ADDITIONS.

FUNGIVORIDAE (MYCETOPHILIDAE).

Leptomorphus walkeri Curt. G., Olveston (C.), 6/9/16.

TENDIPEDIDAE (CHIRONOMIDAE).

Stenochironomus gibbus Fab. (*occultus* Kief.). S., Chew Stoke (A.), 19/5/33.

TIPULIDAE.

Cheilotricha imbuta Mg. S., Moreton (A.), 21/5/33.
Molophilus niger Goet. S., Chew Stoke (A.), 19/5/33.
Pales (*Nephrotoma*) *dorsalis* Fab. G., Olveston (C.), 25/5/16.
Tipula nigra L. G., Olveston (C.), 5/7/16.

STRATIOMYIIDAE.

Odontomyia (*Eulalia*) *ornata* Mg. S., Sharpham (St.), 4/6/27.
Beris clavipes L. S., Sharpham (St.), 4/6/27.

RHAGIONIDAE (LEPTIDIDAE).

Atherix ibis Fab. (*Sylvicola melancholia* Harr.). G., Slaughter (Curtis). S., Moreton (A.), 21/5/33.

CLYTHIIDAE (PLATYPEZIDAE).

Clythia (*Platypeza*) *hirticeps* Verr. G., Bristol (Wm.), bred 7/10/22.

DORYLAIDAE (PIPUNCULIDAE).

Dorylas (*Pipunculus*) *semifumosus* Kow. (*strigulipes* Verr.). S., Brockley Combe (A.), 31/8/33.

SYRPHIDAE.

Liogaster splendida Mg. S., Chew Stoke (A.), 19/5/33.
Pipiza austriaca Mg. (*lugubris* auct. nec Fab.). S., Sharpham (St.), 4/6/27.

LARVAEVORIDAE (TACHINIDAE).

Ceromasia (*Vibrissina*) *sordidisquama* Zett. G., Fishponds (L. Barton-White), 9/33, ex *Acronycta alni* L.
Epicampocera succincta Mg. S., Sharpham (St.), 4/6/27; Moreton (A.), 25/5/33.
Histochaeta (*Thelymorpha*) *marmorata* Fab. (*vertiginosa* Fall.). S., Sharpham (St.), 4/6/27.
Rhynchista prolixa Mg. S., Sharpham (St.), 4/6/27.
Degeeria luctuosa Mg. S., Brockley Combe (A.), 31/8/33.
Sarcophaga scoparia Pand. G., Kingsweston (A.), 9/8/33.
,, *vicina* Vill. G., Kingsweston (A.), 9/8/33. S., Taunton (A.), 6/6/31.
Cynomyia mortuorum L. G., Olveston (C.), 27/7/14.
Lucilia illustris Mg. G., Shirehampton (A.), 24/8/33.
,, *richardsi* Coll. S., Sharpham (St.), 4/6/27.
,, *silvarum* Mg. G., Shepperdine (A.), 10/2/24. S., Moreton (A.), 21/5/33.

MUSCIDAE (ANTHOMYIDAE).

Lyperosia irritans L. S., Stoke St Gregory (Pa.); Wrington (C. L. Walton), 1/8/33.
Limnophora (*Calliophrys*) *riparia* Fall. S., Tickenham (A.), 1/7/33.
Mydaea urbana Mg. S., Sharpham (St.), 4/6/27.
Pegoplata (*Pegomyza*) *virginea* Mg. S., Sharpham (St.), 4/6/27.

The Sea Fish and Fisheries of the Bristol District.

By L. Harrison Matthews, M.A.

THE coast of the Bristol district extends from the banks of the Severn estuary at Berkeley to the mouth of the river Parret in the Bristol Channel, a distance of about forty miles. The northern sixteen miles of coast lie in Gloucestershire and the remainder in Somersetshire, the counties being separated by the river Avon. Fish of many species abound in the waters of the Bristol Channel and Severn estuary, and fisheries have been carried on along their shores from prehistoric times.

Nearly all the commercial fishing is done on the foreshore with "fixed engines," nets and traps of various sorts fastened to stakes, which are visited by the fishermen at low tide. The great rise and fall of tide in the Bristol Channel makes possible this form of fishing, in which the gear is set on dry land and the fish brought to it by the tide.

The fisheries are of great antiquity; those on the foreshore were usually private or "several" fisheries, and were formerly the property of the lords of the manors. They were usually leased in connection with land or houses, though the fishing rights have now in many cases been sold. At Weston-super-Mare it was the custom until a hundred years ago to bring the first basket of sprats, and the first large fish, of the season to the lord of the manor. Documents relating to law suits in connection with the fisheries are in existence showing that they were valuable properties as long ago as the fifteenth century, while the basket-work fish traps of the Severn estuary have probably changed little in pattern since prehistoric times. About a mile inland from the shore there was dug up at Weston-super-Mare during the last century a curved row of fishing stakes such as are still in use on the mud flats of Bridgwater Bay.

The fisheries of the Bristol Channel, with the exception of the salmon fisheries, have been declining for the last fifty years, and have now only a fraction of their former importance. In 1851 Baker (2) estimated from careful enquiries that the annual value of the fisheries between Gore Sand, off Burnham-on-Sea, and Weston-super-Mare was £10,000, while nowadays the value of fish taken is too small for inclusion in official statistics.

The decline of the fisheries is largely due to the development of the great fishing ports, which send regular supplies of deep sea fish to all parts of the country, so that the smaller supplies, dependant upon the season, are crowded out of the market. In addition, a succession of poor seasons, during which one after another of the fishermen were forced out of their occupations, led to the abandoning of fisheries, which were not restarted when better seasons returned. The hard work entailed in carrying on the fisheries, which have to be visited at every tide, twice in the twenty-four hours irrespective of weather and catch, does not nowadays attract many newcomers to the calling.

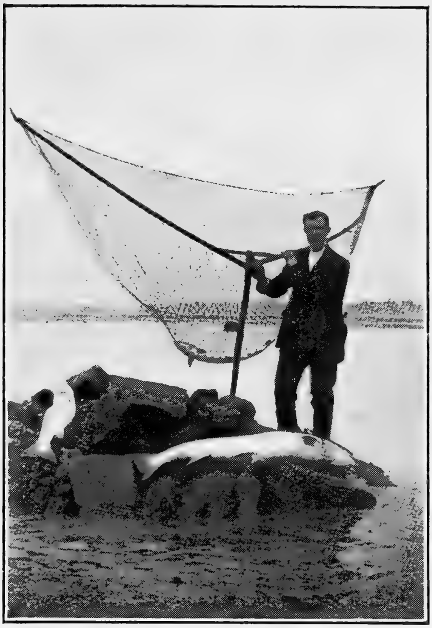


Fig. 1.—SALMON DIP-NET IN USE AT A SALMON POOL.

Fig. 2.—A HANG OF STOW NET STALLS FISHING ON THE EBB.

PLATE I.

Fig. 1.—A RANK OF KYPES AT LOW WATER, showing the putt, butt and forewheel.

Fig. 2.—SKID OR "MUD-HORSE" USED FOR CROSSING THE SOFT OOZE TO VISIT FISHING GEAR.

PLATE II.

An account is here given of the various fisheries and the gear used in carrying them on, followed by an annotated list of the species of fish that occur, or have been recorded, in the district.

SEA FISHERIES OF THE BRISTOL DISTRICT.
I. GLOUCESTERSHIRE.

In the Gloucestershire division of the district by far the most important fishery is that for salmon. Two devices are in use for taking salmon, " salmon pools " and wicker baskets called " putchers."

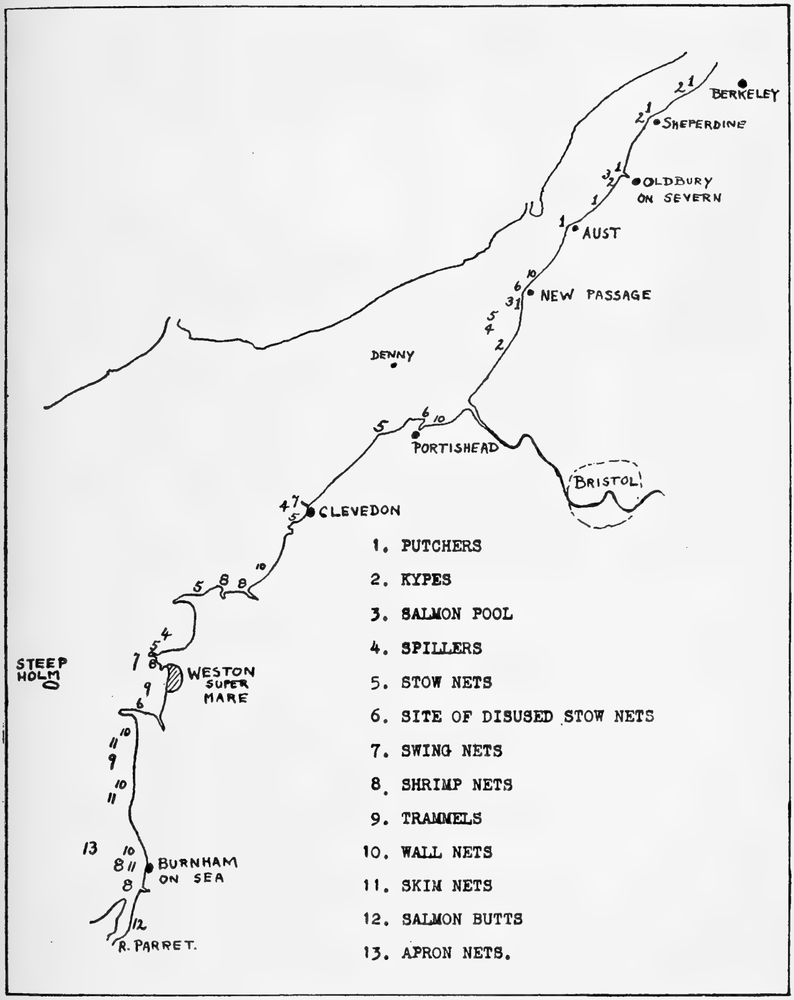


Fig. 1.—SKETCH MAP OF THE UPPER WATERS OF THE BRISTOL CHANNEL, showing the distribution of the Sea Fisheries of the Bristol district.

SALMON POOLS.

At high tide the Severn estuary forms a sheet of water about two miles wide, from New Passage nearly to Berkeley, but at low tide the river runs in a channel about a quarter of a mile wide, leaving large expanses of rock, mud and sandbanks exposed on each side. Among the banks large pools or lakes of water are left at low tide; from the lower ends of the pools a steady stream of water runs away owing to the draining-out of the surrounding banks. Numbers of salmon remain in the pools during low water and are then captured by the owners of the fisheries.

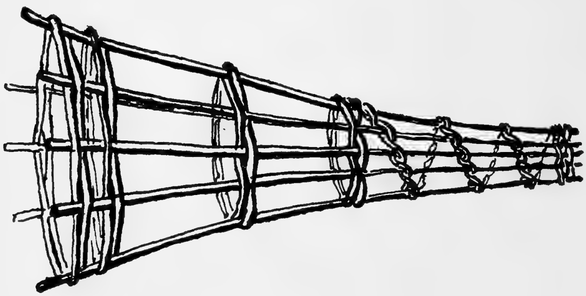


Fig. 2.—SALMON PUTCHER.

The salmon pool at Oldbury-on-Severn is about two miles long, fifteen feet and more in depth at the upper end, and three to four feet deep at the lower, where there is a weir or bench of stones, over which the water flows. About twenty feet from the bench there are two large stones on which the fishermen stand clear of the water in the pool. The fishermen use a large triangular dip net extended on poles about nine feet long. A footrope nine feet long joins the ends of the poles, while a short yoke near the apex of the triangle spreads them apart. A handle about three feet long is also fixed at the apex. When not in use the poles are swivelled round so that the frame is closed, and the net is rolled up round them.

The salmon cruise up and down the pool and when they reach the lower end they attempt to get over the bench with the stream of water flowing over it. As the water on the bench is too shallow for them they turn and swim back again. As they turn in the shallows they create a wash and frequently show the back above water, when the waiting fisherman plunges his net in and dips out the fish. As the water is not clear, but very muddy, the fishermen face downstream when waiting for fish, for they can only see them when they turn in the shallows, except on a " black tide," or dead calm, when the wash caused by the fish swimming down the pool can be seen on the surface.

Three or four fish are reckoned a good average catch, with fish worth £2 to £3 or more each. Fishing is, of course, only possible at low water, and the fishermen have to move off quickly when the tide starts flowing, as it rushes in with great force and velocity.

The Oldbury-on-Severn salmon pool is on the Gloucestershire side of the river, the low tide channel being on the far side, and separated from the pool by a sandbank overlying rock at a depth of three to five feet below the surface. In some seasons the sandbank shifts and partly fills the pool, spoiling the fishing. The salmon pool itself and not merely the fishing right, is private property, and was sold for £1600 about fifteen years ago; it would probably fetch twice that amount now. The pool has been fished from time immemorial; the present owner possesses a document relating to an action-at-law heard at Gloucester in the sixteenth century, in which certain persons were proceeded against for stealing fish from the pool; but doubtless the pool was fished for hundreds of years previous to that.

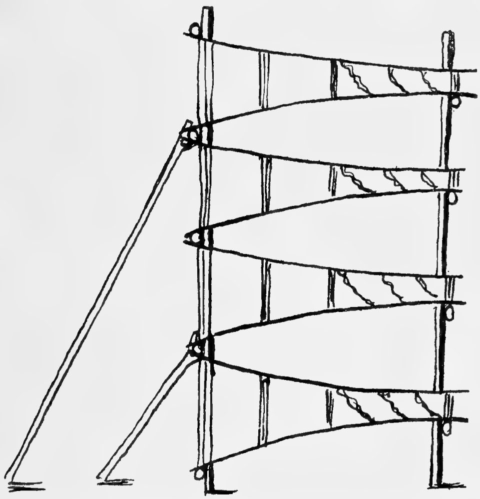


Fig. 3.—DIAGRAM OF SECTION THROUGH A RANK OF PUTCHERS.

Salmon are practically the only fish taken in the pool, though large numbers of twait shad, which are too quick to be taken with the dip net, are present in it as well. Large lampreys are sometimes taken; they usually swim near the surface, stirring up as much wash as would a good-sized salmon. Sturgeon also are sometimes taken in the pool; one weighing 160 lbs. was caught in 1932.

The salmon pools are licensed to their owners by the Severn Fisheries Board, the season being from March to August. Two salmon pools are fished in the district, one at Oldbury-on-Severn and one at New Passage. In both of them salmon putchers are worked, as well as dip nets at the bench.

PUTCHERS.

Putchers are conical openwork wicker baskets, 5 ft. 6 ins. long and 2 ft. wide at the mouth. They are fixed to stakes, driven into the foreshore, so that the open end faces downstream. Two rows of stakes are fixed into the ground, in ranks stretching out roughly at right angles to the bank. To them are fastened horizontal poles, so that a framework is formed to which the putchers are lashed. The vertical stakes are spaced so that four putchers fit in between each, and the two ranks are spaced so that one supports the mouths, and the other the conical ends, of the putchers. The putchers are stacked in layers four high from the ground, the horizontal poles separating each layer, and the mouths of the lowest layer being six to nine inches from the ground. The putchers are fastened to the poles by withy bands fastened with a peg, and when a rank of putchers is properly set it forms a very solid structure.

Salmon ascending the river meet the putchers, get jammed into the head part and are drowned; it is surprising how firmly they wedge themselves in. The putchers only last two seasons, as the fish can smash and burst out of old and weak ones.

All the putchers are made locally from withies grown on the marshes adjoining the Severn. Some of the fishermen have tried using putchers made of galvanised wire, but they were found to be useless, and caught no fish. Concrete posts have been tried instead of wooden ones, but they also were no good, because they were easily broken, not having the spring and elasticity of wooden ones. The stakes on muddy ground are driven in; on rock or stony ground they are wedged into holes excavated in the bottom. At Aust two ranks of putchers are connected by a wall of wire netting so that fish shall not escape between them.

The putchers are licensed by the Severn Fisheries Board, and the season is from April 15th to August 15th. The Special Commissioners of English Fisheries in 1861 abolished many of the putchers, allowing only those with the best titles to continue, as the river was overfished.

A good average tide's catch for a rank of 650 putchers is six fish, though up to twenty-four have been taken on one tide. A north-east wind produces the best catches, but floods, even a summer thunderstorm, send the fish away up the river. The seasons 1921 and 1933 have been the best of late years. Many other animals besides salmon are occasionally taken in the putchers; lampreys, sturgeon, small sharks, and even porpoises. Some putchers are set in the salmon pools both at Oldbury-on-Severn and at New Passage, as well as on the banks of the estuary.

Putchers are used in the Bristol district at Oldbury-on-Severn, Littleton, and Aust, while higher up the estuary they are used at Sheperdine and off Berkeley. They are also used at many places on the opposite side of the river.

Though belonging outside the district, mention may be made here of the drift nets used by the Wye fishermen for taking salmon. They are buoyed nets, four hundred yards long, worked from boats, not only in the Wye, but also out in the estuary of the Severn. None, however, are worked from the Bristol side of the estuary.

Fisheries for fish other than salmon are carried on in the Gloucestershire division of the district with kypes, stow nets, and spillers.

KYPES.

Kypes are basketwork fish traps, conical in shape, which are set on stakes with their open end facing up stream, so that they fish on the ebb tide. They are set in rows at right angles to the bank, from fifty to one hundred-and-fifty in a row. Kypes consist of three parts, of different mesh in the basketwork, finest at the small end and more open towards the mouth. The first part is called the "putt," and is made of very open basketwork with the mouth about five feet in diameter. It is about five feet in length and tapers towards its inner end, where it is jammed into the mouth of the second part or "butt." The butt is of close mesh basketwork and has a ring of backwardly directed withy spikes projecting on the inside near the mouth. It is about five feet long and tapers towards the end, where it is jammed into the mouth of the third part, the "forewheel" or "firwell," in which the catch is retained. The forewheel is made of closely woven fine basketwork. It is about 2 ft. 6 ins. long and tapers from in front backwards. A non-return valve of projecting spikes joined by basketwork fills a constricted part towards the fore end, while into a constriction at the hinder end is jammed a wooden plug to retain the catch. Often when the plug has been lost a rounded stone is jammed into the end of the forewheel in its place.

The kypes are fastened to stakes with the mouths just clear of the ground. The putt and butt are fixed permanently with withy bands, but the forewheel is removeable. The front end of the forewheel is jammed on to the back end of the butt, and its after end is supported by a short forked stake. The hinder constriction is held by the arms of the fork, and a withy band, fastened to one arm and slipping in a loop over the other arm, holds it in position. When the fisherman visits the kypes at low tide he removes the forewheel from the kype, takes out the plug from the after end, and shakes out the catch. Kypes, like putchers, are all made locally from withies grown on the adjoining marshes. About five years is their maximum length of life.

The kypes catch large quantities of shrimps; the fishermen say that about once in ten years the Severn shrimps appear in enormous numbers; however, apart from exceptional years, large quantities are taken regularly. The fish taken in the kypes are occasional salmon, flounders in quantity, dabs, large numbers of small soles, small cod, whiting, conger and freshwater eels, sprats and lampreys. Numbers of other kinds of small non-commercial fishes are also caught. During the close season for salmon the kype fishermen have to fasten sticks about four inches apart across the mouths of the kypes to exclude salmon. Windy and wet weather usually produce the best catches.

Kypes are fished in the Bristol district at Hallen, Oldbury-on-Severn, Sheperdine, and off Berkeley. They are also used at a few places on the opposite side of the estuary. There are two ranks, of seventy and one hundred-and-fifty kypes at Oldbury, and one of one hundred-and-thirty at Hallen. At Hallen, however, the mud is silting up rapidly, so that some of the shoreward kypes are now disused. Further out the bottom is hard shingle and stones, but even there the mud is accumulating on top. Another rank of kypes a short distance further down the shore has been abandoned owing to mud silting up. A few years ago the fishermen when visiting the kypes did not encounter mud more than a few inches deep. Now it is more than knee-deep, and consequently a sledge-like contrivance called a "skid" or "mud-horse" is used for carrying gear and the catch. Without it to support the weight of the fisherman it would be almost impossible to visit the kypes.

STOW NETS.

Stow nets, like those described further on, hung on stakes driven into the ground and visited when dry at low tide, are now very little used in the Gloucestershire side of the Bristol district. There used to be a large sprat fishery at New Passage: it is said that up to fifty years ago there were upwards of a hundred stow nets in use there, and very large quantities of sprats were taken. Only a few of the stakes are left, and no nets have been set for the last ten years. This

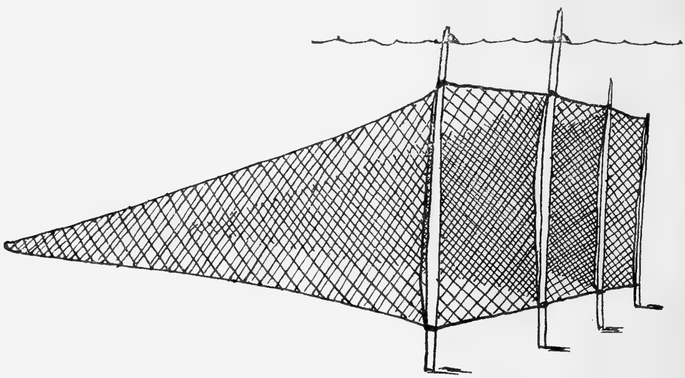


Fig. 4.—DIAGRAM OF A HANG OF STALLS (STOW NETS).

is the highest place up the estuary that a stow-net fishery for sprats has been carried on: the work here is more difficult than lower down the channel, as at spring tides the nets cannot be fished, for the strong currents tear and carry them away. The chief catch was sprats, with shrimps, whiting, flounders, and cod in lesser quantity, and smaller numbers of many other kinds of fish.

A few stow nets are still fished in the winter off Hallen. They are set on stakes far out in the estuary, over a mile from shore, near the south end of the English Stones, and are visited at low tide. The catch is not brought ashore for sale, but is used on the spot for baiting cod lines.

SPILLERS.

Spillers are long lines with a hundred to one-hundred-and-twenty hooks attached to them by snoods at about every fathom. They are staked down to the ground and visited at low tide, when the catch is removed and the hooks rebaited. Spillers are used on the Gloucestershire side of the Bristol district only off Hallen, near the south end of the English Stones in the middle of the estuary. They are baited with sprats and set during the winter for cod, some conger also being taken. No line fishery for cod is carried on higher up the estuary than this.

II.—SOMERSETSHIRE.

In the Somersetshire division of the district the chief commercial fisheries are for sprats and shrimps. These are taken in nets fastened to stakes on the shore, and in anchored swing nets.

STOW NETS.

Stow nets have been in use on the shores of the Bristol Channel for many hundreds of years, the fisheries usually being the property of the lords of the manors, and frequently leased in connection with land or houses. Stow nets are bag-shaped nets which are hung on stakes on the foreshore; the ebbing tide carries the fish into them, and they are visited and emptied at low water. The mouth of the net is twelve to eighteen feet square, and the bag of the net is about thirty feet long. The net together with the two stakes on either side of it is called a "stall," and the row of stakes is called a "hang." The small end of the net, the "cod end," is untied when the net is visited, and the fish are shaken out. On the flood tide the cod end drifts up stream under, or to the side of, the net, but on the ebb the net is opened like a bag and catches the fish that are swept into it. The chief catch of the stow nets is sprats, but many other sorts of fish are taken as well, mainly whiting, codling, flounders, dabs and thornbacks.

Stow nets were formerly used at Portishead. J. N. Duck (8), writing in 1852, says, "Portishead was formerly a place of some celebrity as a fishing ground, and until recently there were fishing stakes below the hotel garden, but as they rendered the approach to the slip dangerous, they were removed; there are some, however, still extant near the Nore Point, but they are seldom used." The slip mentioned was built in the same year as the hotel, 1830, and was rebuilt in 1849. The stalls near Blacknore Point were in regular use until about ten years ago, since when they have been practically disused. The Portishead fishing stalls, or stages, are mentioned in a sixteenth century document relating to a settlement of Portishead property.

A single stow net is fished occasionally off Salthouse Bay at Clevedon, but the nearest regular stow net fishery is now at Middle Hope, where there is a hang of stalls at Middle Hope Cove.

At Weston-super-Mare there is a hang of some fifty or so stalls between Birnbeck Island and the mainland, but there are not now more than about half that number in use. Before the pier connecting the island with the mainland, and the landing stages for the pleasure steamers on the western side of the island, were built, there was a further extensive hang on the seaward or western side of the island. This fishery was at its height from about 1830 to 1880. The fishermen had a thatched hut on the island in which two men called "gull-yellers" used to live during the fishing season. Their job was to scare the gulls from the nets as the tide ebbed. Before the pier was built the fishermen had to wait until the tide had ebbed low enough for them to cross to the island on stepping stones over the causeway, or "stepway," which dries out at low water, before they could visit the nets; hence the necessity for the gull-yellers. One man looked after the western nets and the other the eastern ones. They were both paid £1 a week, each fisherman paying according to the number of stalls that he rented. It is said that on still calm days the gull-yellers at Weston-super-Mare have been heard as far away as at Congresbury. Catches of five to six tons of sprats were made each tide and the fish were sent to Bath, Bristol, and other towns by rail.

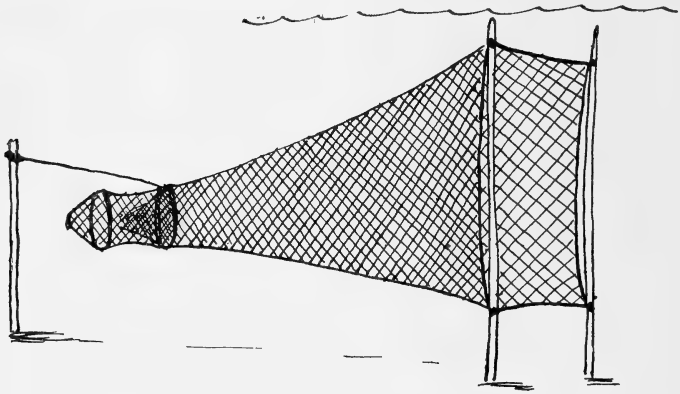


Fig. 5.—DIAGRAM OF SHRIMP OR HOSE NET.

When the pier and landing stage were built on Birnbeck island the western stalls were abandoned, though some of the eastern ones survive to the present day. In 1882 there were 198 stalls at Birnbeck; now there are less than sixty. It is said that the most westerly stake, forming the best and most seawardly stall, took ten years to erect, as the hole to receive the stake could be excavated in the rock only a small amount at a time, during dead low water of the lowest spring tides. The stumps of some of the western stakes are still to be seen.

The earliest known mention of the Birnbeck fisheries is in the plea roll of Henry VII, 1492, regarding a dispute between a fisherman and the lord of the manor. The stow net fishery began to decline when swing nets were introduced about 1880.

The sprat fishing season for stow nets starts at the beginning of October and lasts until the end of January, sometimes continuing until March.

There used to be extensive hangs of stalls on the northern coast of Brean Down, but they have been disused for fifty years or more, though there appear to have been a few nets still in use in the lower channel of the Axe as late as 1900. There were about a hundred stalls in several hangs: they were worked by fisherman from Uphill who visited them by boat.

There is also a hang at Steep Holm on the spit of stones at the eastern end below the landing place. It is doubtless of considerable antiquity; Collinson (4) says that in 1776 the fishermen who rented the fishery built a "tenement" on the island for shelter when they were

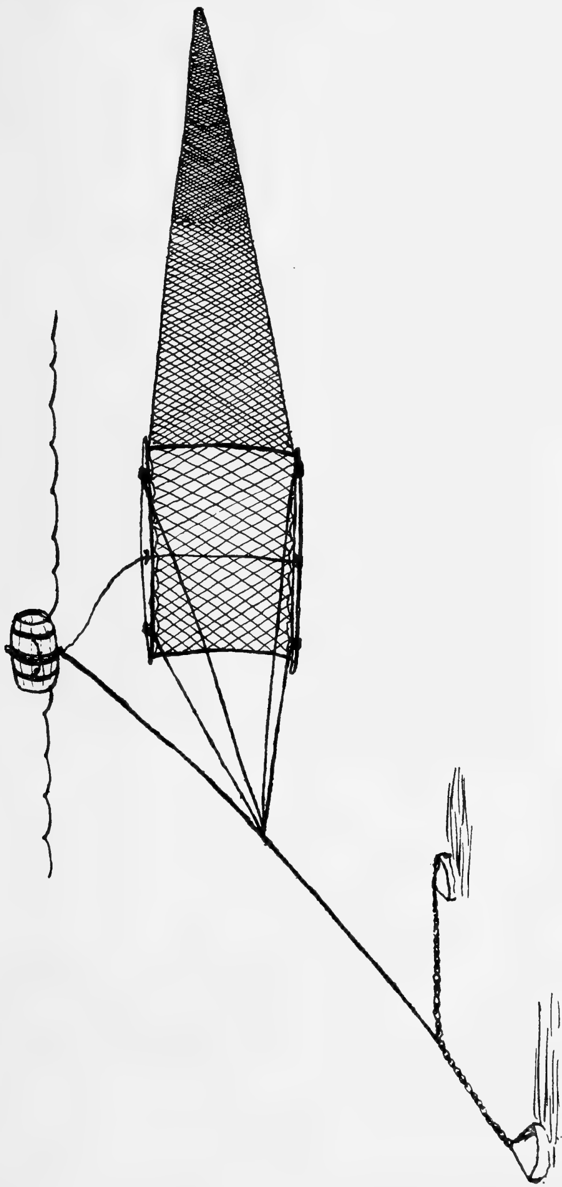


Fig. 6.—DIAGRAM OF SWING NET.

weather-bound. This fishery has been worked intermittently to the present day. The stow net fishery on Flat Holm lies outside the Bristol district, and the fish caught there are landed on the Welsh side of the Channel.

Until recent years a stow net was often carried in the pilot cutters, ketches, and other small coasters, and used when the ship was at anchor in a tideway. The net, extended on an oar or other suitable beam and suitably weighted, was fished over the vessel's side or bow, and sometimes a vertical bar was used to push it down and keep it open. This was not, of course, a commercial fishery.

SWING NETS.

Swing nets are similar in size and shape to stow nets, but are buoyed and moored in the tideway, and not fixed to stakes. The net is extended by two spars at the mouth, the upper one of wood and the lower one of iron, which by its weight keeps the mouth open. The spars are made fast by bridles to a mooring line, fixed to a length of chain, held to the bottom by concrete sinkers, and buoyed at the surface. The net swings with the tide and fishes both on the ebb and the flood. A tripping line is made fast to the lower spar and runs through a thimble on the upper spar to its attachment on the buoy. When the net is visited by boat at low tide, the tripping line is hauled up, closing the net, and the fish emptied out from the cod end. The net is about thirty feet long and its mouth is about sixteen to eighteen feet square. The third of the net nearer the cod end is of smaller mesh than that nearer the mouth. The chief catch of the swing nets is sprats, with numbers of whiting, small cod, dabs, flounders, thornback and conger, and some shrimps. The bottom fish are caught when the net fishes near the bottom, when the tide runs at its greatest force. The fishing season, as with the stow nets, lasts from early in October to the end of January, occasionally longer.

A fishery of three or four swing nets is worked at Clevedon, the nets being moored about a quarter of a mile off the end of the pier, while about fifteen to twenty swing nets are worked off Weston-super-Mare, being moored just inside the Weston Ledge buoy, west of Birnbeck Island. Before the Great War as many as forty to fifty swing nets were in use there each season.

The nets last about four seasons, but are only put out for about a week at a time, and are dried out between each spell of duty. The fishermen make their own nets: formerly they used to make, or "breed," them themselves; nowadays they make them up from rolls of ready-made netting. Nearly all the netting and nets used in this part of the Bristol Channel come from Bridport in Dorset.

SHRIMP NETS.

Shrimp nets or hose nets are similar in shape to the stow nets, but the tail end of them is supported by two withy hoops, and a funnel shaped piece of netting, forming a non-return valve, is fastened to the first hoop. A line from the first hoop to a third short stake behind the net holds the tail clear of the ground. The nets are about six feet square at the mouth, and are set on the stakes well clear of the ground. The shrimp nets are fished from about the end of August to March, and take both brown and pink shrimps, as well as some quantities of flatfish, whiting, and so on. These nets are set singly or in batteries of twelve or more on the mud flats at Burnham-on-Sea, while at Weston-super-Mare a row of shrimp nets is worked on the foreshore opposite Birnbeck Island below the pier. There is also a shrimp fishery at St Thomas' Head, which is worked by the fisherman who uses the Middle Hope stow net fishery for sprats. A few shrimp nets are worked occasionally on the mud flats between Woodspring Bay and Clevedon, but the softness of the mud makes access to them very difficult. The fishery here appears to have been more extensive in former times. During the Great War a Clevedon fisherman worked a shrimp fishery on these mud flats. Orthodox shrimp nets were not used, but a kind of fish wier was constructed of stakes with fine meshed wire netting fixed to them. Large quantities of shrimps and flatfish were taken.

APRON NETS.

I am indebted to T. C. Holt, Esq., of Burnham-on-Sea, who knows more about the fisheries of Bridgwater Bay than anyone living, for particulars of the old apron net fishery, which is now extinct.

Apron nets were set on poles below the level of ordinary spring tides, in the neighbourhood of the tail of Gore Sand in Bridgwater

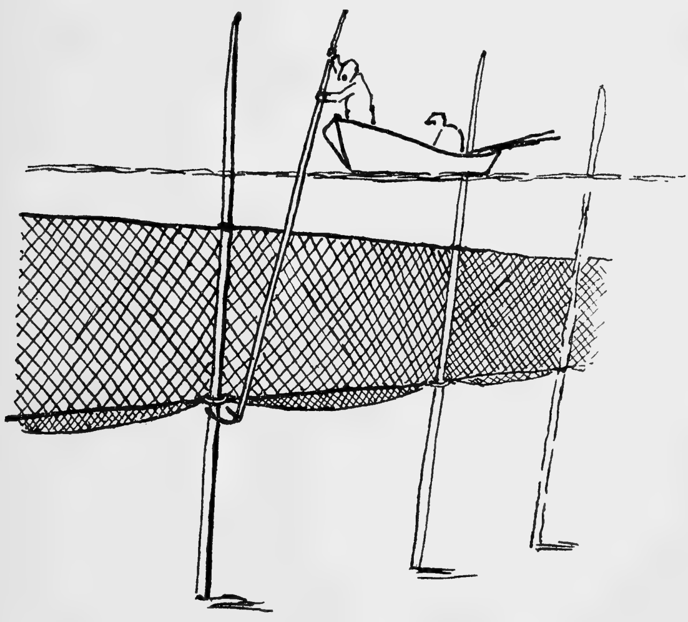


Fig. 7.—DIAGRAM OF APRON NETS.
The man in the "flat" is about to raise the net with the crook.

Bay. They were walls of flat net set on a row of stakes, the head and foot not being fully stretched apart, so that the slack of the net between them formed a loose bag or apron.

A special type of boat known as the "Bridgwater flat" was used in this fishery. It was a hard-chine boat built of elm and oak, about nineteen feet long, much like a Newfoundland dory. It was flat bottomed, with a slight rise of floor amidships: it drew very little water and could easily be pushed off the mud if it got aground. It was fitted with a centre board and rigged with spritsail and a tiny foresail, and had a very long tiller so that the helmsman sat amidships. The "crook" described below was slipped through a ring in the bow and acted as a bowsprit for the foresail. It was worked by two men, one of whom tended the foresail and the other the mainsail and tiller. They were fast and buoyant boats, but wet beating in a seaway owing to their flat sides. Only one or two now remain, rotting on the mud in the neighbourhood of Combwich. The Bridgwater flat was probably derived from the boats of similar shape used on the rhines of Sedgemoor and the surrounding district.

The poles on which the apron nets were extended were known as "lugs." They were forty foot larch poles selected in the covert, felled, barked, and trimmed by the fishermen themselves. For setting up the lugs two boats were used, lashed together with planks, and a specially made iron clamp with two handles was fixed to the top of the lug, which was then up-ended and jumped into the mud to a depth of five or six feet. Setting up four or five lugs was a good tide's work. At the end of the fishing season the lugs were taken up, brought ashore and buried in the mud, to keep them wet all the summer. They were drawn by dropping a running loop of chain over them and then hoisting them out by means of a Spanish windlass set up on two boats lashed together. Sometimes the boats were hauled down till nearly gunwale under before the lugs started to draw, and a third boat always stood by in case of accident.

The lugs were set some two fathoms apart and the nets were hung from them on a head rope. From ten to twenty nets were set by each boat on some twenty to forty lugs. Over each lug was slipped a large iron ring with iron loops at each side. The footropes of the nets were made fast to the loops on each side of the rings so that they were not subjected to chafing on the lugs. A special implement, like a hayfork but with the prongs at right angles to the shaft, called a "crook," was used for pushing the rings down the lugs, and for hauling them, together with the nets, up again when they were fished. The crook was also used as a bowsprit when sailing the flats, and as a boathook, where a hook of the ordinary form would not get a grip in the soft mud.

The catch of the apron nets was mainly sprats, with some whiting and cod. The fishery was carried on mostly by Combwich men, who landed their catch at Burnham-on-Sea, though they occasionally carried it right up to Bridgwater. At the beginning of this century there were between twenty and thirty flats engaged in the apron net fishery;

at the end of the Great War two remained; at the present time none are left afloat and the fishery is extinct.

WALL NETS.

Wall nets or stake nets are flat vertical nets set fully stretched on their stakes and not slack to form a bag. They are extended on a semi-circular row of stakes driven into the sand or mud, the convexity of the semi-circle facing seawards, and arranged so that the end stakes ebb at the same time. The footrope of the net is buried in and pegged down to the mud and the whole net forms an enclosure in which the fish are trapped as the tide ebbs. Twine nets were formerly used, but wire rabbit netting has replaced them of late years. A number of these nets were formerly used on the mud flats of Berrow Bay, but of late they have been disused, until this last season of 1933-34, when one has been in use again. In the first half of the last century these nets were used on the Weston-super-Mare mudflats west of Knightstone. Wall nets caught chiefly rays, flounders, dabs and other flatfish.

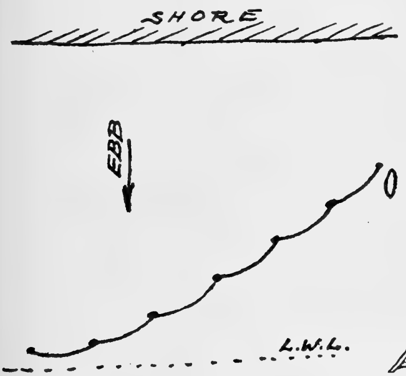


Fig. 8.—PLAN SHOWING METHOD OF SETTING TRAMMELS IN WESTON-SUPER-MARE AND BERROW BAYS.

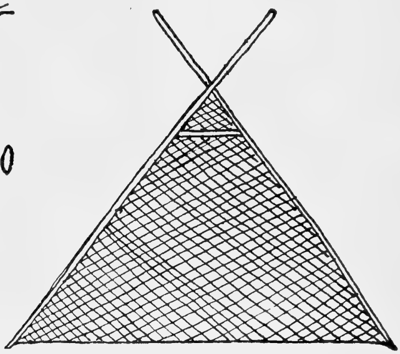


Fig. 9.
DIAGRAM OF SKIM NET.

A somewhat similar contrivance, consisting of a V-shaped wall of wire netting supported on stakes, is used by the Gloucester pilots on the mud flats near their moorings at Portishead, to catch flounders and other flatfish for their own use. Collinson says that in 1791 flatfish and shrimps were caught on the shore at Portishead, evidently in some similar gear. Similar fish wiers have been used at New Passage and in Woodspring Bay.

TRAMMELS.

Trammels are vertical nets with floats on the head rope and sinkers on the footrope. They consist of three walls of netting, the outer walls of coarse mesh, about six inches from knot to knot, and the middle one of fine netting. When a fish swims into the net it passes through the coarse meshing and carries a bag of the fine netting through the meshes of the far wall, forming a purse in which it is trapped.

Trammels are used on the mud flats of Weston-super-Mare and Berrow Bays, but are not set permanently, as are the nets previously described. Each trammel is fastened to a vertical pole at each end, and a set of nets is worked from a boat. At the beginning of the flood tide, the boat comes into shallow water and sets the first trammel by driving the posts into the mud. As the tide rises the boat follows the tide in, setting the nets as it approaches the shore. As the tide ebbs the boat works back over the nets, taking them up again and collecting the fish. During the winter this method of fishing finds employment for five to seven boats and their crews in Weston-super-Mare and Berrow Bays. The fish taken are mostly rays, flounders and dabs, with a few plaice and some soles.

SEINE NETS.

Seine nets are not used commercially in the Bristol district. They are fished occasionally on the mud flats of King Road by the Gloucester pilots and the Pill boatmen, and elsewhere further down the channel by amateur fishermen, but there is no regular or commercial fishery.

SKIM NETS.

The skim net is very similar to the salmon dip net described above. It is a triangular net supported on two poles joined by a footrope and kept open by a spreader near the apex. The poles are crossed at the apex so that they project a short way behind the net. When not in use the spreader is removed and the net is folded up. The poles and footrope are about ten feet long, but there is no handle as in the salmon dip net. The fisherman stands between the short ends of the poles and pushes the net before him in the shallow water on the mud flats. It is used only in Berrow Bay for catching flounders and shrimps. The net is made of very fine twine and with small mesh. Several fishermen still use these nets in Berrow Bay; formerly they were also used in Weston-super-Mare Bay.

PARRET SALMON BUTTS.

The salmon butts of the Parret are similar to the salmon putchers of the Severn estuary, but are set with the mouths facing upstream instead of down, and thus fish on the ebb tide. They are made fast in a manner similar to the putchers, but are not set in such large ranks, only fifty to a hundred being set together. They are usually set on the inside bank of a bend of the river; the salmon swimming down with the ebb get jammed into the small end and cannot swim back.

SPILLERS.

Spillers are long fishing lines with a hundred to a hundred-and-twenty hooks, as described above. They are used for catching cod and conger in the winter off Clevedon and Weston-super-Mare. They are moored with heavy sinkers and one end is buoyed so that they can be raised, cleared of fish, and rebaited each tide. They are baited with sprats and only used during the sprat season. At Clevedon they are set about half a mile off shore, and at Weston-super-Mare they are set just outside low-water mark off Sand Bay. The bottom off Weston-super-Mare is too irregular and stony for these lines to be used elsewhere with success. Longer lines are not used, as the tides are so strong that larger gear is liable to be carried away. Spillers were also formerly used commercially in Bridgwater Bay on the tail of Gore Sand.

THE SEA FISH OF THE BRISTOL DISTRICT.

The muddy waters, strong tides, and varying salinities of the upper part of the Bristol Channel form a habitat distasteful to many fish, so that the list of fishes occurring in the district is limited to those species that can tolerate these conditions. The first list detailed below contains those species that form the typical fauna of the region and are always present in their appropriate seasons. The second list records the species that occasionally or irregularly visit the district, or have occurred as stragglers. Many species recorded by Baker (2) for Somersetshire have not been included unless definite evidence for their occurrence in the district is available, as his specimens came mostly from Stolford, and fishing stations to the westward, which are outside this district.

I.—SPECIES NORMALLY FORMING THE FAUNA OF THE DISTRICT.

The initial "C" distinguishes those taken in the fisheries.

BASS. *Labrax lupus* Lacep.

Common, particularly in the neighbourhood of creeks and stream mouths in the summer. Usually of small size, though fish up to 3 lbs. in weight are not uncommon. Baker (2) had seen one of 12 lbs. from the Parret. Numbers of very small Bass live in Portishead dock.

THREE-SPINED STICKLEBACK. *Gasterosteus aculeatus* Will.

Equally at home in salt as in fresh water, though it does not breed in the sea. Frequently taken in the shrimp and sprat nets and in the kypes.

POGGE. *Agonus cataphractus* L.

Not uncommon: taken as far up the Channel as Portishead.

LITTLE GOBY. *Gobius minutus* Gmel.

Very common throughout the Channel and right up the Severn estuary.

TWO-SPOTTED GOBY. *Gobius ruthensparri* Euph.

WHITE GOBY. *Latrunculus pellucidus* Nardo.

Both species not uncommon.

LUMPSUCKER. *Cyclopterus lumpus* L. Local name "Sprat Pilot."

Very common during winter, mostly small examples of bright green colour.

SEA SNAIL. *Liparis vulgaris* Flem.
Small examples exceedingly numerous all along the coast.

ANGLER. *Lophius piscatorius* L.
Not uncommon. Large specimens are sometimes taken. Baker (2) records one of 80 lbs. from the Parret. The cast of one about four feet long, taken in the Avon between Pill and Shirehampton, is in the Bristol Museum.

GREY MULLET. *Mugil capito* Cuv.
Common, occasionally up to three feet in length. Numbers of good sized Grey Mullet inhabit Portishead Dock.

COD. *Gadus morrhua* L. Local name for codling, "Tubbelin." C.
Common. Small cod are taken in quantity by sprat and shrimp nets and kypes. During winter large fish are plentiful and are taken on spillers at Weston-super-Mare, Clevedon, and Hallen. Codling up to about five pounds in weight are taken in the kypes at Oldbury-on-Severn and Sheperdine. Knight (10) records a cod of 37 lbs., taken by an Uphill man, as being the largest ever taken in the upper part of the Bristol Channel.

BIB. *Gadus luscus* L.

POOR COD. *Gadus minutus* L.
Both these small members of the cod family are very numerous throughout the district.

WHITING. *Gadus merlangus* L. C.
Very common, but seldom large, about 2 lbs. being a good weight. It is said to follow the sprat shoals in winter. Taken in quantity as far up the Severn as Oldbury-on-Severn and Sheperdine.

POLLACK. *Gadus pollachius* L.
Small examples under a foot long common; larger fish seldom taken.

FIVE-BEARDED ROCKLING. *Motella mustela* L. Local name, "Slippery Cod."
Very common.

THREE-BEARDED ROCKLING. *Motella tricirrata* Bl.
Not so plentiful as the previous species.

LESSER SAND LAUNCE. *Ammodytes tobianus* L.
Not very common: found as far up the Channel as Portishead.

PLAICE. *Pleuronectes platessa* L. C.
Common, but not very plentiful; taken regularly at Hallen.

DAB. *P. limanda* L. C. Local name, "Sand Dab."
Very common.

FLOUNDER. *P. flesus* L. C. Local name, "Fluke."
Very abundant throughout the district, ascending rivers and streams into fresh water. Day (6) found reversed examples numerous at Weston-super-Mare. It is taken in the sprat and shrimp nets, by trammel and in wall nets, and by skim net.

SOLE. *Solea vulgaris* Quen. C.
Common, but usually small in size. Numbers of tiny ones are taken in the kypes at Hallen. Taken in the trammel at Weston-super-Mare.

Salmon. *Salmo salar* L. C.

Very common in the Severn estuary. Taken in quantity by the putchers and kypes of the Severn, the drift nets of the Wye fishermen, and the butts in the Parret. In the Parret the flood tide runs with great force, disturbing the mud and rubbish in the river bottom, and with them the salmon. The fishermen drift upstream in their boats and stalk the salmon brought to the surface and swimming with the dorsal fin exposed, capturing them with large semicircular dip nets.

Sea Trout. *Salmo trutta* L.

Not very common.

Anchovy. *Engraulis encrasicholus* L.

Not common. A few taken regularly as far up the Channel as Oldbury-on-Severn.

Herring. *Clupea harengus* L.

A few are always to be found among the shoals of sprats in winter, even as high as Oldbury-on-Severn.

Sprat. *Clupea sprattus* L. C.

Large shoals come up the Channel and Severn estuary in autumn and winter, and are the object of one of the main commercial fisheries of the district. Though still taken in large quantities it does not form so important a fishery as formerly. Rutter (12) writing in 1829 says, " During the sprat and herring season . . . the fishermen in Weston who rent the stands go on donkeys and ponies after every tide to collect the produce of their nets. Numerous jobbers are in anxious attendance to purchase the marine harvest, and the children of the village, with happy faces, flock to Birnbeck with their baskets to glean the fish which have fallen from the nets; and which from time immemorial has been considered their perquisite." Baker (2) writing in 1851 adds that "by the middle of the nineteenth century the sprat had become the most valuable fishery on the Somerset coast. They are caught by stake nets and brought to the markets every day and sometimes after every tide. As much as a ton of sprats was known to have been retailed in Taunton market in one day, and from information collected with great care, I learn that the sprat fishery from the west end of the Gore Sand in Bridgwater Bay to Weston-super-Mare will produce in a good season more than £10,000 at the retail prices. Sprats strung and suspended in lines from the kitchen ceilings are to be seen in the cottages for months after the season is over. The sprat and herring fishery of Weston-super-Mare supported great numbers of the poor in the time of its greatest activity."

Allis Shad. *Clupea alosa* Cuv.

Twait Shad. *Clupea finta* Cuv.

Both common in the Severn estuary. The Allis Shad ascends the rivers to spawn about the middle of April, the Twait Shad in May.

EEL. *Anguilla vulgaris* Turt. C.

Very common. Elvers ascending the Parret and Severn are dipped out in great quantities from the bank by means of boxes, with bottoms made of perforated zinc, attached to long poles. The elvers are salted to free them from slime and then cooked in cakes. A fishery for elvers was carried on for many years near Berkeley, the fish being exported for stocking rivers and lakes on the continent. Adult eels form an important part of the net fishermen's catch.

CONGER. *Conger vulgaris* Cuv. C.

Common throughout the district. Large examples up to 40 lbs and more in weight are occasionally taken. Said to be less abundant than formerly at Weston-super-Mare.

STURGEON. *Acipenser sturio* L. C.

Not uncommon. Examples up to 200 lbs. sometimes taken.

LESSER SPOTTED DOG-FISH. *Scyllium canicula* L.

Not common, and is seldom found above Weston-super-Mare.

THORNBACK RAY. *Raia clavata* L. C.

Abundant as far up the channel as Portishead. Taken in quantity in trammels at Weston-super-Mare and on line at Clevedon, also in stake nets.

SKATE. *Raia batis* L. C.

Common, but not so abundant as the Thornback. Usually only small examples.

LAMPREY. *Petromyzon marinus* L.

Common, ascending the Severn to spawn in April and May. Day (7) records that "a lamprey pie, embellished with gilded ornaments, was sent annually, as a Christmas present, from the corporation of Gloucester to the Sovereign of the realm, up to the period of corporate reform in 1830."

LAMPERN. *Petromyzon fluviatilis* L.

Very common throughout the district.

II.—SPECIES OCCASIONALLY FOUND IN THE DISTRICT.

FIFTEEN-SPINED STICKLEBACK. *Gasterosteus spinachia* L.

Not common above Bridgwater Bay.

FATHER-LASHER. *Cottus scorpius* Bl.

BUBALIS. *Cottus bubalis* Euph.

Both species occasionally taken at Weston-super-Mare in winter.

RED GURNARD. *Trigla cuculus* L.

SAPPHIRINE GURNARD. *Trigla hirundo* Bl.

STREAKED GURNARD. *Trigla lineata* Gmel.

GREY GURNARD. *Trigla gurnardus* L.

All four recorded by Day (6) as occasionally taken at Weston-super-Mare. The Grey Gurnard is the species most frequently found.

GREATER WEEVER. *Trachinus draco* L.

VIPER WEEVER. *Trachinus vipera* Cuv.

Both species have been taken as far up Channel as Clevedon.

MACKEREL. *Scomber scomber* L.

A rare straggler to the muddy waters of the district.

DORY. *Zeus faber* L.
Day (6) records two specimens from shrimp nets at Weston-super-Mare.

BOARFISH. *Capros aper* L.
A local specimen was formerly in the Weston-super-Mare museum.

SNIPE FISH. *Centriscus scolopax* L.
Knight (10) records one specimen from near Uphill.

SWORDFISH. *Xiphias gladius* L.
There is in Weston-super-Mare museum the cast of one 9 feet long, that was washed up on Burnham sands in 1873. Baker (2) records seeing the rotting carcase of a large swordfish on Burnham sands in 1850. About 1830 one strayed up the Severn as far as Worcester, where it was captured after blundering into and killing a man who was bathing in the river.

SKULPIN. *Callionymus lyra* L.
Day (6) records this species from Weston-super-Mare, and Baker (2) states that it was not uncommon in Bridgwater Bay.

GATTORUGINE. *Blennius gattorugine* Bl.
Uncommon.

BALLAN WRASSE. *Labrus maculatus* Bl.
Has been taken at Weston-super-Mare.

HADDOCK. *Gadus aeglefinus* L.
Occasionally taken.

COALFISH. *Gadus virens* L.
Recorded from Weston-super-Mare by Knight (10).

LING. *Molva vulgaris* Flem.

HAKE. *Merlucius vulgaris* L.
Both species recorded from Weston-super-Mare by Day (6) and Knight (10).

TURBOT. *Rhombus maximus* L.

BRILL. *Rhombus laevis* L.

SAIL FLUKE. *Rhombus megastoma* Donov.
All three have been occasionally taken off Weston-super-Mare.

SMEAR DAB. *Pleuronectes microcephalus* Donov.
Occurs irregularly.

POLE FLUKE. *Pleuronectes cynoglossus* L.
Two specimens were taken at Weston-super-Mare by Higgins (9).

ARGENTINE. *Maurolicus borealis* Nilss.
Seven examples were taken at Weston-super-Mare by Higgins (9).

GARFISH. *Belone vulgaris* Flem.
Occasionally occurs in summer.

PILCHARD. *Clupea pilchardus* Walb.
A straggler only to this district.

SUNFISH. *Orthagoriscus mola* L.
One taken in Cumberland Basin, Bristol, in 1900, is now in the Bristol Museum.

TOPE. *Galeus canis* Bonap.
Has been taken off Weston-super-Mare and at Aust.

PORBEAGLE. *Lamna cornubica* Cuv.

One was caught between Weston-super-Mare and Steep Holm in 1871.

PICKED DOG-FISH. *Acanthias vulgaris* Risso.

Occasional.

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The Birds of Barrow Gurney Reservoirs.

By A. C. Leach, M.A.

Before beginning these notes I should like to acknowledge my indebtedness to the records of the Somerset Natural History Society; to the observations of Messrs B. W. Tucker, H. Tetley, W. R. Taylor, and others; and to the courtesy of the Bristol Water Works in granting a regular permit to visit their reservoirs.

In the first place a description of Barrow Gurney and its reservoirs is necessary. We are very fortunate in having so near our city a spot at once so interesting in its bird-life and so beautiful in itself. Its beauty lies in its views over the city and its position under the slopes of Dundry Hill. When there, one can hardly realise that a main road runs between the reservoirs, crowded with cars and char-a-bancs buzzing by to Cheddar and elsewhere, quite unseen by and undisturbing to both watchers and birds.

There are three reservoirs in all, with practically no cover of any kind either for birds or observers. No. 1, the smallest, was constructed in 1848 and holds 150,000,000 gallons; No. 2, in 1864, holding 200,000,000 gallons; No. 3, in 1884, holding 520,000,000 gallons. Actually the popularity of the reservoirs among the birds increases with their capacity, except I fancy in the case of waders, who find 1 or 2 most to their liking according to depth. No. 1 is most frequently partly dry, and it is there that huge flocks of lapwings congregate in autumn. The food supply consists of small fish, weeds, and the insects that live in the water and mud, and so is suitable for duck, grebes and waders. There is also across the road from No. 1 the site of an old reservoir where one can find snipe, shrikes and sedge-warblers, and where coot, moorhen, and duck breed. This would repay more frequent visits.

Such records as we have do not, unfortunately, go back to early days, and before the reservoirs were built I am told that the site was not attractive to water-fowl.

Barrow is in no sense a breeding haunt, nor is it a good place for studying the habits of birds; nor again does it provide much scope for the photographers. It is a small winter-resort for certain species, whither a number of trippers and bird-folk requiring rest or shelter go at various times, but particularly in August or September. Its "season" is a winter one.

In the notes below, with one or two exceptions, I do not mention any birds except duck, waders, grebes and gulls (50 species in all). These, after all, are the main interest of Barrow Gurney. But there are at all times plenty of our smaller birds about, and it is a good spot to note the early return of migrants.

It is the hard rough weather of winter and early spring, and the end of dry summers such as that of 1933, that seem to bring the most interesting birds to Barrow; and I feel that if it could be more frequently visited and watched, the list of its birds, and in particular of its rarities, would be considerably added to.

I have been through the records from 1865 up to the present day, but practically nothing appears about Barrow until 1921; but it was in 1923 that Mr Tucker seems to have "found" it. The record for that year is longer and more varied than that of any other year until 1933. The main facts that seem to stand out are the dearth of records in the summer, due, I think, to two causes: firstly, a scarcity of birds and a scarcity of observers; and secondly, the fact that for wealth of bird-life and the chance of seeing rarities no month will compare with September. But one of the great attractions of Barrow to the ornithologist is that one always feels that something may turn up to make a visit more than worth while. In future it should be interesting to record whether the construction of the new reservoir at Cheddar has any appreciable effect on the bird-life of Barrow.

Below is a list of the birds that are to be seen at Barrow in each month of the year, with a rough indication of their numbers. The details of these can in almost every case be found in the Somerset Bird Reports for each year. The largest recorded number of birds on one day is 1834. Finally, I have added a complete list of the birds of the types with which I am dealing, with a rough indication of their regularity at Barrow.

JANUARY.

Gulls	Herring, Black-headed, and a few Common.
Dunlin	Once.
Teal	About 20.
Pochard	About 40.
Mallard	10 to 20.
Wigeon	About 50.
Tufted Duck	40 to 50.
Scaup	1 to 5.
Smew	1 occasionally. 7 in 1928. Generally "redheads."
Golden-eye	Few Brownheads, occasionally adult.
Great-crested Grebe	Varying numbers.
Black-necked Grebe	1 since 1930.
Redpolls	8 to 10 one year.

FEBRUARY.

Gulls	As in January. 1 Lesser Black-backed, 1932.
Great-crested and Black-necked Grebe	As in January.
Wigeon, Tufted Duck	As in January.
Oyster-catcher	1 in 1929.
Goosander	2 in 1928.
Curlew	Heard in 1929.

Scaup	1 in 1932.
Teal	Up to 30.
Pochard	Generally some.
Mallard	Normal.

MARCH.

Gulls	As in January. 1 "Iceland" in 1931. 45 Lesser Black-backed, 1933.
Snipe	18 Common and 1 Jack Snipe.
Curlew	7 in 1931.
Teal	1 to 15.
Pintail	Pair in 1928.
Pochard	As before.
Wigeon	As before, but a few leave.
Shoveler	4 drakes and 3 or 4 ducks, 1928.
Scaup	Drake, full plumage, 1932.
Golden-eye	Adult drake and 3 ducks, 1924, 1926.
Tufted Duck	As before.
Goosander	3 in 1928. Female or immature.
Mallard	Normal.
Great-crested Grebe	Very few or none.
Black-necked Grebe	As before, but attains full plumage; leaves.
Slavonian Grebe	1 in 1924 and 1934.
Water Rail	Several in 1930.

APRIL.

Lesser Black-backed Gull	Generally arrive first week in numbers.
Curlew	1 in 1928.
Teal	4 pairs in 1932.
Tufted Duck	Numbers decreasing.
Wigeon	Generally left.
Golden-eye	As in March.
Mallard	Normal.
Common Scoter	1 to 3 various occasions.
Great-crested Grebe	Very few.
Black-necked Grebe	2 in 1932. Generally left.
Slavonian Grebe	As in March.
Buzzard	1 over in 1932.

MAY, JUNE, JULY.

A few Mallard and Great-crested Grebe generally seen. The latter are reported as breeding sometimes before 1925, and 7 nests were attempted in 1933 without success.

Three Black-necked Grebe in July 1926.

AUGUST.

Common Sandpiper	Several.
Redshank	1 in 1932.
Mallard	A few.
Shoveler	4 in 1923.
Heron	3 or 4 in 1932.
Ringed Plover	8 in 1923.
Greenshank	1 in 1923.
Tufted	A few.
Golden-eye	Occasional Brownheads.
Black-necked Grebe	Returns.

SEPTEMBER.

Black Tern	2 in 1926; 4 in 1933.
Common Tern	2 in 1926.
Snipe	2 in 1931.
Ringed Plover	8 in 1923.
Golden Plover	1 to 6 in 1923.
Dunlin	6 in 1926; 1 in 1933.
Common Sandpiper	Several generally present.
Curlew-Sandpiper	8 to 10 in 1923.
Ruff	2 in 1923.
Sanderling	3 in 1930.
Black-tailed Godwit	2 in 1933.
Green Sandpiper	3 occasions.
Spotted Redshank	1 in 1933.
Greenshank	1 in 1926 and 5 in 1933.
Curlew	Up to 6 or 7.
Mallard	A few.
Wigeon	A few return in eclipse plumage.
Tufted Duck	Arrive up to 40.
Shoveler	1 in 1926.
Teal	61 on one day, 1933.
Pochard	Arrive up to 60.
Golden-eye	Occasionally.
Common Scoter	1 drake in 1931.
Heron	3 in 1928.
Cormorant	1 in 1930.
Great-crested Grebe	Normal numbers, i.e. about 1 dozen.
Black-necked Grebe	1 usually. 4 in 1933.

OCTOBER.

Ringed Plover	A few occasionally.
Golden Plover	As in September.
Lapwing	Flock of 400 to 500
Curlew	3.
Green Sandpiper	1 in 1924 and 1931.
Mallard, Wigeon	A few.

Teal	Arrive up to 40.
Pochard	Normal up to 312.
Tufted Duck	Numbers increase.
Golden-eye	Several brownheads in 1926.
Scaup	1 in 1931 for winter.
Cormorant	1 in 1924.
Great-crested Grebe	Up to 27.
Black-necked Grebe	1 or 2 for winter.

NOVEMBER.

Great Black-backed Gull	1933.
Lesser Black-backed Gull	Others normal.
Golden Plover	Occasionally seen.
Green Sandpiper	1 in 1933.
Redshank	1 in 1927.
Curlew	Up to 40 passing over.
Teal	As in October.
Wigeon	Small numbers.
Mallard, Tufted Duck	Normal.
Pochard	Up to 200.
Scaup	As before.
Golden-eye	A few brownheads.
Grebes	Normal.

A Ferruginous Duck was once reported.

DECEMBER.

Gulls	Normal, including a Lesser Black-backed.
Iceland Gull	1 in 1933.
Great Black-backed Gull	1 in 1933.
Green Sandpiper	Wintering 1933-34.
Curlew	Small parties in fields.
Mallard, Teal, Pochard	Normal.
Wigeon	Majority arrive up to 50 or more.
Tufted Duck	Normal.
Scaup	As before.
Golden-eye	As in November.
Goosander	1 female or immature, 1927.
Smew	1 redhead, 1931.
Grebes	Normal.
Great Northern Diver	1 in 1928.
Red-throated Diver	1 in 1927.

COMPLETE LIST OF BARROW GURNEY RESERVOIR BIRDS.

Abbreviations:—Com. (Common). Reg. (Regular). Occ. (Occasional). R. (Rare). V.R. (Very Rare).

Dipper (1921)	*Cinclus cinclus gularis* Lath.	V.R.
Black Tern	*Chlidonias niger niger* (L.) ...	V.R.

Common Tern	*Sterna hirundo hirundo* L.	V.R.
Black-headed Gull	*Larus ridibundus ridibundus* L.	Com.
Common Gull	*Larus canus canus* L.	Reg.
Herring Gull	*Larus argentatus argentatus* Pont.	Reg.
Lesser Blacked-backed Gull	*Larus fuscus graellsii* Brehm.	Reg.
Iceland Gull	*Larus leucopterus* Fab.	V.R.
Great Black-backed Gull	*Larus marinus* L.	R.
Grey Phalarope	*Phalaropus fulicarius* (L.)	V.R.
Common Snipe	*Capella gallinago gallinago* (L.)	Reg.
Jack Snipe	*Lymnocryptes minimus* (Brünn.)	V.R.
Ringed Plover	*Charadrius hiaticula hiaticula* L.	Occ.
Golden Plover	*Charadrius apricarius apricarius* L.	R.
Lapwing	*Vanellus vanellus* (L.)	Com.
Oyster-catcher	*Haematopus ostralegus occidentalis* Neum.	V.R.
Dunlin	*Calidris alpinus schinzii* (Brehm.)	Occ.
Curlew-Sandpiper	*Calidris testacea* (Pall.)	V.R.
Black-tailed Godwit	*Limosa limosa limosa* (L.)	V.R.
Ruff	*Philomachus pugnax* (L.)	V.R.
Sanderling	*Crocethia alba* (Pall.)	V.R.
Common Sandpiper	*Tringa hypoleucos* L.	Reg.
Green Sandpiper	*Tringa ochropus* L.	Occ.
Redshank	*Tringa totanus totanus* (L.)	Occ.
Spotted Redshank	*Tringa erythropus* (Pall.)	V.R.
Greenshank	*Tringa nebularia* (Gunn.)	Occ.
Curlew	*Numenius arquata arquata* (L.)	Reg.
Water Rail	*Rallus aquaticus aquaticus* L.	R.
Waterhen	*Gallinula chloropus chloropus* (L.)	Com.
Coot	*Fulica atra atra* L.	Com.
Mallard	*Anas platyrhynca platyrhynca* L.	Reg.
Teal	*Anas crecca crecca* L.	Reg.
Shoveler	*Spatula clypeata* (L.)	Occ.
Pintail	*Anas acuta acuta* L.	R.
Wigeon	*Anas penelope* L.	Com.
Pochard	*Nyroca ferina ferina* (L.)	Com.
Tufted Duck	*Nyroca fuligula* (L.)	Com.
Scaup	*Nyroca marila marila* (L.)	Occ.
Golden-eye	*Bucephala clangula clangula* (L.)	Occ.
Common Scoter	*Oidemia nigra nigra* (L.)	R.
Goosander	*Mergus merganser merganser* L.	V.R.

Smew	*Mergus albellus* (L.)	Occ.
Heron	*Ardea cinerea cinerea* L.	Occ.
Cormorant	*Phalacrocorax carbo carbo* (L.)	V.R.
Great-crested Grebe	*Podiceps cristatus cristatus* (L.)	Com.
Black-necked Grebe	*Podiceps nigricollis nigricollis* Brehm.	Reg.
Dabchick	*Podiceps ruficollis ruficollis* (Pall.)	Com.
Slavonian Grebe	*Podiceps auritus* (L.)	V.R.
Great Northern Diver	*Colymbus immer* Brünn.	V.R.
Red-throated Diver	*Colymbus stellatus* Pont.	V.R

Notes on the Keuper and Rhætic exposed in a Road Cutting at Uphill, Somerset.

By G. A. Kellaway and K. P. Oakley, B.Sc., F.G.S.

CONTENTS.

I. INTRODUCTION. (K.P.O.)

Recently, during the construction of a new main road between East Brent and Weston-super-Mare, a deep cutting was made at Uphill, just to the east of Manor Farm, through the low east-west ridge of Trias which occupies a gap in the outcrop of Carboniferous Limestone at this point. It exposes an excellent section through the Keuper Marls and Rhætic.

The railway cutting an eighth of a mile to the east provided a similar section and this has been described on several occasions by earlier geologists. Thomas Wright,[1] Charles Moore,[2] H. B. Woodward,[3] William Sanders,[4] Bristow and Etheridge[5] all recorded their observations on this classic section. More recently it has been mentioned by Prof. Sollas[6] and Mr L. Richardson.[7] It is now, however, considerably overgrown, and when Mr Richardson visited it in 1911 he was unable to discern anything like the succession originally exposed. This is particularly regrettable, since the older descriptions are far from being consistent with one another. It seems, therefore, worth while to put on record a few notes on the succession observed in the new cutting before the sides become obscured by rainwash and overgrowth.

We also take the opportunity of making some observations with regard to the conditions of deposition during Rhætic times, and of drawing more detailed comparisons than have hitherto been made between the Rhætic and some of the *lagoon-phase* deposits of other formations.

[1] XXI.
[2] VI.
[3] XX.
[4] XIII.
[5] II.
[6] XVI.
[7] XII, pp. 55-57.

II. TECTONIC FEATURES. (K.P.O.)

The dip of the strata averages about 25° S., but there is a certain amount of variation—the angle being considerably modified, for instance, in the proximity of faults. The cutting may be said to run, in general, in the direction of dip, but only here and there does it correspond to a true dip section. Being practically S-shaped, it swings round almost in the direction of strike over part of its course.

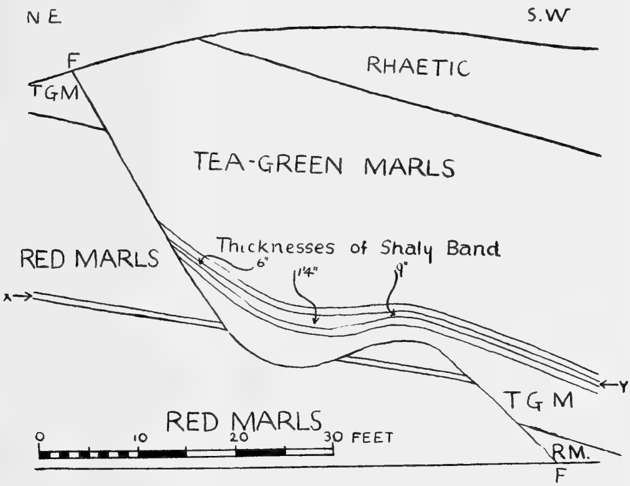


Fig. 1.—Northern fault; "east" face of cutting.

At the northern end of the cutting there is an extensive exposure of the Red Marls. These are disturbed by minor faults which are readily discernible on account of the way in which they displace the numerous green bands which occur at intervals throughout the Red Marls. The Tea Green Marls and Rhætic which succeed the latter are well exposed in the remainder of the cutting and show repetition by strike-faulting. The two main faults which appear in the section downthrow towards one another, forming a trough 110-120 ft. wide. The Rhætic beds are exposed between these two faults and also at the southern end of the cutting, the more complete succession being displayed in the former exposure.

The *southern fault*, which brings the Rhætic beds against the Tea Green Marls, is seen in a part of the section which does approximate to a true dip section, and so the observed hade (10° N.) may be taken as correct. Using the "Breccia" bed (3) at the top of the Tea Green Marls as a datum line, the throw of this fault has been estimated to be about 30 ft.

Water percolating from above and passing along the surfaces of the impervious Lower Rhætic shales, in accordance with their dip, is thrown out at the S. fault. This is particularly noticeable on the east face of the cutting.

The *northern fault* shows some remarkable features (see fig. 1*). It has a throw of about 30 ft. and downthrows to the south. On the west side of the cutting it is seen to be of reversed type, hading a few degrees to the north, while on the east face, less than twenty yards away, it is of normal type, hading to the south. The fault-surface is, in fact, spiral in form (see fig. 2). The apparently high angle of hade on the east face is largely accounted for by the obliquity of the section at this point.

The form of the fault surface is further complicated by a transverse flexure. This is seen in section on the east face of the cutting. The recurved portion of the fault-surface, analogous in form to the central limb of a monoclinal fold, cuts into the Red Marls and at one point interrupts one of the green marl bands (see X in fig. 1). The same band, after continuing its course again for a short distance, is finally cut off by the fault-surface after the latter has resumed its original inclination.

The compressive forces involved in the formation of this fault must have acted in such a way that the downward moving mass had a scooping effect. As a consequence of this, there has been considerable squeezing of the marl beds on the downthrown side, near the recurved fault-surface. A down-folding of the beds and a thickening of the shaly layers (see particularly bed Y in fig. 1) in that region are very evident. The helicoidal form of the fault-surface suggests that it was determined by torsional movement. The fault may be, in part, of the nature of a tear, although no direct evidence of this was obtained.

Although neither of the faults in this cutting can be identified with certainty with those recorded in the railway cutting, the two faults shown at the Hutton Road end of Sanders' section are clearly of the same peculiar curving type as the northern one in the road section. They lie, too, in the same general line of strike.

It is interesting to find, in the east bank of the old Uphill-Weston road immediately to the W.S.W. of the cutting, that the Keuper Marls which are exposed there are thrown into asymmetrical folds with an amplitude of six feet or more, and approaching monoclines in form. No actual dislocation, however, has occurred there.

The gentle folding of the Trias probably represents a repetition of movement along the Mendip axis of uplift,[1] during the Mesozoic or perhaps Tertiary times. The rather complex nature of the faulting of the beds in this area suggests that Tertiary earth-movements were responsible for the actual dislocations. In the railway cutting, for instance, Carboniferous Limestone has actually been thrust over the Keuper and Rhætic. During the last century there was a famous con-

*Drawn to scale from measurements obtained by Mr Kellaway with the help of Mr W. F. Brimson to whom thanks are due.

[1]III.

troversy over this thrust junction—some regarding it as a buried "sea-cliff."[1]

III. SUCCESSION. (G.A.K.)

The most complete series is to be seen in the E. face of the cutting, whence the following details were obtained (see fig. 4):—

		Ft.	Ins.	
	Soil and Rubble.			
20	Shale. Brown, calcareous	0	6	
19	Limestone. Blue-hearted with "Crazy Cotham" at base	0	10	*Gyrolepis alberti* Ag. *Modiola* sp. *Protocardium* sp. Bones, scales and teeth, and many broken lamellibranch shells.
18	Marls. Yellow, blocky	2	2	
17	Limestone. Bluish-grey, hard	0	10	
16	Marls. Yellow, blocky	1	8	
15	Limestone. Argillaceous, "sun-cracked"	0	1	
14	Limestone. Hard, banded	0	10	*Protocardium rhæticum* (Mer.). *Naiadites lanceolata* Brodie.
13	Marls. Thin bedded and yellow	0	10	
12	Shales. Black	6	0	
11	Limestone. The "Upper Pecten bed"	0	11	*Chlamys valoniensis* (Defr.). *Dimyodon intus-striatus* (Emm.). *Placunopsis alpina* (Winkler). *Pleurophorus angulatus* Moore. *Pl. elongatus* Moore. *Protocardium rhæticum* (Mer.). "*Schizodus*" *ewaldi* Borneman.
10	Shales. Black, with a hard layer 1 ft. 11 in. below bed 11.	6	0	*Placunopsis alpina* Winkler.
9	Limestone. Impersistent, the "Lower Pecten bed" av.	0	3	*Cardium cloacinum* Quenstd. *Chlamys valoniensis* (Defr.). *Myophoria postera* Bronn. *Placunopsis alpina* Winkler. *Protocardium rhæticum* (Mer.). *Pteria contorta* (Portlock).
8	Shales. Black	6	9	*Pteria contorta* (Portlock). "*Schizodus*" *ewaldi* Born.
7	"Bone-bed"	0	6	*Acrodus minimus* Ag. *Ceratodus latissimus* Ag. *Gyrolepis alberti* Ag. *Hybodus minor* Ag. *H. raricostatus* Ag. *Plesiosaurus* sp. *Sargodon tomicus* Plein. *Saurichthys acuminatus* Ag. Quartz pebbles and coprolites.
6	Shales. Dark grey	2	10	
5	Limestone. Hard, blue-hearted	1	9	
4	Marls. Greenish, with bands of black shale	5	6	
3	"Breccia" bed	0	9	
2	Tea Green Marls	33	0	
1	Red Marls (seen) .... c.	90	0	

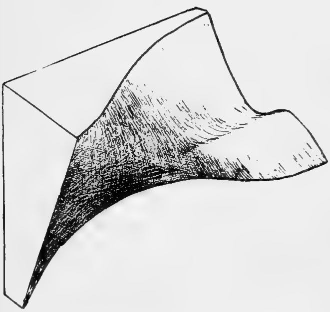
Richardson[2] records *Darwinula* from the *Naiadites* bed (14). The

[1] XX.

[2] XII, p. 56.

following list gives the names under which certain of the beds are described: —

bed 19 = Cotham Marble equivalent.
15 = " Suncracked " Limestone.
14 = *Naiadites* Limestone.
11 = " Upper Pecten bed."
9 = " Lower Pecten bed."
7 = Bone-bed.
6 = Infra-Bone-bed Shales.
4 = Grey Marls.
3 = " Breccia " bed.
2 = Tea Green Marls.
1 = Red Marls.



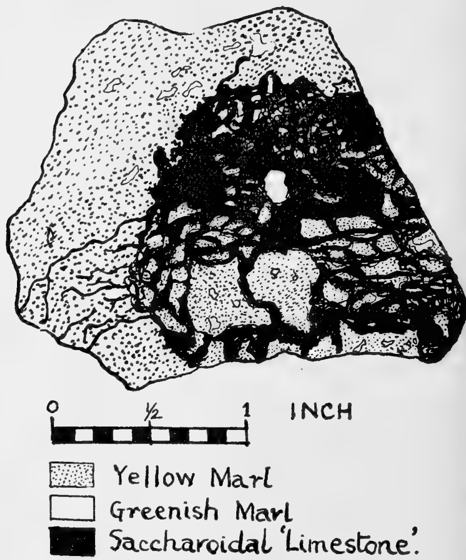


Fig. 2.—Block-diagram of northern fault.
Fig. 3.—Piece of bed 3 (" Breccia " bed); semi-diagramatic.

Provisionally, beds 1 and 2 are referred to the Keuper,

6 — 12 to the Lower Rhætic,
13 — 19 to the Upper Rhætic,

while beds 3, 4, 5 and 20 are of doubtful age. The names given to the beds are descriptive and are not intended to imply that they are of the same date as beds similarly named elsewhere. The position and correlation of these beds is discussed later.

IV. DETAILS OF BEDS WITH NOTES ON LITHOLOGY AND CONDITIONS OF DEPOSITION. (K.P.O.)

Keuper Marls and Base of Rhætic.

1. The Red Marls. These show their normal development. Green mottling is noticeable in places and a conspicuous feature is the occurrence of green bands at fairly regular intervals. In the centre of each of these there is usually a nodular layer of "box-calcite," hollow nodular masses lined with crystalline calcite and often filled with loose crystals of calcite, resembling granulated sugar. The crystals are principally minute scalenohedra. Vertical strings of calcite also occur.

2. The Tea Green Marls. These consist of greenish, grey, and buff coloured marls, with numerous indurated bands generally referred to as "marlstones." These hard bands are persistent and fairly regularly spaced. Twenty of them were counted in the thickness of Tea Green Marls exposed in the cutting. For minute details of the lithology of these marls, reference should be made to the vertical section of the Uphill Railway cutting prepared by Bristow and Etheridge and published by the Geological Survey.[1] In places the Tea Green Marls are gypsiferous.

3. The "Breccia" Bed. The normal Tea Green Marls are succeeded here by a thick band of marlstone of rather unusual type. Externally it is porous, yellow and very finely fragmental, while large patches of the interior have the appearance of a well-defined breccia on account of the development of a matrix of black saccharoidal limestone in which angular fragments of pale-coloured marl naturally become very conspicuous (see fig. 3). These patches have crenulate margins and are surrounded by a thick rind of the fragmental marlstone in which brecciation can only be made out with difficulty. The dark material penetrates the cortex of the marlstone in the form of tortuous filament-like veins. The brecciated appearance, then, is to be attributed largely to the subsequent development of granular calcite. At the same time, the bed was primarily "conglomeratic," since some of the fragments isolated in the black matrix are of greenish marl, while others are of the harder yellow marlstone.

It is supposed that this bed represents marly deposits which had hardened sufficiently to be broken up by a disturbance of the bottom waters of the Keuper "lake." Just such conditions as these might be expected to occur during intermittent flooding of the "lake-basins" by marine waters. In fact, Dr R. L. Sherlock[2] has suggested that the change from red to green marls at the top of the Keuper indicates the oncoming of marine conditions. It seems likely that at the opening of the Rhætic, the sea entered the British Keuper cuvette in a series of gentle incursions which would have stirred up the marly sediments and ultimately have given rise to fragmental marlstones such as bed 5.

It appears that the veining of the marlstone by calcite was a penecontemporaneous process. It was clearly different from the process

[1] II.
[2] XV.

which gave rise to the rock which Dixon[1] and Vaughan have termed *pseudo-breccia*, although the effect was similar. The chief difference from the latter is the absence of gradation between the matrix and the fragments. It is thought that during the consolidation of the redeposited material granular calcite crystallised out from the lime-saturated waters with which the sediment was soaked. Pieces of the fragmental marl composing the bed were wedged off and isolated by the crystallising calcite. The presence of re-entrant angles shows that the latter determined the shape of the fragments.

4. The Grey Marls which succeed give further evidence of the change of conditions which we think are indicated by the nature of the "Breccia" bed. They consist of greenish-grey marls and marlstones, alternating with thin seams of blackish shale. The latter may indicate the rather hesitant on-coming of Rhætic conditions, although there is no palaeontological evidence to support this (see pp. 473, 484).

5. The top of this marl series is formed by a bed of argillaceous limestone. This is in the main a compact blue-hearted limestone, but the upper part is soft and marly. It is unfossiliferous and provides no clear evidence of non-sequence with the beds above or below.

The Grey Marls amount in all to about 7¼ ft.

6. Infra-Bone-bed Shales. These are grey shales, rather soapy to the touch, and with a coating of powdery, sulphur-yellow limonite on the partings and joint surfaces. No fossils were found in these, but it is clear from their lithology that they belong to the Lower Rhætic series. The presence of shales below the Bone-bed is in itself a feature of interest, since in many places in Somerset the Bone-bed rests directly on Triassic Marls. The sporadic distribution of the Infra Bone-bed Series suggests an irregular surface of Keuper Marls due to mild diastrophic flexuring. The fine black muds would have accumulated in the quiet waters occupying the hollows, while the intervening areas were either unsubmerged at first or more likely just submerged but swept clear by current-action in the surface water.

7. Ceratodus Bone-bed.
5½ in.-6 in.

d.	Rust-coloured sandy shale, ...	c. ½ in.
c.	Ferruginous pyritic limestone, ...	c. 1 in.
b.	Ditto; more shaly, ...	3 in.
a.	Massive grey pyritic limestone, ...	1 in.

Layers b. and c. are the most fossiliferous and consist of layers of grey limestone with limonitic partings. This limestone contains lenticles of pyrites and conspicuous patches of an amorphous, vivid green material, which is almost certainly disintegrated Tea Green Marl. The mineral which gives the Marls their green colour is apparently relatively stable. It is probably a complex iron silicate.

In a few cases the green material is in the form of elongate pellets coated with iron pyrites.

[1] *Q.J.G.S.*, 1911, pp. 507-11.

The lowest layer (a) is a more massive saccharoidal limestone. It is grey and relatively tough. Although it lacks the ferruginous partings, it is pyritic and has abundant green patches representing decomposing pellets of the green marl. Coprolites or rolled pellets of phosphatic mud also occur in this layer.

Ordinary sedimentation is believed to have been at a minimum during the formation of the Bone-bed. The concentration of fish scales, etc., on the parting-surfaces of the limestone layers may indicate the winnowing action of currents, as in the case of the Ludlow Bone-bed, but possibly the concentration is more apparent than real and at least partly due to weathering along bedding-planes.

Lower Rhætic above the Bone-bed.

8, 10, 12. Pteria contorta Shales. These are grey to black papery shales. Their partings are sometimes coated with a powder of rust-coloured or sulphur-yellow limonite. They are harder than the shales below the Bone-bed and are frequently spotted with minute grey flecks reminiscent of the spotting seen in some Valentian shales, and perhaps due to the flocculation of colloidally suspended sediment before its deposition.

The thicknesses of these shale beds show considerable variation within quite short distances. Different values were obtained, for instance, on the two sides of the cutting, a distance of only 15-20 yards. The following table gives the details of the shale-beds, thicknesses of intervening beds being omitted for sake of clearness.

	E. side.	W. side.
13-19. Upper Rhætic.		
12. Shale	6 feet 0 ins.	6 feet 3 ins.
11. " Upper Pecten Bed."		
10. Shale	6 feet 0 ins.	4 feet 0 ins.
9. "Lower Pecten Bed."		
8. Shale	6 feet 9 ins.	6 feet 6 ins.
7. Bone-bed.		
6. Shale	2 feet 10 ins.	3 feet 2 ins.

To judge by the lithology and to some extent by the character of the fauna, the shales must have been formed under shallow-water conditions not wholly favourable to normal marine life. Only in this way can we explain the general absence of cephalopods, corals, echinoids, crinoids, and brachiopods. As in the case of the black shelly clays laid down in the Woolwich lagoon of Eocene times, the fauna was almost exclusively a lamellibranch one, and while individuals were abundant in certain places, the number of species which thrived under the special conditions was strictly limited. The conditions were probably unfavourable on account of the lack of circulation in the waters of the Rhætic gulf. For although connection with the sea had been definitely established, the British area was at the time of the formation of these shales an extensive shallow-water gulf, virtually cut off from the open sea, and not unlike the present-day Baltic. It was, in fact, an enormous lagoonal area, using the term lagoon in the sense defined by Mr E. E. L. Dixon.[1] In such a shallow restricted sea there would be almost complete absence

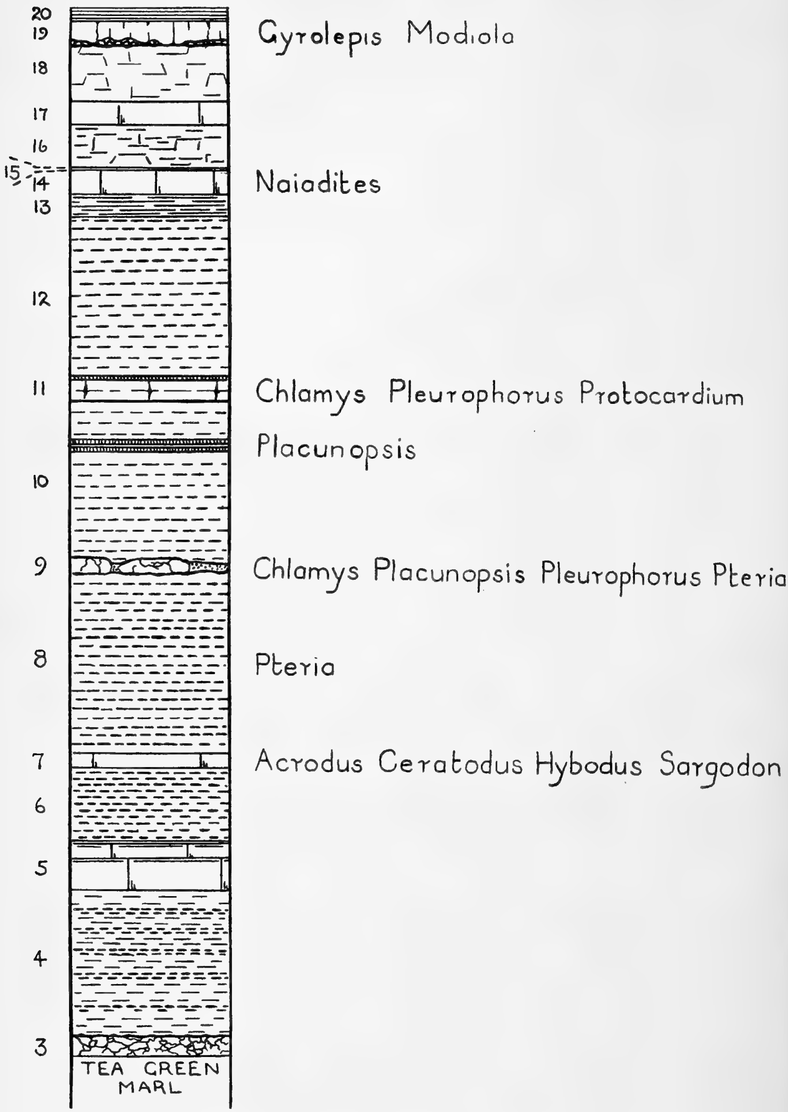


Fig. 4.—The general sequence in the Rhaetic at Uphill.
The thickness of beds 3-20 = approx. 38 feet.

[1] *Q.J.G.S.*, 1911, pp. 511-2.

of circulation, and extremely fine, black fetid muds would accumulate over a wide area,[1] under what are generally spoken of as "Black Sea conditions." Although the chemical processes concerned may have been similar to those in the bottom waters of the Black Sea, the analogy breaks down on account of the shallowness of the Rhætic gulf. Nor were the waters completely lethal to benthonic life. The conditions were more analagous to those now existing in the Wash and in the shallow parts of the Irish Sea, where similar black "buttery" muds are accumulating.[2]

The Rhætic shales are rich in carbonaceous matter[3] and the dark colour is due to this, rather than to iron sulphide. It is clear that *reducing* conditions prevailed during the formation of the shales.

Comparison may also be drawn with some of the Lower Palaeozoic graptolitic shales. Although most of the latter are regarded as a deep-water facies, some are believed to have been laid down under lagoonal conditions similar to those obtaining in Lower Rhætic times. An account of these has been given by Prof. W. B. R. King.[4]

The "Pecten" Limestones.

These are bands of impure limestone containing a comparatively abundant lamellibranch fauna. They seem to represent temporary clearings of the fetid gulf waters, during which a more normal shelly fauna was able to establish itself.

9. The "Lower Pecten Bed." When well preserved, this is a dark-grey crystalline limestone, grading in places into a more compact argillaceous type. It is very variable both in thickness and nature. Its impersistence is almost certainly due to decalcification. On the east side of the cutting this horizon is represented by a 3 in. band of rust-coloured sandy clay, in which a few badly preserved Pectens occur. On the west face the bed is better developed, particularly at the Bleadon end of the cutting. Between the two bounding faults of the central faulted part of the section, it is represented by two lenticular masses of finely crystalline limestone. The maximum thickness of this impersistent band is 7 in. The limestone lenticles are joined by a 2 in. band of ferruginous sandy shale.

10a. About 1 ft. 6 in. below the "Upper Pecten Bed" there occurs a band of indurated black marl which glistens in the light on account of large numbers of minute selenite crystals, which resulted no doubt through the decomposition of iron sulphide in the presence of calcium carbonate. This band is capped by a thin layer of "beef."

11. The "Upper Pecten Bed." This differs in being much more constant. It is separated from the Lower by 4 ft.-6 ft. of black shale. The details of the bed as it appears on the east face are as follows:—

[1] XIV.
[2] IX.
[3] "Kerogen" type.
[4] IV, V.

" Beef " layer,	1 in.
Clay seam,	½ in.
" Beef " layer,	1½ in.
Clay seam,	½ in.
Grey limestone (irregular base),	5 in.
Hard shaly marl,	3 in.

The main fossiliferous part of the bed is a fine-grained argillaceous limestone, greyish-buff in colour, but showing patchy recrystallisation at the centre. The recrystallised patches are dark blue and include the interiors of shells.

Immediately above the limestone are two *" beef " seams*, separated from the Pecten limestone and from one another by thin seams of clay. These " beef " layers consist of fibrous calcite. The calcite is buff-coloured and rather impure. Cone-in-cone structure is to some extent developed—the two sets of cones interdigitating rather irregularly about a median plane. The widespread occurrence of " beef " seams above the "Upper Pecten Bed" suggests that they were formed contemporaneously with the sediments in which they occur and that their formation was connected with some general factor such as the concentration of calcium bicarbonate in the sea-water at the time. Only some such factor would affect such a large area at once, although we have not as yet sufficient evidence to deduce what the particular conditions were.

The cone-in-cone structure is almost certainly secondary, and resulted no doubt from adjustment to pressure stresses, by solution and recrystallisation in a layer of previously formed fibrous calcite.

13-19. The Upper Rhætic.

The Upper Rhætic marks an abrupt change in the type of sedimentation. Pale yellow marls (beds 13, 16 and 18) alternate with hard bluish limestones of the compact calcite-mudstone type. The latter may be compared with some of the *Modiola*-phase limestones of the Lower Carboniferous, the Lithographic Limestone of Solenhofen, and the " Pendle " bed at the base of the Purbeck in Buckinghamshire. All these are regarded as *lagoon-phase* deposits.

The reason for the change from black muds to yellowish calcite-muds, however, is not clearly understood. Certainly conditions were no less " lagoonal " in the Upper Rhætic, in fact, the progressive dwarfing of the Upper Rhætic fauna implies increasingly restricted waters.

14. " Naiadites Limestone." A fine-grained compact limestone, greenish buff in colour and showing distinct banding. Some of the bands are due to the presence of drifted plant debris. At these levels the bedding planes are littered with stem fragments and leaves of the small Lycopod, *Naiadites lanceolata*. These were probably drifted out at fairly regular intervals from salt-marshes bordering the shallow-water lagoonal area.

15. Immediately above the *Naiadites* limestone occurs a thin layer of fine-grained shaly marlstone, the parting surfaces of which exhibit

desiccation or shrinkage cracks. Similar "sun-cracked" seams occur in the *Naiadites* limestone and are responsible for about half the banding which characterises it. These bands are accentuated by weathering.

The shrinkage cracks form a series of well-defined polygons. These average 1.5 to 2 mm. across, but on one surface polygons up to 7 mm. across were observed. The polygons are rather irregular, the number of sides varying from 3 to 7, but there is a distinct tendency towards the production of the regular hexagonal type. The cracks are in the main curved. Such a minute polygon-lattice is characteristic of limey muds laid down in extremely thin layers.[1] The size of the polygons (*i.e.*, the spacing of the cracks) depends, too, on the rate of shrinkage.

The cracks have been filled in by calcite, which possibly crystallised out from the water which subsequently covered the sun-dried mud flat, assuming the desiccation theory of the origin of these cracked surfaces, to be true. It is not impossible, however, for mud-cracks to form under water,[2] and if this were the case the calcite probably filled up the cracks contemporaneously with their formation. In any case, the occurrence of this mud-crack horizon emphasises the extreme shallowness of the water during Upper Rhætic times.

17. The second limestone in the Upper Rhætic is entirely unfossiliferous. It is a tough, pale-grey rock, with a splintery sub-conchoidal fracture.

19. The uppermost limestone is regarded as the equivalent of the COTHAM MARBLE.* Although it lacks the well-known arborescent markings, its general lithology is identical. It is an extremely hard compact blue-hearted limestone with a buff-coloured cortex and a smooth sub-conchoidal fracture. It has a porcellaneous texture. On fractured surfaces the interior is seen to be greenish grey with dark blue-grey bands and patches probably representing carbonaceous material. It may be mentioned in this connection that the dissemination of bituminous material, by the bursting of bubbles rising through the soft sediment, from decomposing organic material below, has been suggested as an explanation of the dendrites in normal Landscape Marble. This is in accord with the conclusions generally held regarding the swamp-like conditions which obtained during the formation of this bed. Calcite-mud was probably precipitated in much the same way as the aragonite-mud, forming at the present time in the Bahamas Banks mangrove swamps.[3]

The limestone is slightly pyritic and pockets of limonite occur in the weathered cortex. Annelid borings in the bed indicate a halt in deposition during which the sediment hardened.

[1] XVIII. [2] VII.

[3] I.

*Confirmation of this has been obtained at time of going to press. Mr Kellaway has detected at the base of this bed an irregular band of much broken up material, which in places shows typical "False" or "Crazy Cotham" structure. The lower part is shelly and limonitic and there is a rough irregular undersurface. The upper part is grey and tends to merge into the overlying massive limestone. In places an irregular, but smooth, upper junction can be seen.

V. CORRELATIONS. (G.A.K.)

Of the previous workers who are mentioned in the introduction, only T. Wright[1] and L. Richardson[2] have published accounts of the adjacent section in the railway cutting which are of any assistance to us here. Wright's account is rather confused, though very useful in some respects, and when Mr Richardson visited the section it was badly overgrown so that he was only able to make out a few parts of the sequence. Briefly, Wright's account is as follows:—

At the top he describes 31 ft. 4 ins. of Lower Lias with *Psiloceras planorbis* and *Ostrea liassica* [beds a-f].

"g.	Beneath the preceding bed are 12-14 beds of limestone and shales or marl (a bed of limestone and a bed of marl alternatively). *Ostrea liassica*. *Modiola minima*, sparingly	12 feet	0 ins.
h.	Thin band of dark grit, containing scales and teeth of Fishes	0 feet	1½ ins.
i.	Dark grey shaly marl	4 feet	6 ins.
j.	*Upper Pecten-bed*; a dingy coloured pyritic limestone containing *Pecten valoniensis*, *Cardium rhæticum* and other shells undetermined	0 feet	2 ins.
k.	Grey marl	0 feet	2 ins.
l.	Band of limestone with Pectens and Gypsum	0 feet	2 ins.
m.	Dark marl	4 feet	0 ins.
n.	*Lower Pecten-bed*; a dark pyritic limestone containing *P. valoniensis* Defr., *A. contorta* Port. and *Anomya* sp.	0 feet	6 ins.
o.	Dark marls	3 feet	0 ins.
p.	Laminated shale	0 feet	3 ins.
q.	Dark marl	1 foot	9 ins.
r.	Stony band or impure limestone	0 feet	3 ins.
s.	*Coprolite-bed* (*Bone-bed*); teeth and scales, coprolites	0 feet	2 ins.
t.	Dark shaly marl	3 feet	6 ins.
u.	Band of stone	0 feet	8 ins.
w.	Dark indurated marl	2 feet	0 ins.
x.	Band of stone	0 feet	6 ins.
y.	Dark indurated marl resting on a pebbly conglomerate	3 feet	6 ins.
	Green Keuper Marls."		

This record has been quoted at fair length on account of its interesting information about certain outstanding horizons which are easily recognised from Wright's description.

Mr Richardson (*op. cit.*) recognises the following beds:—

5b.	"*Cardium cloacinum* Limestone with *Placunopsis alpina*, *Pt. contorta*, *Cardium cloacinum*, *Chlamys valoniensis*, *Protocardium rhæticum*, '*Isocyprina*' *ewaldi*	2 feet	0 ins.
	Shales, black	——	
15.	Bone bed	0 feet	6 ins.
16.	Shales, black, laminated: about	3 feet	0 ins.

Non sequence.

Marlstone, hard, yellowish green	1 foot	0 ins.
Marls and marlstones according to Bristow and Etheridge, about	37 feet	0 ins."

We suggest that the following table correlates, as far as is possible, the details given by these authors, with those which we have given above.

[1] XXI.
[2] XII, pp. 55-57.

	Our Details.	Details given by Wright.	Details given by Richardson.
	—	f-a.	—
	—	g. (pars ?).	—
20	—	g. (,,).	—
19	Cotham Marble (equiv.).	h. ?	—
18	—	g. (pars ?).	—
17	—		—
16	—		—
15	Suncracked Limestone.		—
14	*Naiadites* Limestone.		—
13	—		—
12	—	i.	—
11	Upper Pecten Limestone.	j. k. l.	5b *C. cloacinum* bed.
10	—	m.	—
9	Lower Pecten Limestone.	n.	—
8	—	o. p. q.	—
7	Bone-bed.	r. s.	15 Bone-bed.
6	Infra-Bone-bed Shales.	t.	16 Black Shales.
5	—	u.	Marlstone.
4	Grey Marls.	x. ? w. y. (pars).	—
3	Breccia Bed.	y.	—
2	Tea Green Marls.	Green Keuper Marls.	—
1	Red Marls.	—	—

Bed 19 of our record—the "Cotham Marble equivalent"—contains at the base a band, sometimes separated from it by a very thin marly layer of gritty limestone, which in places shows very good "False Cotham structure" and which contains vertebrate remains almost as abundantly as the *Ceratodus* Bone-bed (bed 7). Wright implies by his description that there is a bone-bed at the top of bed 12, but in the road cutting no trace of it can be found.

Another point of interest about Wright's section is that he records a "dark indurated marl resting on a pebbly conglomerate" (bed y) overlying his "Green Keuper Marls." This bed (y) therefore occupies a similar position to bed 3 of our record in relation to the Bone-bed, *viz.*, about 10 feet below it. As the Carboniferous Limestone mass of Bleadon Hill is approached, derived material appears to become more predominant at this level. This is to be expected, since the shore-line must have lain around the foot of the hill. In view of this fact, and the uneven nature of the top of bed 3, we are inclined to postulate a break in deposition as represented by a slight non-sequence between the Tea Green Marl (2) and the Grey Marls (4).

Mr Richardson suggests a non-sequence at the top of the Marlstone (5) overlying the Grey Marls (4). There is very little evidence of any such non-sequence in the road-cutting section unless a marly, brownish layer, between the Black Shale (6) and the top of the Marlstone (5), may be taken as indicating such a break. Should this non-sequence exist, and we are inclined to favour the idea, then the Rhætic section at Uphill is very similar to that seen at Lavernock on the opposite side of the Bristol Channel. The sequences at the two localities may be compared as follows:—

Uphill (K. & O.).[3]	Lavernock. (Details taken from work by Richardson[1] and Miskin[2]).
7 *Ceratodus* Bone-bed.	Bone-bed.
6 Black Shales.	
5 Marlstone or Limestone.	
4 Greenish Grey Marls with black shales.	Grey Marls with Marlstone.
3 "Breccia" bed.	Conglomerate.
2 T.G.M.	T.G.M.

Space will not permit of a detailed comparison of the Grey Marls of Lavernock (" Sully beds " of Mr Richardson) with bed 4 of Uphill, but they are very similar except for the absence of wavy lamination, indented surfaces, and fine-grained conglomerates such as characterise the Grey Marls of S. Glamorganshire according to F. F. Miskin.[2] The chief points of similarity are that both are barren palaeontologically and consist of greyish marls with marlstone bands and occasional seams of black shale. They are possibly similar in being unconformable to the beds above and below, in lying between the Bone-bed (or Infra-Bone-bed shales) and the Tea Green Marls proper, and in being separated from the latter by a conglomeratic bed.

Miskin has suggested that the Grey Marls of Lavernock should be referred to the Upper Keuper rather than to the Lower Rhætic.

Consideration has also been given to the possibility that bed 5 might be a sub-Bone-bed limestone such as the Wedmore Stone, but Mr Richardson's definition of the position of the latter and the absence of fossils militates against this view. The lack of direct palaeontological evidence renders it unsafe to dogmatise as in to which series these beds should be placed. We therefore divide the beds exposed at Uphill into the following divisions:—

RHÆTIC.	Upper Rhætic, beds [19-13], 7 feet 2 ins.
	Lower Rhætic, beds [12-6], 23 feet 3 ins.
?	Grey Marls, beds [5, 4 and 3?], 7 feet 3 ins.
TRIAS.	Tea Green Marls, bed [2], 33 feet 0 ins.
	Red Keuper Marls, bed [1], 90 feet 0 ins. (seen).

In Section III specific names were applied to some of the beds. We are anxious to state that we do not regard our Upper and Lower Pecten limestones, to take a concrete example, as being necessarily the chronological equivalents of similar beds which have been described elsewhere under the same name. This may be true over small distances, but conditions in Rhætic times must have varied greatly from place to place at the same period; and, in the absence of better zonal indices than long-range lamellibranchs the risk of correlating thin beds which are pro-

[1] X. [2] VIII.

[3] Suggested unconformities are shown by wavy lines.

bably lenticular, and merely facies deposits dependent for their formation upon the prevalence of certain physical conditions, is far too great.

If there is any level in the Rhætic rocks which supplies a reliable datum line for correlative purposes, the *Ceratodus* Bone-bed provides the most satisfactory horizon both lithologically and palaeontologically. Furthermore, if the generally accepted idea that the Bone-bed is a condensed deposit is correct, then additional strength is lent to this idea, for a deposit which is formed when ordinary sedimentation is at a minimum must be formed slowly, and hence the conditions governing its formation have time to establish themselves over a wide area.

To correlate Rhætic sections upwards from the base, and from evidence obtained by this means to prove that the Bone-beds seen at various localities are not the homotaxial equivalents of one another, is quite mistaken.[1]

The Cotham Marble horizon, too, is a most useful datum line, providing as it does a convenient dividing line between the Upper Rhætic and the White Lias (=*langportensis* beds). Unfortunately, the Cotham Marble cannot always be identified in exposures, and, indeed, was recognised with difficulty at Uphill, where it is impersistent and of the " Crazy Cotham " type.

We have drawn the line between the Upper and Lower Rhætic in our section at the top of the Black Shales, following the usual custom. There is no palaeontological evidence to support this here, since we have found no fossils in beds 12 and 13. The change from the black shale to the yellow marls is very sudden, and in this respect the beds differ from sections in the Bristol district, where the limestones and shales of the lower part of the Upper Rhætic are grey or greenish in colour, and are transitional from the black shales and dark limestones of the Lower Rhætic.

The discovery of " sun-cracked " limestone in the Upper Rhætic is interesting, as similar beds are developed in the Upper Rhætic in N. Somerset and S. Gloucestershire, only to a much greater extent.

APPENDIX.

By G. A. Kellaway.

The Distribution of *Ceratodus* in the British Rhætic Rocks.

The fossil teeth of *Ceratodus* must be familiar objects to all geologists who have visited Aust Cliff to collect from the famous Bone-bed found at the base of the Rhætic in that classical section; and as many of the localities at which *Ceratodus* has been found in the Rhætic are in or near Bristol, it was thought that a complete list of such exposures might prove of interest to the Society. A paper on this subject was published by Mr L. Richardson in 1906 where he also gives the

[1]XVII, see especially pp. 16-19, where Mr Tutcher gives a very valuable account of the Bone-bed based on well established evidence. XXII, pp. 30-35, " The Rhætic," by J. W. Tutcher.

first authentic record of the discovery of *Ceratodus latissimus* Ag. in the Bone-bed of Garden Cliff, Westbury-on-Severn, Glos.[1] This small communication is intended to be supplementary to the previously mentioned work to which, for fuller details, the reader is referred.

For the sake of completeness, however, all the localities mentioned by Mr Richardson are listed below; they are as follows:—

Somerset. Blue Anchor, near Watchet.
Holwell, near Frome.
Bristol. Redland.
Pylle Hill railway cutting.
Gloucestershire. Aust Cliff.*
Lilliput railway cutting, Chipping Sodbury.
Garden Cliff, Westbury-on-Severn.
Leicestershire. Spinney Hills, near Leicester.†
Nottinghamshire. Stanton-on-the-Wolds.
Glamorganshire. Penarth, near Cardiff.

To these records the following may be added:—

1. Charlton (Glos.), near Bristol: in the railway cutting. This specimen was discovered by Mr J. W. Tutcher after the publication of his paper on "The Strata exposed in constructing the Filton-Avonmouth railway."[2] From his "bed 21"—the "Bone-bed."

2. Uphill road cutting, near Weston-super-Mare (Som.). A small broken specimen was found by Mr K. P. Oakley in the summer of 1933: from the "Bone-bed," bed 7.

3. Wainlode Cliff, near Gloucester. A small specimen discovered in 1933 (G.A.K.): from the "Bone-bed" (Mr Richardson's "bed 15").

4. Barnston (Notts). Recorded by E. Wilson in the same paper as the Stanton specimen.[3] This locality is not included in Mr Richardson's list though the record was made by Wilson in 1882. The total number of localities thus becomes fourteen.

All the specimens recorded above may be referred to *C. latissimus* Ag.

It may safely be said that in every one of these cases *Ceratodus* is restricted to one horizon, which may be a bed only a few inches thick but which is the principal bone-bed in the section. It has been satisfactorily demonstrated that for the Bristol district the *Ceratodus* Bone-bed is a continuous stratum of fairly constant age (see J. W. Tutcher, *op. cit.*). The same may possibly be true of the *Ceratodus* bed elsewhere, taking it over small areas, though it might be dangerous to say that,

[1] XI.

*Dr F. S. Wallis writes *in litt.*:—"There are about 380 specimens of *Ceratodus* in this museum [Bristol] . . . all . . . [of them] . . . are from Aust." The famous Higgins collection forms the nucleus of this fine series.

†Mr H. H. Gregory of Leicester Museum kindly informs us on the authority of Mr A. J. S. Cannon, that though *Ceratodus* has been found in the Spinney Hills near Leicester, it has never been found in the well-known section at Glen Parva brickworks.

[2] XVII.

[3] XIX, p. 453.

to take an extreme case, the *Ceratodus*-bearing beds of Barnston (Notts.), and Blue Anchor (Som.) were of exactly the same date.

Besides *Ceratodus* there is one other fossil which seems to be associated with the "Bone-bed" and which may possibly be of zonal importance. This fossil is *Mytilus cloacinus* Tutcher, 1908 (*op. cit.*), which has so far been found only in the *Ceratodus* "Bone-bed" of Aust and Charlton, and in the Bone-bed of Sedbury.

The authors wish to record their gratitude to Dr F. S. Wallis and Mr J. W. Tutcher for the assistance they have rendered, and to Professor W. B. R. King and Professor A. E. Trueman for constant help and advice.

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	Reed, F. N.	18 Stackpool Road, Southville, Bristol	*B.F.G.*
	Reed, W. N.	18 Stackpool Road, Southville, Bristol	*F.G.*
*	Reynolds, S. H., Sc.D., F.G.S.	13 All Saints' Road, Clifton, Bristol, 8	*G.*
	Richards, G.	Pensylva, Cecil Road, Weston-super-Mare	*F.G.*
	Richardson, Frank	15 Percival Road, Clifton, Bristol, 8	*G.*
*	Roper, Miss I. M., F.L.S. ...	176 Chessel Street, Ashton Gate, Bristol, 3	*B.E.F.O.*
A.	Rose, Miss P. M.	Oaklands, Grange Court Road, Westbury-on-Trym, Bristol	*B.F.*
	Rudge, Miss D. M.	6 Elgin Park, Bristol, 6	
	Rudge, Miss E. L.	6 Elgin Park, Bristol, 6	
	Rutter, Miss E. M.	Cambridge House School, St. John's Road, Clifton, Bristol, 8	*B.*
A.	Salmond, P. W.	20 Tyndall's Park, Clifton, Bristol	*F.G.*
	Salmond, Mrs.	20 Tyndall's Park, Clifton, Bristol	*F.G.*
	Sampson, Miss D.	5 Hatherley Gardens, Crouch End, London, N.8	
	Sanders, Miss L. M.	Redroofs, Downs Cote Park, Westbury-on-Trym, Bristol	*F.*
*	Sandwith, Mrs.	26 Canynge Square, Clifton, Bristol, 8	*B.*
	Savory, J. H.	Windyridge, Abbots Leigh, near Bristol	*O.*
J.	Scase, R. P.	Wills Hall, Stoke Bishop, Bristol	*O.*
	Selley, A	116 Coronation Road, Bristol	*G.*
	Shaw, Miss T.	12c Kingsdown Parade, Bristol, 6	*B.F.G.*
A.	Shield, E. H.	78 Sefton Park Road, Bishopston, Bristol, 7	*F.*
	Shilstone, H. C.	124 Victoria Avenue, Redfield, Bristol, 5	*F.G.*
A.	Shrimpton, D. F.	172 Brynland Avenue, Bishopston, Bristol, 7	*B.*
*	Skene, Macgregor, D.Sc., F.L.S.	The University, Bristol	

	Smith, H. G., B.Sc.	Zoological Dept., The University, Bristol	
A.	Smith, Miss N. G.	36 Henley Grove, Henleaze, Bristol	*O.*
	Smith, Stanley, M.A., D.Sc., F.G.S.	The University, Bristol	*G.*
A.	Smith, Mrs. W.	Greenhills, Redcliffe Bay, Portishead	*F.*
	Statton, A. G.	2 Auburn Road, Redland, Bristol, 6	
A.	Strudwick, Miss F. E.	26 Woodstock Road, Redland, Bristol, 6	*F.*
	Sully, H. T.	Elmside, Julian Road, Stoke Bishop, Bristol, 9	*F.*
	Tarring, E.	3 Narrow Wine Street, Bristol, 1	*B.*
	Taunton, W. C.	36 Egerton Road, Bishopston, Bristol, 7	*E.O.*
	Taylor, Miss E. M.	29 St. Oswald's Road, Redland, Bristol, 6	
A.	Taylor, R. J.	12 Claremont Avenue, Bishopston, Bristol, 7	*F.*
	Taylor, W. R., M.A.	12 Pembroke Vale, Clifton, Bristol, 8	*E.O.*
	Tetley, H., B.Sc., F.Z.S....	4 The Avenue, Sneyd Park, Bristol, 9	*E.O.*
	Tetley, Mrs.	4 The Avenue, Sneyd Park, Bristol, 9	*O.*
*	Thompson, H. S., A.L.S. ...	11 Buckingham Place, Clifton, Bristol, 8	*B.F.*
	Tombleson, F. B.	Shirley, Briercliffe Road, Westbury-on-Trym, Bristol	*F.G.*
	Trueman, A. E., D.Sc.	The University, Bristol, 8	*G.*
	Tuckett, R. C.	5 Beaufort Buildings, Clifton, Bristol, 8	
	Turner, H. W., M.A., F.G.S.	The University, Bristol, 8	*G.*
	Turner, Mrs. H. W. (1935)	Mortimer House, Clifton, Bristol, 8	
*	Tutcher, J. W., M.Sc.	57 Berkeley Road, Bishopston, Bristol, 7	*F.G.*
	Vizard, Miss E. M.	25 Logan Road, Bishopston, Bristol, 7	*B.*
	Waight, Miss M.	14 Osborne Avenue, Ashley Down, Bristol, 7	
	Walker, L. E.	5 Crowndale Road, Knowle, Bristol, 4	*F.*
*	Wallis, F. S., D.Sc., F.G.S.	1 Alma Road, Bristol, 8	*F.G.*
A.	Warne, Miss	156 Coldharbour Road, Bristol	*B.*
	Webb, H. Vicars	58 Belmont Road, St. Andrew's, Bristol	*F.*
	Westcott, Miss M. V.	20 Linden Road, Redland, Bristol, 6	*F.*
	White, E. Barton, M.D., F.E.S.	Mental Hospital, Fishponds, Bristol	*E.*
	White, Mrs. E. Barton	Mental Hospital, Fishponds, Bristol	*E.*
†	Wills, W. Melville	Bracken Hill, Leigh Woods, Bristol	
A.	Woolcott, J. W.	The Wabe, Hill View, Henleaze, Bristol	*F.*

A.	Woolcott, Mrs.	The Wabe, Hill View, Henleaze, Bristol	*F.*
A.	Wynne-Edwards, V. C., B.A.	McGill University, Montreal, Canada	*O.*
	Yonge, C. M., D.Sc.	The University, Bristol	

Honorary Members.

C. Lloyd Morgan, LL.D., F.R.S., F.G.S., 79 Pevensey Road, St. Leonards-on-Sea.
R. M. Prideaux, F.E.S., Brasted Chart, near Sevenoaks, Kent.
H. S. Hele Shaw, M.I.C.E., LL.D., F.R.S., 64 Victoria Street, Westminster, S.W.1.
W. J. Sollas, M.A., LL.D., F.R.S., F.R.S.E., F.G.S., University Museum, Oxford.
Sydney Young, D.Sc., F.R.S., The Ferns, Stoke Bishop, Bristol, 9.
Sir Ernest Cook, D.Sc., 40 Alma Road, Clifton, Bristol, 8
H. Womersley, F.E.S., 36 Wattle Street, Fullerton Estate, Adelaide, S. Australia.

REPORT OF COUNCIL

TO DECEMBER 31st

1934

THE past year has been one of great importance and anxiety to the Society. After long previous discussion a grand re-organisation scheme of membership has been carried out and has proved successful. Through this scheme, not only has the financial position of the Society been improved but the various Sections, which were formerly very slenderly attached to the Parent Society and were, with one exception, non-contributory to it, have become actual parts of the Society. Every sectional member is now either a full member or an associate of the Parent Society. Many former associates have become full members and a still larger number of sectional members have become associates, besides belonging to one or more Sections. Under the new scheme the Society proper has thus been strengthened both in numbers and income, although the Sections have, as was to be expected, suffered slightly for the present through the loss of members who desired to pay only the very small sectional subscription.

The successful year has been saddened by the death of the Society's President, Professor O. V. Darbishire. Only those who have had the privilege to work on the Council with him can fully realise how deeply at heart the late Professor Darbishire always held the welfare of the Bristol Naturalists' Society and how much labour he expended on its behalf. To his clear thought, wise planning, and ceaseless energy we owe in large measure the present successful re-organisation of our body at a crisis when difficulties were great and disaster might easily have ensued ; he gave ungrudgingly of his time to this end. Always anxious that knowledge should be accessible to all desiring it, he made our new scheme so comprehensive that the young receive special favour under it and the chief benefits of the Society are still obtainable at the lowest subscription upon which the body can continue its work. Beyond Bristol University and our own Society the helpfulness of Professor Darbishire was ever at the service of naturalists, especially throughout the South-West of England, and he was Hon. Treasurer to the South-Western Naturalists' Union, with which we are affiliated, while, through the Bristol Kyrle Society, he endeavoured to bring the cheering and refining influence of growing plants into some of the poorest and most dismal districts of Bristol. Our Society was represented at the funeral by Dr. F. S. Wallis, Miss M. D. Hiley, Mr. F. W. Evens and Mr. H. Tetley. The Secretary (Miss I. M. Roper) was unable to attend because of illness.

The Seventh Annual Dinner in February was again very well attended and appreciated. The Lord Mayor and the Lady Mayoress honoured the gathering by their presence, and the Lord Mayor and the President, the late Professor O. V. Darbishire, made interesting speeches with reference to the natural history of the neighbourhood and the happy situation of Bristol for such study. Mrs. H. W. Turner, Miss M. Jeffcoat, and Mr. Ivor Evans, entertained the company later with an excellent programme of songs and recitations.

The Summer Field meeting was at Malmesbury and (by kind permission of the Earl of Suffolk, per Mr. F. J. Bates, J.P.) Braydon Pond. It was excellently attended and the arrangements, which were, as usual, carried out by the officers of the Field Section, were admirable. The Fosse Way and Malmesbury Abbey added points of archæological interest. Local naturalists met the party at Braydon Pond and gave interesting information regarding the fauna and flora and the historical and general features of this great sheet of water and the surrounding forest.

Members of the various Sections provided a fine and varied display of exhibits for the Exhibition Night in October. Beautiful minerals shown by the Geological Section attracted special attention whilst the Botanical Section showed an exhibit of 30 aromatic plants besides collections of local wild flowers and of ornamental fruited shrubs. The Ornithological Section exhibited some beautiful photographs of bird-life.

The Open Lecture on Nov. 1st was delivered in the Museum Lecture Theatre by Prof. A. E. Trueman, D.Sc., who spoke on the History and Geography of some Common Stones, and gave a most lucid and interesting account of chalk and of still more local rocks. It is to be regretted that these Open Lectures are not better attended.

Early in the year the British Empire Naturalists' Association (B.E.N.A.) was contemplating a local branch in Bristol but, on learning that its activities would clash with our work, very kindly withdrew the suggestion, and many of our members joined as individual members.

Miss Roper has resigned the editorship of the *Proceedings*, and the Council has made a very satisfactory choice in asking Mr. H. W. Turner to take her place.

In order to bring about closer co-operation between the Parent Society and its Sections, an arrangement has been made by which each Section offers during the winter one meeting open to the Parent Society. These open meetings are additional to the general meetings of the Society. It is too early yet to tell if the venture will be a success, but these special meetings have proved of great interest and acquaint members generally with the work and attractions of each individual Section.

The Sheriff of Bristol, T. H. Davies, Esq., has been for a number of years a member of the Bristol Naturalists' Society. Congratulations were sent to him by the Society upon the honour conferred upon him.

THEODORA SHAW, *Hon. Reporting Secretary.*

The Hon. Treasurer in Account with the Bristol Naturalists' Society.

Dr. RECEIPTS AND PAYMENTS ACCOUNT FOR THE YEAR ENDING 31ST DECEMBER, 1934. *Cr.*

1933 £ s. d.		£ s. d.	£ s. d.
	To Members' Subscriptions :—		
4 0 0	Ordinary. Arrears from 1933	10 0	
47 10 0	,, 1934	54 15 0	
2 10 0	,, In advance 1935 ..	3 0 0	
1 5 0	Associate. 1934	15 10 0	
	Junior. 1934	15 0	
			74 10 0
12 0	Field Section : Capitation Fee		
	,, Subscriptions to Sections received by Treasurer (per contra)		11 5 0
	,, Members' Donations to Book-binding Fund		1 0 0
			86 15 0
9 12 6	,, Donations to Publishing Fund		5 0 0
1 0 0	,, Geological Section		
2 17 6	,, Sales of Publications		4 11 0
18 19 6	,, Sales of Dinner Tickets		19 10 6
1 18 11	,, Interest on Deposit		2 5 3
119 9 8	,, Balance from last Account		114 4 1
213 15 1			£232 5 10

1933 £ s. d.		£ s. d.	£ s. d.
	By Subscriptions :—		
1 1 0	Ray Society	1 1 0	
2 10 0	Zoological Record (Vol. 70) ..	2 10 0	
1 2 0	S. W. Naturalists' Union, 1934	18 0	
			4 9 0
52 4 6	,, Cost of Proceedings, 1933		46 7 6
10 9 6	,, Printing, Postages, etc...		9 5 1
9 14 0	,, Lecture Expenses		1 19 0
1 11 0	,, Rent and Fire Insurance		1 11 0
16 16 6	,, Dinner Expenses		16 12 5
1 10 6	,, Book-Binding		1 0 6
2 12 0	,, Geological Magazine		
	,, Subscriptions to Sections paid over by Treasurer (per contra)		11 5 0
114 4 1	,, Cash at Bank		139 16 4
213 15 1			£232 5 10

Bristol, 16th January, 1935.

F. W. EVENS, *Hon. Treasurer.*

Audited and found correct.

ERNEST H. COOK,
CHAS. BARTLETT, F.C.A. } Auditors.

LIBRARIAN'S REPORT,

FOR THE YEAR 1934.

THE re-organisation of our Society has rendered its extensive library open to many more readers, all members and associates having liberty to use it during the hours the Museum and Art Gallery is open and also to borrow volumes from it for home-reading. This privilege is scarcely fully recognised as yet by the new entrants into the Parent Society, so the increasing use of the library should make further advance.

The book-binding fund has received two small donations. This fund sadly needs adequate help, as many periodicals should be bound both for their better preservation and also for convenience of research or reading. Funds are also required for the purchase of more newly-published books.

The Ann Arbor General Library of the University of Michigan purchased from us some copies of our *Proceedings* to fill gaps in their set.

The re-issue in a modified form of Dr. A. Vaughan's classic paper on the Avon Gorge is under consideration by the Publication Committee, Professor Reynolds being willing to prepare the paper for publication.

The Countryside, the quarterly magazine of The British Empire Natural History Association, has been added by purchase to the library.

The following books have also been added to the library and cordial thanks are given to the donors :—

Matthews, L. H., M.A. " The Marine Deposits of the Patagonian Continental Shelf," reprint from " The Discovery " Report, 1934, presented by the author.

" The One Hundredth Annual Report of the Bootham School Nat. Hist. and Lit. Society," 1934, presented by Mr. H. S. Thompson.

Presented by Miss D. Marshall :—

Crabtree, J. H. " Wonders of Insect Life " (undated).
Fabre, J. Henri " The Hunting Wasps," 1916.
Pycraft, W. P. " Camouflage in Nature," 1922.
Pycraft, W. P. " Birds in Flight," 1922.
Bolus, L. " Nature Notes " (Nos. 1-12), 1923.
Two incomplete volumes of " The Country-side."

Presented by Miss Morley :—

Beetham, Bentley, F.Z.S. " Photography for Bird Lovers," 1911.
White, Gilbert. " Natural History of Selborne," edited by Grant Allen. 1898.
" Palaeontographical Society," Vol. lxxxvi, 1932, presented by Geological Section.

THEODORA SHAW, *Hon. Reporting Secretary.*

BOTANICAL SECTION,

1934

THE reconstitution of the Parent Society was well supported by the Botanical Section, for although nearly half of the members were sectional subscribers only, the number of resignations has been very low. In addition, four new members have been elected.

Eleven meetings were held in the Botanical Library of the University, but, instead of continuing with exhibits at the winter meetings, the procedure was followed again this year of having a paper each month.

Mr. L. C. Luckwill read a paper on " Xerophytism " at the January meeting, and dealt both with the adaptations shown by plants for reducing transpiration and also for storing water. The paper was illustrated by means of photos, diagrams and microscope slides.

On February 19th, Mr. H. S. Thompson contributed a paper on " Medicinal Plants." A short history of Botany was included, as flowers and plants were first studied for their medicinal values.

" Conifers " were very ably dealt with by Mrs. Bell at the March meeting, and illustrated by leaves and cones of a large number of species.

Miss Pratt gave a paper on " Medical Herbalism in Modern Practice " on April 16th. The history and practice of Herbalism were first explained, and then Miss Pratt mentioned many plants used for specific complaints. Questions on the preparation of the medicines were asked at the conclusion of the paper.

Throughout the summer the meetings were devoted to discussions of exhibits and other points of botanical interest.

In October, the first of the Open Sectional meetings was held, to which all members of the Society were invited. Thirty-one members were present, of whom seven did not belong to the Botanical Section. A number of short papers were given as follows :—

Mr. Luckwill : Notes on Dogwood, Ivy, Clematis, Wayfaring Tree, Bartsia and Rhytisma.
Miss Grignon : Plants found within a radius of One Mile of the Tramways Centre, Bristol, and at Avonmouth.
Miss Pratt : Common Plants of Medicinal Value.
Mr. Hudson : Weeds.
Mr. Thompson : Geographical Distribution of Plants.

The Section sustained a great loss by the death of Professor O. V. Darbishire in October. Professor Darbishire had been President of the Section since it was started in 1925, and has, at all times, given both encouragement and material help to the members.

In order that the Botanical Notes which formerly appeared in the *Proceedings* may be brought up to date, members are asked to record carefully the locality and time of flowering of any new or uncommon species, together with any other notes which might prove to be useful, and to give them to Mrs. Sandwith.

F. F. GLASPOOL, *Hon. Secretary and Treasurer.*

ENTOMOLOGICAL SECTION, 1934

SEVEN meetings have been held either at the Bristol Museum or at members' houses during the year. There have been two resignations with no accessions in membership, reducing the number of members to fourteen.

January 24th. Annual Meeting. Mr. Charles Bartlett F.R.E.S., was re-elected President and Honorary Secretary; to the latter office through the resignation of Mr. J. V. Pearman owing to pressure of other duties. Mr. Pearman had held the position for the last eight years and a vote of thanks was passed to him for his valued services and hospitality, the meetings having been held on many occasions at his house.

The President exhibited foreign examples and gave notes upon species of Lepidoptera which were rare and casual visitors to this country.

February 14th. Messrs. M. J. L. Davis and A. H. Peach read papers giving their experience of collecting in the New Forest, and the unanimous opinion was expressed that the Forest had seriously depreciated, largely owing to the regrettable firing, grazing, drainage, planting of Scotch firs and foreign conifers, and interference generally, with unfortunate results to the flora and fauna.

March 31st. Miss I. M. Roper gave a paper upon " Coleopterous Galls " and Mr. C. Edwards read a paper upon the " Metamorphoses of Insects."

April 18th. Mr. H. Tetley read a paper upon " Locusts and their Migrations " illustrated by examples.

October 9th. Mr. J. V. Pearman gave notes upon " Psocidæ." He has completed reports on African Psocoptera for the Imperial Institute of Entomology, and on Ceylon species for the Imperial College of Science, both of which have been published in " Stylops." He also records *Liposcelis brunneus* Motsch and *Embidopsocus enderleini* Rib., both from Camberley, 13th Sep., 1934. Mr. J. W. Norgrove gave notes on trips to Tintern, Brockley and Wicken Fen, illustrated by specimens, and Mr. H. Audcent described his holiday visit to France, with special reference to Diptera.

November 13th. Dr. E. Barton White gave notes upon his visits this year to Wicken Fen and Margam, and his extensive collection of Lepidoptera was inspected and gave much pleasure. Exhibits included a pair of chocolate coloured *Vanessa c. album* from Oxford, and remarkable aberations of *Arctia Caja* and *Callimorpha dominula.* Mr. A. Kromler read a paper upon his collecting experiences in September at Bitterwell.

December 11th. Mr. H. Audcent's collection of 2,500 species of Diptera (one of the best in the country) was open to inspection, together with books, apparatus, etc., which were explained. Mr. Audcent has contributed an article on British Lariopeidæ (Diptera) to the Transactions of the Society for British Entomology, November, 1934, illustrated by four plates drawn by his son, Mr. J. Audcent, and has read through on behalf of the author, the large and exhaustive work by M. Seque on the " Faune de France," Diptera.

The B.N.S. *Proceedings* issued this year (for 1933) contains Part VI of Mr. Audcent's Bristol Insect Fauna, Diptera.

Exhibits have been very numerous at every meeting and the following deserve mention :—

Lozophora beatricella Wals. (*Tortricidæ.*) One specimen, captured at Steep Holm 28th May, 1933, by Mr. C. Bartlett, new to Somerset and not recognised out of England and only known to occur in four Eastern counties.
Leucphasia sinapis v. garnarew, Wye Valley, and *Sesia culiciformis*, Osborne Road, Clifton, by Mr. M. J. L. Davis.

The Bristol Museum would welcome specimens of insects taken in Gloucestershire and Somerset, with full data; the members of this Section have promised their support to this object.

It is remarkable that in a City of the size of Bristol, with such good country within easy access, there are so few entomologists; except in the cases of the Orders Lepidoptera, Diptera, Coleoptera and Psocoptera, practically nothing is being done, and students are urgently wanted to take up the other great orders, Hymenoptera (Fourwinged flies), Neuroptera (Dragonflies, etc.), Orthoptera (Grasshoppers, etc.) and Hemiptera (Plant bugs, etc.).

CHAS. BARTLETT, *President and Hon. Secretary.*

FIELD SECTION,

1934

THE year has been an experimental one in so far that it has inaugurated a completely new scheme of membership, one of the essential features being that persons must be members of the Parent Society as well as of the Section. Observation on the effect of these new principles is still in progress ; inference would be difficult and premature at the present stage. In spite of the fact that nine members have been elected during the year, the membership now stands at 89, a nett reduction of 12. In a period of flux such a reduction is only to be expected and many " Sleeping members " have naturally resigned.

In common with the Parent Society, the Section has suffered a staggering blow in the death of an ex-President, Prof. O. V. Darbishire. His long experience, wise counsel and inspiration were always available to the Committee and his essentially " Field " outlook was one that the Section could ill afford to lose.

At the Annual Meeting, Dr. F. S. Wallis and Mr. G. H. Beacham were re-elected President and Vice-President respectively. Miss T. Shaw continued to serve as Hon. Treasurer and Miss M. D. Hiley as Hon. Secretary. Several members spoke on some of the problems connected with the field work of the previous summer and the President stressed the principle of continuity in nature. He said that the idea of continuity should permeate and indeed had permeated all the meetings of the Field Section. The members should be keen to assimilate knowledge from various specialists and then link the facts together into one continuous whole—the natural history of the Bristol District. The area of Broadfield Down was chosen as the special district for investigation during the summer, and your Section is indebted to Messrs. Charles Bartlett, H. Vicars Webb, H. Stuart Thompson and the President for their concise notes.

In May, Mr. Ivor Evans led a party through Bourton Combe and over Backwell Common. The geologists were specially interested in the quarry at the entrance to the Combe, whilst the botanists noticed the spring foliage in the many varieties of trees in this area.

Mr. and Mrs. H. F. Barke were the leaders of a meeting in July to explore Goblin Combe. Before tea, the flora, fauna and rocks of the Combe were investigated, whilst, during the evening, a climb to the top of Cleeve Toot was interesting owing to the exceptional visibility.

In September, Mr. G. E. J. McMurtrie arranged an attractive meeting in the Wrington area. The meeting included much of archæological interest and the members were also interested in the fossils and rock structures to be found in the classical Wrington quarries.

Despite adverse weather conditions in October, members concluded this preliminary survey of an intensely interesting and compact area with an investigation of Brockley Combe. Mr. Beacham made a special feature of the ecological factors involved in the association of trees and undergrowth, and the co-leader, Mr. Barke, discussed the formation of the dry limestone valleys.

As in recent years, the Annual Field Meeting of the Society was held under the direction of this Section. In June, a large party of members and friends visited the neighbouring county of Wiltshire, and Malmesbury and Braydon Pond gave excellent scope for archæological and natural history activities. Mr. H. O. Edmonds pointed out the need for more detailed investigation of Fosse Way, the Rev. Bertram Lamplugh gave a concise history of the famous church at Malmesbury, and Messrs. E. N. Tuck, M.A., A. V. Hinwood, R. Maundrell and G. A. Kellaway supplied many interesting details regarding the natural history of the Braydon Pond area.

Mr. H. Vicars Webb again helped the Section and supplies the following notes regarding the meetings devoted to Ornithological studies :—

Wednesday, April 25th. The first evening ramble from Filton to Stapleton marred by weather, but some good observations made at the Duchess Pond, where a Swan and Coot were nesting together on the islet. Little Grebes, Water Hens, two pairs of Mallard, and two Swallows seen. The migrant Willow Warbler heard. Blackbirds in splendid voice. Party of nine members.

Saturday, May 5th. A party of fifteen for the Pensford district. A sunny afternoon, but birds did not seem inclined to sing. Migrants heard or seen included a Willow and Chiff-Chaff Warblers, Swallows, House Martins, and a Swift. In Lord's Wood, Marsh Marigolds and Anemones in profusion. A short time spent in Publow Church, its tower a fine example of the Somerset type.

Wednesday, May 16th. A party of thirteen for Leigh Woods. The extended portion for the public is an attractive one for bird life, trees, plants and flowers. A good opportunity for comparing the songs of Blackcap, Willow and Wood Warblers. No Cuckoo or Nightingale heard. Blue Hyacinths made lovely scenes at various spots.

Saturday, May 26th. A combined excursion for bird life and botany. Twenty-two members assembled at Bath and took the car for Bathford, and then walked the three miles through the charming woodland scenery of the Warleigh Manor Estate. Migrant and resident songsters in splendid voice all the afternoon and evening. While the party were having tea at a Conkwell cottage, the songs of Blackcap, Blackbird and Willow Warblers were kept up incessantly. A male Cuckoo heard. The botanists, led by Mr. Ivor Evans, had an excellent time with many interesting and rare plants. The Limpley Stoke Valley scenes much enjoyed. Party separated at the Aqueduct to return into Bath by devious ways.

Wednesday, June 6th. A party of thirteen met at Westbury for Blaise Castle Woods and Kingsweston Down. No outbursts of songs, but migrants and others gave sweet melodies now and again. The full glory of June foliage very beautiful. Near the lawns of Blaise House, fine groups of Rhododendrons have been cultivated. Further observations of birds made before party separated near Shirehampton.

Mr. Ivor Evans was very successful with the specialised botanical meetings and reports as follows :—

Saturday, April 28th. Tockington. 32 members present. With the kind permission of Mrs. E. C. Turner of Old Down, Tockington, members were able to view her wonderful gardens and rockeries. Rare and interesting plants were explained by Mrs. Turner who personally conducted the party. Thanks from all members were expressed and responded to by the owner.

Saturday, May 26th. Warleigh Woods—see Mr. Vicars Webb's notes. Observations were made in Woods and on Canal Banks, where were displayed several notable aquatics ; the following plants were also noted : Evergreen Alknet, Comfrey, Butcher's Broom, Wild Garlick, Yellow Fumitory, Mare's Tail.

Saturday, June 9th. Tickenham. 14 members present. Route was taken from Backwell Station, crossing moors to Cadbury Camp, returning through woods to Clevedon. The following plants were noted : Water Veronica, Water Plantain, Hound's Tongue, Fennel, Fig Wort, Water Mint, Greater Mullein, Yellow Rattle, Fumitory, Small Leaved Lime, Medlar, Oak (species), Birch, Rhododendron, etc.

Saturday, July 7th. Wick district. 10 members present. Bus to Golden Valley. Wick Rocks examined and the following plants noted : Stonecrop Species, Cow Wheat, Teasle, Thistle (various), Vervain, Water Forget-me-Not, Aquatic Species of Plants, and Local Trees.

M. DORIS HILEY, *Hon. Secretary.*

GEOLOGICAL SECTION,
1934

DESPITE big changes in conditions of membership, our numbers have remained constant. Resignations only number four, against five new members, and the present roll is sixty.

We continue to subscribe to the *Geological Magazine*, and circulate it before placing it in the library.

At the last Annual Meeting, Professor Reynolds and Mr. H. F. Barke were re-elected President and Vice-President respectively; Dr. F. S. Wallis retired, after **13** years' arduous service, from the Hon. Secretaryship, and Mr. H. C. Shilstone was elected in his stead; Mrs. H. F. Barke continued as Hon. Treasurer, and Mr. G. McMurtrie as Hon. Auditor; the following formed the new Committee: Mrs. A. Marsden, Dr. S. Smith, Prof. A. E. Trueman, Dr. F. S. Wallis, Mr. G. A. Kellaway and Mr. J. W. Tutcher. At the close of the Meeting the University Spelæological Society were " At home " to us in their Museum.

In February, Prof. S. H. Reynolds lectured to us on Pleistocene Deer. He pointed out the differences between them, especially as regards antlers and feet-bones. Several fine pairs of antlers, kindly lent by the City Museum authorities, were on view.

At our March meeting, Dr. Stanley Smith read his paper on the " Geology of the northern part of the Tortworth Inlier." This paper was of much interest in view of Dr. Smith's remarkable discovery of Cambrian strata in the Breadstone district. Mr. G. A. Kellaway followed with an interesting paper on the " Rhætic rocks of Uphill," and described a new exposure there, and correlated the strata with other Rhætic rocks.

During the Summer Session, three Sectional Field Meetings took place :—

In April, Prof. A. E. Trueman conducted a party to the site of the new great reservoir under construction at Cheddar in the Keuper Marls.

In June, Dr. S. Smith and Prof. Reynolds took us to examine the site of the bore-hole recently sunk at Portishead for water in the Old Red Sandstone and Lower Carboniferous Limestone, and to see the core obtained.

In September, Mr. H. F. Barke took us to inspect the well-known Oolite quarries and mines at Box and Corsham, and we penetrated a mile and a half into the heart of the Hill.

In October, Dr. F. S. Wallis opened the Winter Session with a lecture on " Geology and the Citizen." This lecture indicated the general lines upon which the larger provincial Museums, such as those of Bristol and Cardiff, are working in presenting Geological Science to the public. At the close, Prof. Trueman spoke of the complete neglect of the simplest teaching of Geology in our schools, and Mr. Shilstone pointed out that not a single Evening Class is held this winter in Geology or Mineralogy in Bristol.

At our November meeting, Mr. G. A. Kellaway gave a paper on " The Lower Lias of Burnett and Keynsham." His research work was confined to the Lias, which lies there unconformably on the Coal Measures.

Lastly, it is pleasant to record that early in the year, Prof. A. E. Trueman, D.Sc. was awarded a Gold Medal by the South Wales Institute of Engineers for his paper, " A suggested correlation of the Coal Measures of England and Wales." This senior award is not an annual event, but is reserved for work of peculiarly outstanding merit. It is of interest to note that this is the first occasion on which the award has been made to a worker in the field of pure Geology.

HY. CUTHBERT SHILSTONE, *Hon. Secretary.*

ORNITHOLOGICAL SECTION,

1934

SEVEN meetings have been held this year, and a visit to Steep Holm took place in May.

Miss A. Morley, in January, gave a full description of " Bird Life on Clifton Down," a paper which was later enlarged and published in an excellent little book with the same title. The Rev. F. L. Blathwayt, in March, gave a valuable account of " Some changes in Somerset Ornithology " and outlined the striking alterations that have taken place in recent times. In October, Mr. H. H. Davis read a paper on " Some interesting Waders of the Bristol district, 1933—34." To go further afield, Mr. F. L. Vanderplank described the " Birds of Geneva," Mr. J. H. Savory " Bird-life in Holland " and, lastly, Mr. B. W. Tucker came from Oxford to give a very useful lecture on " Heligoland as an Ornithological Observatory."

On the visit to Steep Holm on 26th May, 1934, members of the Section were able to confirm the nesting of the Cormorant on this island, this being the first definite record for Somerset ; ten nests were seen, all on the north side.

The Iceland Gull, previously seen in the Bristol district, has continued its stay and has now been in this neighbourhood for over two years. It is quite unusual for an Arctic Gull to stay so far south for so long, and full advantage has been taken of its presence in noting the changes of plumage through which it has passed. This information has been summarised in a paper published recently in *British Birds.*

Other notes have been published in the same magazine, and several members contribute fully to the Annual Report on Somerset birds.

There has been some decrease in membership as a result of the re-organisation of the Society, but the great majority of members have joined under the new regulations.

H. TETLEY, *Hon. Secretary and Treasurer.*

Account of the Annual and General Meetings.

THE 71st ANNUAL MEETING.

January 18th, 1934.

Prof. O. V. Darbishire, M.A., Ph.D., F.L.S. was elected President, and Dr. F. S. Wallis, F.G.S., a Vice-President; Mr. F. W. Evens, F.I.C. was elected Hon. Treasurer, and there were minor alterations in Council. Revised rules as to membership and finance were passed by a two-thirds majority of members present. The retiring President, Dr. F. S. Wallis, delivered his Annual Address entitled " Science and the Community," (see p. 417).

THE 570th GENERAL MEETING.

February 1st, 1934.

THE 7th ANNUAL DINNER.

The President, Prof. O. V. Darbishire, presided over a company of seventy-five members and friends, and an enjoyable evening was spent. When the loyal toast had been honoured, the President proposed " The City and County of Bristol," and expressed great satisfaction that the Lord Mayor of Bristol, Councillor F. C. Luke, and the Lady Mayoress were the guests of the evening. The President described the city as an ideal centre for Natural History pursuits, but the Bristolian is so accustomed to seeing Nature in its many phases on our Downs or in Leigh Woods that he does not appreciate his good fortune. In a northern manufacturing city, like Manchester, for instance, where scarcely a blade of grass can be seen anywhere, the populace are only too anxious to go to the countryside to see for themselves the beauties of Nature, and, as a result, their Natural History Societies always seem to be in a flourishing condition, whereas we find a serious difficulty in filling our ranks.

In replying to the toast, the Lord Mayor said it was delightful to find a body of people who appreciated what Bristol had to offer. Many visitors volunteered stern criticism of this " Uninteresting City " when they had probably only seen it from the vicinity of Temple Meads Station; and yet there were few cities which were able to cater for such a multiplicity of tastes as Bristol.

An excellent programme of songs and recitations was contributed by Mrs. H. W. Turner, Miss M. Jeffcoat and Mr. Ivor Evans.

THE 571st GENERAL MEETING.

March 1st, 1934.

" Nature and Life of Corals," by Prof. C. M. Yonge, D.Sc.

Corals may most easily be described as sea anemones which have the power of forming very strong calcareous skeletons, of which the greater part of coral reefs are composed. Like anemones, they are carnivorous, feeding on the minute animals in the sea which they catch by means of long tentacles armed with " Sting cells." The surface of the body is kept clear of falling mud, etc., by means of fine, vibratile hairs, called cilia, the beating of which creates water currents which cleanse the body. These cilia may also assist in feeding.

The bodies of all reef-building corals contain vast numbers of minute plants. These are passed from one generation to the next by way of the eggs. The plants obtain protection from the corals and also utilize their excretory products, being able, in the presence of sunlight, to form starch from these and, later, proteins and fats. The plants apparently can only live in the bodies of corals. The animals obtain some advantage also from this association, notably the automatic removal of the excrement which would otherwise impede their growth.

Corals propagate themselves by means of minute bodies called planulae; these swim about for a short time in the sea, then settle down and change into young corals, with a mouth, ring of tentacles and an internal skeleton. They grow with remarkable rapidity, and in this way coral reefs are able to maintain themselves despite the destructive action of the sea, exposure and other factors.

SUMMER FIELD MEETING.

June 16th, 1934.

Malmesbury and Braydon Pond, Wiltshire, proved attractive for the Summer Field Meeting which was well attended. Dr. F. S. Wallis and Miss M. D. Hiley, the President and Hon. Secretary respectively of the Field Section, undertook the leadership. Bristol was left via Codrington, Tormarton, Acton Turville, Sherston and Easton Grey, giving delightful views of the Cotswold country and, beyond Sherston, of the headwaters of the River Avon.

A pause was made where the Fosse Way, now a green lane, crossed the route, and Mr. H. O. Edmonds gave a lucid explanation of this Roman road, its method of construction, the reason for certain bendings, its value, and its re-discovery in many places. Later, at Braydon Pond, Mr. Edmonds showed many photographs of the Fosse Way throughout its course.

The visit to Malmesbury Abbey was all too brief for due enjoyment of the many points of interest, and the fine Market Cross was also left with reluctance.

A short walk through the ancient town brought the party to the old King's Arms Hotel, where, in a charming room, tea was enjoyed before the journey was resumed.

At Charlton, a quarry showing the Upper and Lower Cornbrash was visited under the leadership of Mr. G. A. Kellaway, and here some enthusiastic geologists remained to search for fossils until the main party returned from Braydon, which was reached via Garsdon, the home of Washington's ancestors.

Braydon Pond was visited by kind permission of the Earl of Suffolk per Mr. F. J. Bates, J.P. This Pond is about ¾ mile long and ½ mile wide, being surrounded by woods of conifers and oaks. Some local naturalists gave valuable information, particularly regarding the rich bird-life of the district, while Mr. E. N. Tuck, M.A. spoke of the historical features of the area which has connections with Palæolithic and Roman times. While some of the party enjoyed boating on the Pond, others found interest in the plant and insect life of its bank, the rushes of which were frequently covered with the empty cases left by Dragonflies.

The return to Bristol was made through Charlton, across the Fosse Way, and then via Tetbury, Westonbirt, Old Sodbury and Chipping Sodbury.

THE 572nd GENERAL MEETING.

October 4th, 1934.

Exhibits of Natural History by the Members.

The geological exhibits were especially fine. Mr. J. W. Tutcher showed echinoderms (sea-urchins) from the Jurassic and Cretaceous rocks, including figured and rare specimens, and posed the problem as to why occasional elevated specimens, with none of intermediate size, occur in the same beds with the more depressed normal specimens. The University displayed Dr. Stanley Smith's completed maps of the Zones of the Mendip area, together with a fine group of minerals. Still more beautiful were minerals, including labradorite, agates, fluor-spar, copper ores and native copper, collected by the late Capt. Trelease and shown by his granddaughter, Mrs. Pepperell. Mr. Shilstone explained the construction of a cheap home-made blowpipe which left the hands free, while Mr. Kellaway's exhibit was of fossils from the several rock systems of the area, including the Cambrian of Berkeley.

Mr. Tetley exhibited from the Bristol Museum, winter skins of stoats of varying degrees of whiteness, thus proving that change of colour, more complete in the female, is not of necessity due to intense cold.

Mr. Tetley also showed a skin of the grey squirrel which has now reached Blaize Castle Woods and elsewhere near Bristol. This creature is very destructive and a pest calling for extermination.

Some very beautiful photographs of bird-life, taken by members of the Ornithological Section, were much admired.

The Botanical Section was well represented. Mrs. Bell showed 30 aromatic plants ; Mr. Luckwill had a fine exhibit of salt-marsh plants and mentioned that the Spartin grass, first noticed at Hythe in 1870, has now spread along the coasts of England and northern France so as to colonize thousands of acres ; Mr. Hudson's six troublesome garden weeds were models of mounting for exhibition ; and of the numerous wild flowers collected by members, a group shown by Mr. Tarring attracted special notice.

The University had a group of shrubs in fruit, and specimens from the Ecological Herbarium ; Miss Strudwick's drawings of plants, used to illustrate "Further Illustrations of British Plants," as well as her coloured sketches of Alpine plants, proved most attractive.

Miss Roper showed volumes recently acquired by the Library, the free use of which is the privilege of all members and associates of the Society.

THE 573RD GENERAL MEETING.

November 1st, 1934.

"The History and Geography of some Common Stones," by Prof. A. E. Trueman, D.Sc.

[Before the lecturer started, Dr. F. S. Wallis (Vice-President) referred to the loss which the Society has sustained in the death of its President, Prof. O. V. Darbishire.

It was only last January that Dr. Darbishire prepared a scheme for the reorganization of membership, by means of which it was hoped to place the finances of the Society on a surer basis. To carry through this scheme, he was elected President for a further term.

Dr. Darbishire was chiefly distinguished as the author of many papers on lichens, and, indeed, his work on these plants was of international importance.

To members of the Society, however, he was known as a real naturalist, one who delighted in all the many phases of Natural History, and was never better pleased than when he was out in the field with those of a kindred mind.

It was, perhaps, particularly appropriate that mention of his death should be made at a meeting to which members of the public were invited, for Dr. Darbishire had a wider mission than to the University or the Bristol Naturalists' Society only, for by lectures, by identification of specimens and by his advice, he was always ready to serve the whole community of the South-West of England.

The members stood in silence as a tribute to his memory.]

Almost any common rock affords an interesting object of study, whether its history, its influence on scenery or its effect on the life of man, is considered. Since almost any stone could be chosen to illustrate this lecture, it was necessary to make selections of those which are most familiar.

Attention was first paid to chalk, familiar in the white cliffs of the south coast, and widely known as a rock composed partly of small marine organisms. The conditions under which it was formed were considered, and it was suggested that, although it was formed in water of varying depth, the depth was probably not that of a deep ocean. The wide extent of chalk areas, resulting from a great transgression of the sea on the land, and the lowness of such land as remained unsubmerged, probably led to the scarcity of land-derived sediments and to the extreme purity of chalk.

Chalk gives rise to dry uplands with little soil and with few streams. These areas proved to be very important to primitive man who was unable to move freely in swampy lowlands or in densely wooded country. Early man thus followed the four belts of chalk which lead from the south and east coasts of England to Salisbury Plain which consequently became of great importance in prehistoric times.

Another common stone, which is frequently associated with chalk, is flint, formed from the remains of sponges and other siliceous organisms concentrated by solution and precipitated in rhythmic bands. The suitability of flint for the manufacture of weapons and tools was early appreciated by the first inhabitants of Europe, and for many thousands of years it formed almost the only material in use.

Reference was also made to the sandstones occurring in the Coal Measures immediately north of Bristol and in parts of Somerset, known as the Pennant Sandstone. This rock was formed as a delta in a vast area of fresh water. It gives rise to low uplands, as in Winterbourne Down, through which the Frome has cut a narrow gorge. A similar rock in South Wales builds the barren moorlands of the Coalfield, in which the rivers have cut the deep valleys characteristic of that area.

These sandstones have not only influenced the scenery and controlled the growth of towns but they have also markedly affected the development of coal mining in the Bristol coalfield as well as in South Wales.

THE 574TH GENERAL MEETING.

December 6th, 1934.

"Insect Pests of Gardens in the Bristol District and how to control them," by H. G. H. Kearns, Ph.D., F.E.S.

The lecture is printed in full on page 542.

O. V. Darbishire.

BY the death of Otto Vernon Darbishire, on October 17th, 1934, the Bristol Naturalists' Society has lost one of her staunchest supporters. It was fitting that, at the time of his death, he should be occupying the Presidential Chair of the Society for the second time, for he had always the interests of the Society and of its Botanical Section very much at heart.

Professor Darbishire was born at Conway on March 16th, 1870. He received his school education in Dresden and Florence, and then spent some time at the University College of Bangor, in the foundation of which his family had taken a part. Later he went up to Oxford where he was at Balliol under Jowett. There he studied botany under Vines and took his B.A. degree. He then returned to Germany, where he started research work under Reinke at Kiel, and for some time acted as assistant. He worked both on algae and on lichens, and these remained his chief study throughout life. He was always happy when collecting and demonstrating seaweeds, but most of his research was on the lichens. Quite early he published an important monograph on the Roccellaceae and he was working on a revision of this family at the time of his death. His last—a posthumous—published work will be a description of a new species of Roccella. He also worked out the lichens of several important polar expeditions and, in latter years, had contributed many papers on lichen anatomy.

On his return from Kiel, he was appointed Lecturer in the Botany Department of Manchester University and later went to Newcastle in the same capacity. In 1911, he was appointed Head of the Botany Department at Bristol University, and in 1919, was elected to the newly created Melville Wills Chair. All who knew him in Bristol are acquainted with his devotion to his Department and with the pride with which he presided over its steady growth. He was equally interested in introducing new students to the elements of his subject and in directing the research work of the more advanced; and he was always ready to help his amateur friends outside the University. During the War he commanded the Bristol Contingent of the Officers' Training Corps.

His loss will be felt by a wide circle of old students and of other friends in the University and in our Society.

M. S.

PROFESSOR O. V. DARBISHIRE, M.A., PH.D., F.L.S.

Photo Lafayette] [*To face p.* 516

EDITORIAL.

IT is not intended that editorial comment should become a permanent feature of the *Proceedings* but there have been a number of exceptional events in the Society's history during the past year which seem to call for mention in the present issue.

The lamented death of our President, Professor Darbishire, is referred to in other places in this number and tributes are paid to his work for the Society, and it may suffice here to record our own special sense of the loss we have sustained in the withdrawal at the outset of the valuable help which we confidently anticipated from him in the production of the *Proceedings*.

Nor is it fitting that this issue should appear without some reference to the self-sacrificing work of Miss Roper for so many years as Editor. Doubtless, other opportunities will be found of paying tribute to her in this and other connections, and again we will only express our deep sense of appreciation of the assistance that she has so generously given to us from the store of her great experience.

The *Proceedings* now appears, therefore, under new Editorship, and with abbreviated title, but this present Part continues Vol. VII which it will complete, and a title page and index for the Volume will appear in due course. A start is made in the present issue with the publication of short accounts of Field Observations. It is hoped that this feature may in future receive more contributions and that it will both encourage the keeping of such records by naturalists and also increase their interest in the *Proceedings*.

With this issue is brought to a close the very valuable series of contributions by Mr. Audcent which have run throughout the present volume.

The postponed list of members also appears with this issue and shows the total membership of 190 to be made up as follows :—Life 3, Ordinary 126, Associate 55, Junior 6 ; and it is particularly to the future of the Society under its new terms of membership that we would here draw attention. Sectional membership has declined, and a determined effort on the part of all members to secure recruits is very necessary. Any information would be gladly supplied by either the Hon. Treasurer or the Hon. Secretary. Special attention is drawn to the rule whereby members of the household of an Ordinary Member may join the Society without entrance fee and as Ordinary Members for a subscription of 5/- per ann., and receive all privileges except the receipt of the *Proceedings*. It is very desirable, too, that the number of members taking the *Proceedings* should increase by Associate Members becoming Ordinary Members.

Will Members sending in contributions please try to let the Editor receive them not later than December 31st, and send them in typed form. It is hoped by these means to publish the *Proceedings* earlier in the year.

The Water Supplies of Bristol: Past and Present.

By George Parker, M.A., M.D.

In ancient times the supply was given by fifteen or twenty public springs or conduits, as well as by many private shallow wells. Of these springs there were two or three sacred to medicinal uses dating from pre-historic days.

1. Hazel Well on Kingsdown, mentioned in the report of the Saxon trial of 883 which was witnessed by Prince Alfred. In the time of the Civil Wars, the legend of Dame Pugsley, married and widowed the same day, was attached to this spring in Freemantle Square. Besides its use for drinking purposes it had a great repute for diseases of the eye.

2. St. Ann's Well near Crew's Hole was an ancient place for pilgrimage and had a beautiful Chapel attached to it.

3. Hotwells or St. Vincent's Spring, known in the 15th century, became famous for its medical properties in the 17th and 18th centuries. Its water was also used for drinking purposes, especially on long voyages, and could be bought in London in bottles. It is a powerful radio-active water and has a temperature of 75° F. The spring is now closed for fear of pollution from the bed of the river, under which it flows. Sion Spring seems to be a branch of this, and to it a well was sunk in 1811, 245 feet deep, which gave 3,400 gallons a day and supplied parts of Clifton.

4. Richmond Spring in Gordon Road, and Buckingham Spring and the Princess Victoria Street Spring, the latter being 300 feet deep, lie near Sion Spring.

5. Black Rock Spring between the Sea Walls and the Suspension Bridge was, we know, used by John Wesley medicinally in 1770, and was intended by the Merchant Venturers, in 1845, to form the source of their projected water supply for Clifton.

6. Redcliffe Spring, given by Robert Berkeley in 1207 to the parish of Redcliffe. The water is brought in pipes from Knowle, and branches were given to St. John's Hospital and St. Thomas' parish.

7. All Hallows Conduit water came from an orchard above Maudlin Street and was carried across the Frome to All Saints Lane. It was the gift of the Benedictines of St. James about the year 1400.

8. St. John's Conduit water came from two springs, one on Brandon Hill and another in Park Street, and was carried to St. John's Church across the Frome, down Pipe Lane. It is supposed to be the gift of the Carmelites, and was much used by shipping.

9. The Quay Pipe water came from the Boiling Springs on Ashley Hill by lead pipes to the Wharf at Quay Head, Tramways Centre. The position of this fountain was shifted slightly two or three times, and the fountain was made to run with wine after some of Marlborough's victories. The water is now utilized in the United Brewery, and said to amount to more than 500,000 gallons a day.

10. St. Nicholas Pipe, close to the corner of Bristol Bridge, was removed in 1762 when the bridge was rebuilt.

11. Jacob's Wells Springs gave a good and copious supply to the Cathedral and Unity Street districts. The water is now used for the Public Baths.

12. Temple Conduit water, brought from a spring near the Three Lamps, Pylle Hill, and given to the parish in 1366 by Sir T. Gurney.

13. St. Peter's Pump, or St. Edith's Conduit, was built by Canynge's executors in 1474.

14. Springs in the PITHAY, OLD MARKET STREET and LEWIN'S MEAD, all had public conduits.

15. ROYAL FORT SPRING was included by Prince Rupert in 1644 as a doubtful supply for his fortress, and was made one of the excuses for his surrender of the city; but later found to be a very copious supply. It has now a cistern holding 10,000 gallons, used till lately by the whole neighbourhood.

HANHAM INTAKE. Water was obtained from the river in 1696 under an Act of Parliament and brought to a reservoir at Lawrence Hill by wooden pipes and carried thence to various parts of the City.

In less than a century the Hanham works fell into disuse and it was said that Bristol's extraordinary supply of pure water from the conduits made other sources unnecessary. The system, indeed, was thought to be near perfection. But about 1846, public opinion completely changed and an official statement went so far as to say that few, if any, large towns in England had such an inadequate water supply as Bristol.

What caused this great change ?

1. The town had grown much larger, and the new parts, e.g., Bedminster, had no conduits. Some of the old conduits were contaminated, and most of the shallow surface wells were foul.

2. People knew there was a very high death rate, at least in some districts, e.g., 35 per 1,000 in St. James, and the population had grown to 140,000, and was rapidly multiplying.

3. The local authorities, with their divided and clashing jurisdiction, confessed themselves powerless in health matters.

4. The inhabitants were terrified at the outbreaks of cholera in 1831 and 1849, and the constant fevers which, though little understood at that time, were clearly somehow connected with the water. Moreover, sanitary science was just becoming active and powerful and insisted upon pure water as a primary need of every town. The new fashion was to give a supply to each house; the old conduits took it only to a parish or street cistern.

The final or "Clark's" report of the Board of Health's Commission in 1850 was that Bristol needed three things :

1. A fresh water supply.
2. Sewers and drainage.
3. A single local authority with power to carry out reforms.

Various bodies attempted to provide new water supplies, but the Bristol Water Works Company was incorporated by Act of Parliament in July, 1846, and it had to take over the Merchant Venturers' and other works and pay compensation for them.

It draws its supplies now, after several Acts have granted it extra sources :

1. From springs at Chewton Mendip, 14 miles away (tapped 1846).
2. Barrow Gurney Cold Bath springs, 8 miles away (1846).
3. Deep wells at Chelvey, 9 miles away (1865).
4. Sherborne spring at Litton, 13 miles away (1882).
5. From the River Yeo and Langford springs, 12 miles away (1882).
6. From Cheddar, which is not yet in full working order (1917).

The water is stored at (1) Blagdon, 1,700 million gallons approximately, in a lake of 450 acres, (2) In the Barrow filter beds, 825 million gallons, (3) At Cheddar reservoir, 1,200 million gallons, making a total of 3,700 million gallons approximately.

The Company gives a constant supply to 400,000 people of 13 million gallons daily, or 32 gallons per head.

The water, is very pure, as shewn by constant tests. After elaborate filtering and storage, no further treatment by chlorine or ozone or other method is required. The only complaint which can be made is of a certain amount of hardness, temporary 7%, permanent 5%.

Though much of the water comes in by gravity through the pipe lines to Bristol, pumping is required for the higher districts, Durdham Downs, St. George, Knowle, Bedminster Down and Rownham. One-half of the total has to be pumped from Chelvey and Blagdon, and in the case of the Cheddar water, pumping has to be done twice. In Bristol itself, one-third has to be pumped to the higher level zones, and part of that third has to be re-pumped to supply the highest level of all.

The thirteen million gallons daily of the Company's water does not form the entire supply of Bristol and Avonmouth. Besides the use for industrial purposes of the river water, many private firms have a supply of their own from deep wells ; thus the Avonside Paper Mills have a well 125 feet deep, which gives on occasion 6,000 gallons per hour ; Baker, Baker & Co., have also a deep well, and Capper Pass & Co., have one 83 feet deep, which can yield 7,000 gallons per hour ; Georges' Brewery has two supplies, one 86 feet deep, giving 5,000-11,000 gallons per hour, and a deep one of 570 feet, which has given 1,640 gallons per hour ; and on the Bathurst Wharf there is a well 164 feet deep, yielding 1,200 gallons per hour ; Shield's Laundry has one 396 feet deep, yielding 3,882 gallons per hour. The Redcliffe Iron Works have one 200 feet deep, which can yield 6,000 gallons per hour ; Rogers' Brewery has two supplies, one 300 feet deep, yielding 1,200 gallons per hour, and the other 210 feet deep, yielding 3,000 gallons per hour. The United Brewery, as we have seen, draws a supply from the Boiling Springs. These supplies from the deep wells of Bristol are usually pure and good ; those from the Avonmouth district are generally bad. It had been proposed in the latter case to utilize the Sudbrook spring which flows under the Severn, but the waters were found to contain too much sulphate of magnesia for human consumption.

The Recent Drought. This was due simply to a shortage of rainfall ; thus the Litton supply for twelve months was only two-thirds of the normal. Previous droughts occurred in 1854 and 1864 ; in the latter it was impossible to continue the constant supply, but the quantity in store has been much increased since then, and this year, in spite of the prolonged drought, the constant supply was maintained throughout, partly owing to the voluntary care of the consumers, and partly by borrowing 1,000,000 gallons a day from the West Gloucestershire Company at the cost to our Company of about £40,000. When the Cheddar reservoir is complete, there should be no anxiety as to the supply stored for a long while.

On a Boring for Water in the Lower Avonian and Old Red Sandstone at Portishead.

By Stanley Smith, M.A., D.Sc., F.G.S., and
S. H. Reynolds, M.A., Sc.D., F.G.S.

THE Portishead area has long been known as one of the parts of the Bristol district where the effects of the Armorican movements are most noticeable. The main structures have been described by Dr. Edward Greenly and one of us (S. H. R.) in a paper* in which it is shown that on the northern side of Portishead there are two steeply-hading overthrust faults running from the Pier to Woodhill Bay, i.e., nearly east and west. The effects of these are well marked at the surface and they have been cut by the culverts constructed for the Bristol Corporation Electric Power Station. Recently, the presence of a third disturbance in the same neighbourhood, which is not revealed at the surface, was disclosed in a boring for water put down at the Power Station. The exact position of the borehole, the surface level of which is 113 feet O.D., is shown in the following sketch map (Fig. 1):

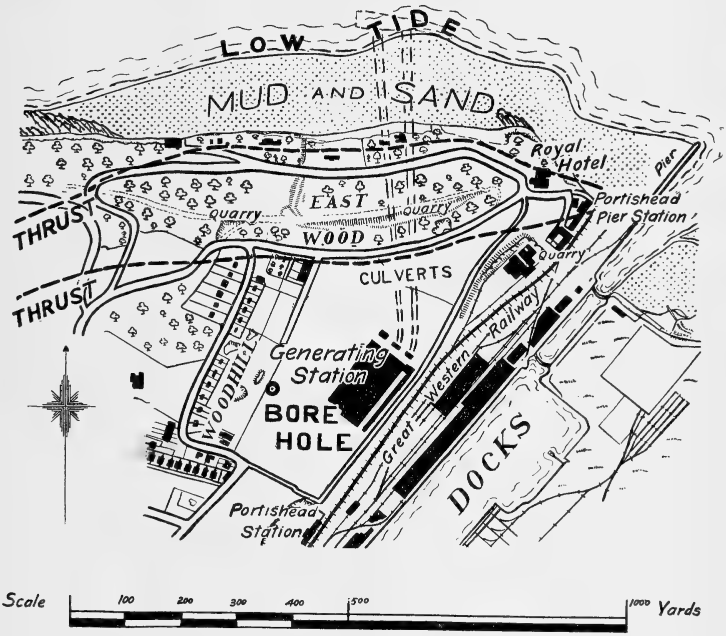


Fig. 1.

The bore starts in the Lower Limestone Shales (K1) which form the western limb of an asymmetric synclinal fold† and, at a depth of 250 feet, enters the Old Red Sandstone, in which it continues to a depth of 375 feet. Here it encounters the disturbance to which reference has already been made, and

* *Quart. Journ. Geol. Soc.* Vol. lxxx (1924), pp. 447-466, pl. xxxix.
† See Reynolds and Greenly op. cit. text-fig. 4 on p. 452.

passes again into K1 beds. It reaches the Old Red Sandstone for the second time at 570 feet and was abandoned at a depth of 674 feet. The dip of the strata varies much at different levels and is often so high that the thickness of the strata, as penetrated in the bore, is far greater than their actual thickness. The dip is steepest and the rocks show most signs of disturbance just below the thrust. Boring ends, however, in nearly horizontal strata.

The details of the boring are given below :

	Thickness as penetrated in the bore. Feet	*To depth of. Feet*	*Approximate dip. Degrees*
CARBONIFEROUS (—TOURNAISIAN = K1 + Km)			
1. Light red and mottled sandy limestone, occasionally shaly, with crinoids and obscure brachiopods	30	30	15
2. Light red sandy calcareous shale ..	18	48	
3. Light red limestone and shale, shale predominating in the higher part, limestone in the lower	50	98	20
4. Hard, deep red, gritty limestone	55	103	
5. Light red and grey limestone and shale, similar to "3" but less shale	39	142	
6. Red crinoidal limestone, α type (upper band of Bryozoa Bed)	15	157	20
7. Compact light red and grey limestone with some shale in lower part	50	207	40–45
8. Grey crystalline limestone	1	208	
9. Shale	1	209	
10. Red crinoidal limestone α type .. .. .. 6 feet; Shale .. .. .. 4; Red crinoidal limestone α type .. .. .. 5 — Lower band of Bryozoa Bed	15	224	40
11. Shale	½		
11A. Massive coarse-grained limestone ..	½	225	40
12. Grey limestone and shale	4	229	
12A. Similar beds, red	3	232	
13. Red crinoidal limestone α type	1	233	
14. Grey sandy limestone, fossiliferous in part, and shale. Black shale with thin beds of hard limestone at base	17	250	
OLD RED SANDSTONE.			
15. Red micaceous sandstone passing down into	6	256	30
16. Thinly bedded grey sandstone and shale	7	263	
17. Dark red marly sandstone	2	265	
18. Dark red and greenish grey sandstone, generally micaceous and fissile and sometimes false bedded	35	300	30
19. Conglomerate formed of subangular and rounded "pebbles" of shale in a soft micaceous sandy matrix (similar to "34" but red and without coaly material) ..	3	303	
20. Reddish sandstone, generally massive, pebbly in places, fissile in others	62	365	
21. Hard grey, slightly calcareous sandstone	10	375	

————THRUST————

CARBONIFEROUS (—TOURNAISIAN = K 1 + Km)

22. Highly disturbed black shale with thin bands of limestone. Thicker band (6 inches) of crystalline limestone at base ..			8	383	70
23. Thinly bedded fossiliferous grey sandy limestone alternating with shale, highly disturbed			65	448	90 in places
	feet				
24. Red crinoidal limestone *a* type	2	Upper band of Bryozoa Bed			
Grey limestone	2				
Red crinoidal limestone *a* type	16				
Grey crinoidal limestone ..	4				
Red crinoidal limestone *a* type	1		25	473	50
25. Grey limestone and shale similar to "23," considerably disturbed			41	514	
	feet				
26. Red crinoidal limestone *a* type	3	Lower band of Bryozoa Bed			
Grey limestone	2				
Red crinoidal limestone *a* type	2		7	521	50
27. Grey argillaceous sandy limestone with soft black shale containing lamellibranchs at the base			49	570	

OLD RED SANDSTONE

28. Greenish grey sandstone, slightly calcareous. On the whole hard and massive but softer in the middle and with a few shaly partings	21	591	60
29. Dark sandy shale and sandstone	9	600	
30. Dark red soft marly sandstone	2	602	
31. Thinly bedded red and greenish grey sandstone, similar to "17," marly in places ..	26	628	
32. Dark shale	7	635	0
33. Banded red and greenish grey sandstone, same as "32"	5	640	
34. Conglomerate similar to "19" but green and containing much carbonaceous matter —traces of plants	7	647	
35. Massive sandstone	27	674	0

While the succession of beds lying above the thrust is very similar to that below, the two are not identical. This fact strongly suggests that they were originally laid down some distance apart and were brought into their present relationship through lateral movement along a plane of low inclination. It should also be pointed out that the Carboniferous beds in neither series appear to tally so closely with those exposed in the old quarry near Portishead Pier Station* as might be expected.

In Fig. 2, the two sequences are, for purposes of comparison, drawn to scale and shown in juxtaposition, the junction between the Carboniferous and the Old Red Sandstone being taken as the datum line. In order that the scale should not be too small, both columns are drawn in two sections.

* See S. H. Reynolds *Proc. Bristol Nat. Soc.* ser. 4, vol. v, p. 92.

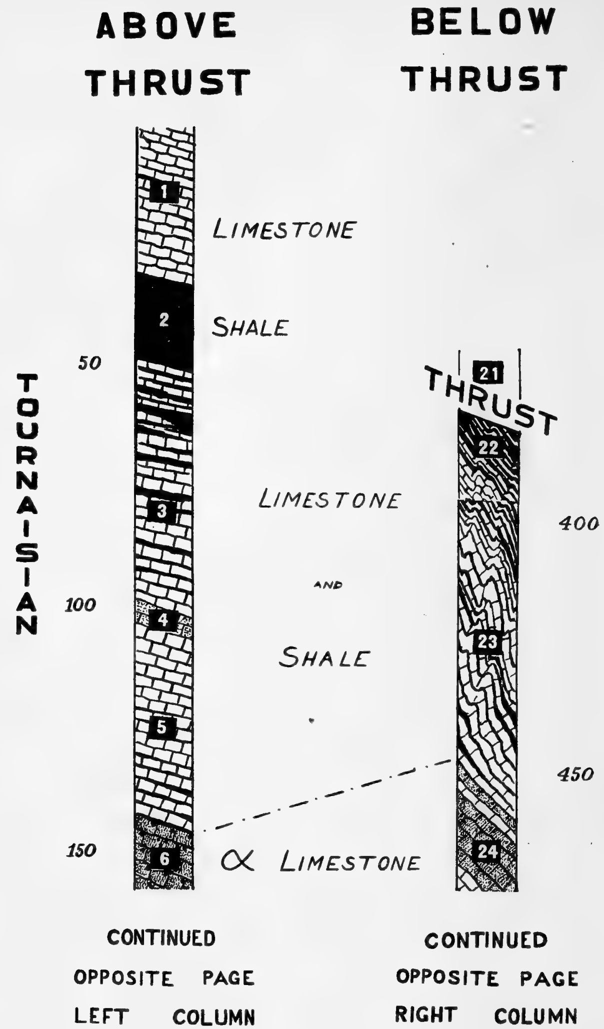
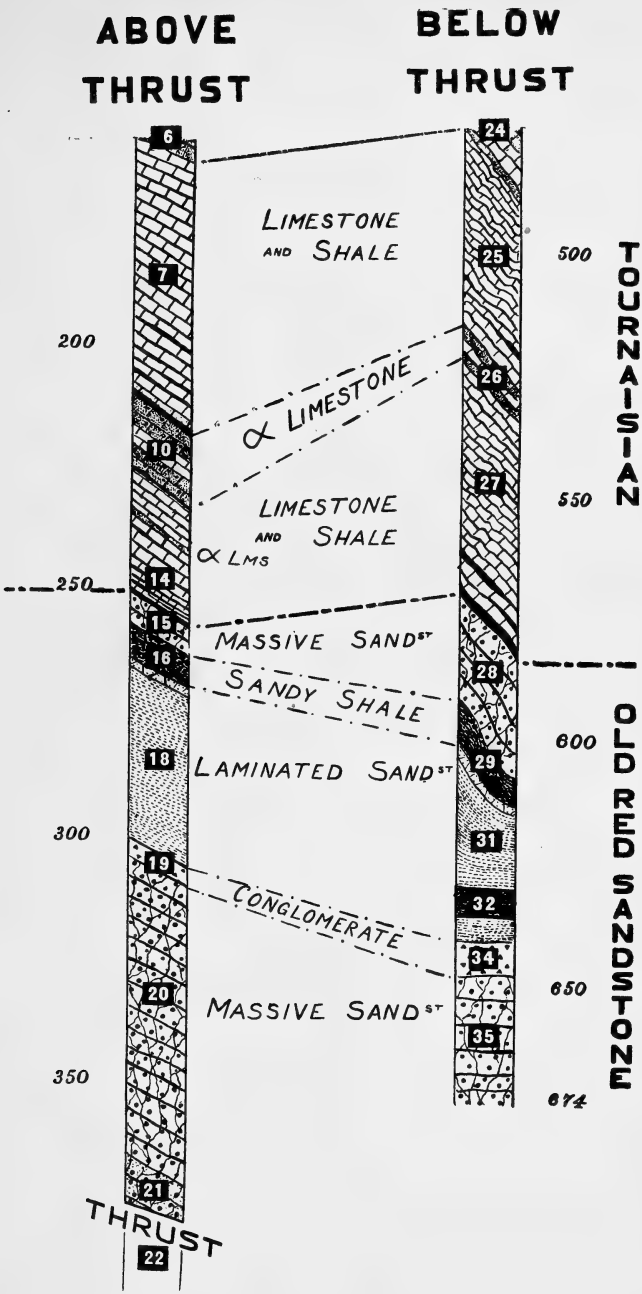


Fig. 2.—Strata penetrated by bore-hole. Scale 1 inch = 40 feet. The numbers of the beds (omitted in the case of thinner ones) are those assigned to them in the table on pp. 522, 523.


ABOVE THRUST
BELOW THRUST
6
7
10
14
15
16
18
19
20
21
THRUST
22
24
25
26
27
28
29
31
32
34
35
200
250
300
350
500
550
600
650
674
LIMESTONE AND SHALE
α LIMESTONE
LIMESTONE AND SHALE
α LMS
MASSIVE SANDST
SANDY SHALE
LAMINATED SANDST
CONGLOMERATE
MASSIVE SANDST
TOURNAISIAN
OLD RED SANDSTONE

REMARKS ON THE SECTION

Beds above the Thrust.

Tournaisian K1 + Km.

The beds consist in the main of reddish and mottled sandy limestones with subordinate shales. The rocks, though occasionally showing a little puckering, are practically undisturbed. Two thick (6 and 10) and a very thin (15) band of *a* limestone, or Bryozoa beds, were penetrated, these being crinoidal and bryozoan limestones highly impregnated with iron oxide exactly as in the corresponding band in the Avon section. Fossils are not plentiful but thin sections sometimes show the presence of ostracods and, at a depth of 234 feet, *Cleiothyris roissyi* and *Camarotoechia micheldeanensis* were found. The latter fossil was also found at several other horizons, including the bands of Bryozoa bed. The Carboniferous rocks pass down comformably into the

Old Red Sandstone.

The beds are mainly red and micaceous and contain in the higher part flaggy beds and some sandy shales. They neither include cornstones nor show any very exceptional features. Bed 18 is a soft laminated highly micaceous sandstone occurring in fine bands alternately green and red. At a depth of 301 to 304 feet a peculiar conglomeratic bed (19) was penetrated. This rock is primarily a red micaceous sandstone but is full of argillaceous patches, mostly red and analogous to pebbles. These patches may be angular or rounded and vary in size up to a length of five inches, though most are only half an inch to one inch. They are irregularly scattered with no trace of sorting according to size, and many appear to show slickensiding.

Beds below the Thrust.

Tournaisian K1 + Km.

At a depth of 375 feet the bore again passed into K beds which, owing to their thinly bedded character, are intensely disturbed and contorted by the overthrusting of the more massive Old Red Sandstone. (See Pl. 1, Fig. 1.) The extreme disturbance ceases at about a depth of 449 feet where the massive upper Bryozoa bed is entered. The disturbed strata, though they form the core for about 75 feet, are of no great thickness, perhaps not more than 20 or 25 feet. They probably represent only the lower part of the supra Bryozoa beds, part of K1 in the series above the thrust, the main development of red and mottled limestones not being seen in the lower series. The considerable thickness of core which they form is due to their repetition by folding and faulting, and to the fact that they sometimes lie nearly vertically. A fosilliferous band in " 23 " containing many ill-preserved brachiopods (*Orthotetes crenistria* and *Cleiothyris roissyi*) occurs just above the upper band of Bryozoa bed. There is still some considerable disturbance and puckering in the strata between the Bryozoa beds. The lower Bryozoa bed contains some indeterminable brachiopods.

At the base of the Carboniferous is an exceedingly soft, almost jet black shale (27) yielding lamellibranchs (*Modiola lata*, *Modiola* sp. and an indeterminable form suggesting *Sanguinolites*). This shale shows slickensided surfaces and very readily disintegrates in water.

Old Red Sandstone.

The sequence is very similar to that above the thrust but on the whole the rocks are not so red.

The conglomerate band (34) (Pl. 1, Figs. 2 and 3), which was entered at a depth of 69 feet below the base of the Tournaisian, is rather thicker than it is in the upper series. It differs in its green colour and in the greater abundance and more uniform character of the shaly patches. But its most remarkable feature is the occurrence of much carbonaceous material of the nature of coal, representing fragmentary plant stems of more than one kind.

FIG. 1

FIG. 2

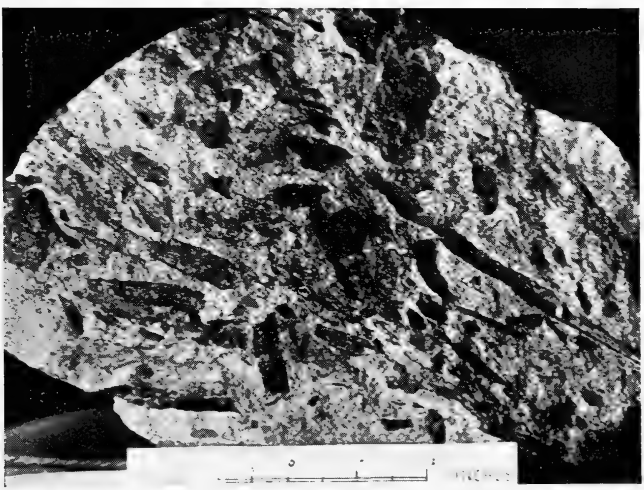


FIG. 3

ROCKS PENETRATED BY THE PORTISHEAD BORING.

Photo S. H. R. & E. W. S.]

[*To face p.* 526

We desire to thank the Chief Engineer and General Manager of the City of Bristol Electricity Department, Mr. A. J. Newman, for allowing us every facility to examine the cores and for permission to publish the results.

EXPLANATION OF PLATE 1

Fig. 1. Highly contorted, thinly bedded limestone and shale, K1 (23). Portion of core shown about 18 inches long.

Fig. 2. "Conglomerate" bed in the Old Red Sandstone (34). Portion of core shown about 18 inches long.

Fig. 3. Piece of same bed as in Fig. 2 (plane of bedding). The dark objects are carbonized plant stems and often show traces of structure.

Bristol Insect Fauna.

DIPTERA (PART VII AND LAST).

By H. AUDCENT.

XVI. OPOMYZIDAE.

(GEOMYZIDAE part.)

YELLOWISH-BROWN flies (3-4·5 mm.), caught by sweeping in damp meadows. Wing long, with reduced anal lobe, 3rd and 4th veins (R_{2+3} and MA_1) converging at apex, a few dark spots. The larvae are leaf-miners; *O. florum* Fab. feeds on wheat. Czerny in *Fliegen der Palaearktischen Region*, Vol. 54, 1928.

Geomyza (*Balioptera*) *combinata* L. G., Painswick (W.); S., Kewstoke (C.); Taunton (P.); Wells (L.).

„ „ *tripunctata* Fall. G., Olveston (A.), 5/9/22; Bristol (A.), 1/12/24. S., Leigh Woods (H.); Weston-super-Mare (J.); Wells (L.); Salford (A.), 2/4/22; Tickenham (A.), 16/9/22.

„ „ *venusta* Mg. G., Kingsweston (A.), 9/6/23. S., Tickenham (A.), 22/7/22.

Opomyza florum Fab. G., Cirencester (T.), 7/23.

„ *germinationis* L. G. and S., common.

XVII. CHIROMYIIDAE.

(OPOMYZIDAE part.)

Like *Opomyzidae*, smaller flies, anal lobe of wing larger, no spots.

Chiromyia (*Pelethophila*) *flava* L. G., Cirencester (on windows) (T.); Shepperdine (A.), 4/8/24; Hallen (bred from oak galls) (A.), 9/7/26; Cleve (St.), 29/9/24; S., West Town (Wm.), 21/7/28.

„ „ *oppidana* Scop. (*lutea* Fall.). G., Hallen (bred from oak galls) (A.), 9/7/26.

XVIII. COELOPIDAE.

(PHYCODROMIDAE.)

Medium size black or brown flies, with flat thorax and very hairy legs. Wing like that of *Scatophagidae*. Found exclusively on the seashore among decaying seaweeds, on which their larvae feed. J. Collin in *E.M.M.* 1910, p. 48.

Coelopa (*Fucomyia*) *eximia* Stenh. G., Aust (A.), 28/8/33.

„ „ *pilipes* Hal. S., Brean (A.), 27/8/24.

Orygma luctuosa Mg. G. and S., common.

Phycodroma (*Malacomyia*) *sciomyzina* Hal. G., Aust (A.), 28/8/33. S., Berrow (A.), 28/6/25.

XIX. HELOMYZIDAE.

Flies of a medium size, usually of a yellow-brown colour, often found in winter and in damp, dark places, e.g., caves. Costa of wing bears a series of long spines besides the usual ciliation, the sub-costal vein is distinct and long. Strong vibrissae (mouth bristles). The larvae are saprophagous, coprophagous or mycetophilous. J. Collin in *E.M.M.*, 1910, p. 124; Czerny in *Zoo-Bot. Ges*, XV, 1, 1924; Czerny in *Fliegen der Palaearktischen Region*, Vol. 53, 1927.

Allophyla atricornis Mg. S., Leigh Woods (H.) and (A.), 12/10/22.

Amoebaleria (*Blepharoptera*) *caesia* Mg. S., Banwell (A.) in a cave, 20/10/28; Leigh Woods (A.), 17/10/24.

,, ,, *spectabilis* Lw. G., Cirencester (T.), 16/6/23. S., Abbot's Leigh (A.), 16/5/26; Goatchurch Cavern (Wm.), 26/3/27.

Eccoptomera longiseta Mg. G., Kingsweston (A.), 30/3/29.

Helomyza (*Blepharoptera*) *serrata* L. G., and S., fairly common.

Heteromyza oculata Fall. S., St. Audries (A.), 24/8/29.

Neoleria (*Blepharoptera*) *flavicornis* Lw. S., Nailsea (C.); Wells (L.).

Spanoparea ruficornis Mg. G., Dursley (A.), 12/10/30.

Suillia (*Helomyza*) *bicolor* Zett. (*Zetterstedtii* Lw.). S., Leigh Woods (A.), 18/10/24.

,, ,, *flava* Mg. G., Olveston (A.), bred from *Agaricus arvensis* L. 8/10/22.

,, ,, *fuscicornis* Zett. (*montana* Lw.). G., Hallen (A.), 10/10/25; S., Leigh Woods (A.), 12/10/22 and 18/10/24.

,, ,, *inornata* Lw. S., Nailsea (C.); Culm Head (H.); Wells (L.).

,, ,, *laevifrons* Lw. S., Sharpham (A.), 5/9/25.

,, ,, *notata* Mg. (*pectoralis* Lw.). G., Dursley (A.), 20/6/25.

,, ,, *pallida* Fall. G., Ruscombe (W.); S., Leigh Woods (H.); Wells (L.); Sharpham (A.), 8/8/25.

,, ,, *rufa* Fall. (*affinis* Mg.). G., Painswick (W.); Wotton-under-Edge (P.); Dursley (A.), 1/5/30. S., Nailsea (Wm.), 1/6/27; Wells (L.).

,, ,, *similis* Mg. S., Sharpham (A.), 31/7/25.

,, ,, *ustulata* Mg. G., Ruscombe (W.); Blaise Castle (A.), 4/3/22. S., Holford (A.), 2/21; Leigh Woods (A.), 19/3/27.

,, ,, *variegata* Lw. G. and S., fairly common.

Tephrochlamys canescens Mg. (*rufiventris* Mg.). G. and S., fairly common.

,, *flavipes* Zett. G., Painswick (W.); Bristol (A.), 3/11/31.

Thelida (*Heteromyza*) *atricornis* Mg. G., Blaise Castle (A.), 6/6/20.

,, ,, *commixta* Coll. S., Shepton Mallet (C.), 31/3/09 Wells (L.).

XX. TRICHOSCELIDAE.

(GEOMYZIDAE and HELOMYZIDAE part).

Small flies (2-3 mm.), caught by sweeping grass. Wing like that of *Helomyzidae* but sub-costal vein short and weak. Life history unknown.

Trichoscelis (*Geomyza*) *obscurella* Fall. G., Hallen (A.), 24/7/28. S., Shapwick (A.), 3/9/22.

XXI. CLUSIIDAE.

(HETERONEURIDAE.)

Small dark flies (3-6 mm.), caught by sweeping in woods. The larvae live in decaying wood. Wing with the two cross-veins close together in the basal half of the wing, cubital and anal cells present (cp. *Chloropidae*). Czerny in *Fliegen der Palaearktischen Region*, Vol. 54, 1928.

Clusia (*Stomphastica*) *flava* Mg. G., Painswick (W.); Olveston (A.), bred from rotten wood, 25/4/23.

Clusiodes (s.g. *Clusiaria*) *geomyzina* Fall. S., Brockley Combe (Wm.), 28/5/27; Taunton (A.), 6/6/31.

Clusiodes (s.g. *Clusiodes*) *albimana* Mg. G., Olveston (A.), bred from rotten wood, 28/4/23. S., Abbot's Leigh (A.), 16/5/26.

Heteromeringia nigrimana Lw. G., Olveston (A.), 26/4/23.

XXII. CHAMAEMYIIDAE.

(OCHTHIPHILIDAE, AGROMYZIDAE part.)

Small dark flies (2-3 mm.). The larvae are carnivorous and feed on Aphids and Coccids, they may be found in plant galls where they are probably inquilines. They resemble *Sepsidae* but palpi are distinct; wing unspotted with 2nd vein (R_1) curved towards the sub-costal, anal vein short and weak; no preapical bristle on hind tibia. J. Collin in *E.M.M.*, 1911, p. 233.

Chamaemyia (*Ochthiphila*) *juncorum* Fall. G., Bristol (Wm.), 18/7/23. S., Berrow (B.), 23/6/26.

,, ,, *maritima* Zett. (*flavipalpis* Hal.). S., Berrow (B.), 23/6/26.

,, ,, *polystigma* Mg. G., Olveston (A.), 30/7/22. S., Sharpham (A.), 22/8/22.

XXIII. DROSOPHILIDAE.

Small brown flies (2-4 mm.), attracted by fermenting substances (e.g., decaying fruit, vinegar) in which the larvae live. In the wing the cubital cell is absent (i.e., no basal cross-vein between 5th and 6th vein), the anal cell is usually present, the sub-costal vein is usually very weak; the arista usually bears a few long hairs above and a lesser number below; vibrissae usually present. As these flies vary considerably, breed rapidly and are easily bred, T. H. Morgan made use of them for experimental studies in mendelism. J. Collin in *E.M.M.*, 1911, p. 230.

Cacoxenus indagator Lw. G., Bristol (B.), 1/5/27. Parasitic on *Osmia* (*Hymen.*).

Camilla (*Noterophila*) *glabra* Fall. S., Berrow (B.), 18/6/30; Wells (L.).

Drosophila fasciata Mg. (*ampelophila* Lw.) G., Bristol (Wm.), 3/8/28.

,, *confusa Staeg.* S., Shepton Mallet (C.), 17/3/09.

,, *fenestrarum* Fall. G. and S., fairly common.

,, *funebris* Fab. This is the Vinegar Fly. G. and S., common. G., Painswick (W.), bred from a turnip, 29/3/94.

,, *melanogaster* Mg. G., Blaise Castle (A.), 18/2/22; Bristol (A.), on window, 28/9/27.

,, *obscura* Fall. G., Bristol (A.), 28/9/27.

,, *phalerata* Mg. G., Olveston (C.), bred from an Agaric, 8/10/15; Shepperdine (A.), 23/8/24. S., Leigh Woods (H.); Taunton (P.); Wells (L.)

,, *transversa* Fall. G., Shepperdine (A.), 23/8/24.

Leucophenga maculata Duf. G., Blaise Castle (A.), 7/9/29. S., Leigh Woods (A.), 12/4/30. Flies with silver sheen.

Scaptomyza flava Fall. G., Bristol (A.), 10/10/31. S., West Town (Wm.), 3/27; Shapwick (A.), 22/4/24.

,, *graminum* Fall. G. and S., common.

,, *incana* Mg. (*tetrasticha* Beck.). S., Wells (L.).

XXIV. ASTEIIDAE.

(AGROMYZIDAE part.)

Small black flies with yellow markings (2-3 mm.), caught by sweeping in damp places. The unbroken costa reaches the apex of the 4th vein (MA_2) and there is only one cross-vein (instead of the usual three) situated on MA_2 at base of wing (*Asteia*), or two cross-veins, the second one being situated between MA_2 and CuA_1 (*Liomyza*). The larvae of *Asteia amoena* Mg. live in damp detritus in hollow trees; the life-history of the other species is unknown.

Asteia amoena Mg. G. and S., fairly common.

XXV. AULACIGASTERIDAE.

(DROSOPHILIDAE part.)

Only one genus and one species in that genus. A small fly (2·5 mm.) of a brownish colour with fulvous basal tarsal joints. Wing like that of *Liomyza* but costa has one break just behind the apex of R_{2+3} which is short, the lower cross-vein is nearer the apex of the wing and there is an anal cell. The larvae live in wounds on Elm trees.

Aulacigaster leucopeza Mg. (*rufitarsis* Mcq.). G., Painswick (W.), 6/6/93; S., Wells (L.).

XXVI. EPHYDRIDAE.

Small to medium-size flies of a dull grey colour, usually found near water. The larvae are terrestrial or aquatic, saprophagous, carnivorous or leaf-miners. Costa with two breaks, sub-costal vein short not reaching the costa, a cross-vein between 3rd and 4th veins (MA_1 and MA_2) and only one cross-vein between 4th and 5th veins (MA_2 and CuA_1) situated towards apex of wing, no anal cell. Becker in *Berl, Ent. Zeit,* Vol. XLI, 2, 1896, Becker in *Fliegen der Palaearktischen Region,* Vol. 56, 1926.

Caenia palustris Fall. S., Sharpham (A.), 6/8/23 and 16/8/25.

Discocerina (*Clasiopa*) *calceata* Mg. (*nigrina* Stenh.). G., Painswick (W.). S., Shepton Mallet (C.).

,, ,, *obscurella* Hal. G., Painswick (W.); Tortworth (A.), 27/4/27.

,, ,, *plumosa* Fall. G., Tormarton (A.), 13/7/29.

,, ,, *pulicaria* Hal. S., Sharpham (A.), 22/8/22.

Ephydra micans Hal. S., Taunton (P.).

,, *riparia* Fall. (*albula* Mg.). S., Tickenham (Wm.), 23/7/22.

Halmopota salinarum Bché. G., Aust (A.), 6/9/22.

Hydrellia griseola Fall. (*chrysostoma* Mg.). G. and S., common.

,, *ranunculi* Hal. (*hydrocotyles* Hal.) G. and S., common.

Hydrina (*Philygria*) *interrupta* Hal. S., Berrow (A.), 6/4/29.

,, ,, *interstincta* Fall. G., Blaise Castle (A.), 13/9/26.

,, ,, *nigricauda* Hal. S., Berrow (A.), 27/8/30.

,, ,, *punctatonervosa* Fall. S., Berrow (A.), 29/9/24.

Ilythea spilota Hal. S., Shepton Mallet (C.), 9/5/09.

Mosillus subsultans Fab. G., Olveston (A.), 2/9/23. S., Clevedon (W.); Tickenham (Wm.), 8/8/22.

Napaea (*Parydra*) *aquila* Fall. G., Littledean (A.), 25/5/31. S., Flax Bourton (H.); Tickenham (A.), 24/5/26; Prior Park, Bath (A.), 18/7/25.

,, ,, *coarctata* Fall. G., Shepperdine (A.), 2/8/24. S., Crook Peak (Rd.); Leigh Woods (H.); Tickenham (A.), 22/4/25.

,, ,, *fossarum* Hal. G., Aust (A.), 6/9/22; Shepperdine (A.), 2/8/24.

,, ,, *littoralis* Mg. S., Wells (L.).

,, ,, *pusilla* Mg. G., Cirencester (T.), 6/8/23. S., Ashton Park (H.).

,, ,, *quadripunctata* Mg. G. and S., common.

Notiphila cinerea Mg. G. and S., common.

Notiphila guttiventris Stenh. G., Bristol (C.) ; Bitton (C.) ; Stoke Bishop (A.), 6/32 ; S. Keynsham (C.).

,, *riparia* Fall. G., Shepperdine (A.), 30/7/24. S., Shapwick (A.), 17/7/22 ; Tickenham (A.), 19/7/24.

,, *uliginosa* Hal. S., Berrow (A.), 13/7/30.

Ochtera mantis D. G. S., Sharpham (A.), 19/8/25.

Pelina aenea Fall. G., Shepperdine (A.), 20/8/24.

,, *aenescens* Stenh. G., Aust (A.), 6/9/22.

Philygriola picta Fall. G., Stone (A.), 27/6/28.

Psilopa (*Ephygrobia*) *leucostoma* Mg. G., Shepperdine (A.), 6/8/24. S., Sharpham (A.), 18/8/25.

,, ,, *nigritella* Stenh. G., Painswick (W.), 13/11/91.

,, ,, *nitidula* Fall. S., Sharpham (A.), 19/5/24.

Scatella paludum Mg. (*sorbillans* Hal.). G., Fishponds (A.), 24/3/28. S., Shepton Mallet (C.), 1/8/09.

,, *quadrata* Fall. G., Cirencester (T.) ; Kingsweston (A.), 6/5/28. S., Wells (L.) ; Shepton Mallet (C.) ; Rodney Stoke (A.), 16/4/29.

,, *stagnalis* Fall. G. and S., common.

Scatophila noctula Mg. S., Shepton Mallet (C.), 1/8/09.

Teichomyza fusca Mcq. G., Blaise Castle (Wm.), 14/8/21. S., Keynsham (C.) ; Chew Stoke (A.), 24/5/33.

XXVII. CYPSELIDAE.

(BORBORIDAE, SPHAEROCERIDAE.)

Small black flies (0·5-4 mm.), with short, broad hind metatarsus. Found chiefly on decomposing animal and vegetable matter (e.g., dung) in which the larvae live. The 4th and 5th veins of the wing (MA_2 and CuA_1) may not go beyond the posterior cross-vein (*Leptocera*), or CuA_1 may be cut off shortly after the cross-vein (*Cypsela*) or both may reach the edge of the wing (*Sphaerocera*). In *Leptocera* there are no basal cells and no sub-costal vein ; the basal cells are distinct and the sub-costal vein present but slender in the other genera. Vibrissae are present and strong, the third antennal joint is rounded and bears a long, usually pubescent, arista. Richards in *Proc. Zool. Soc.* XVIII, 1930. In his monograph, cited above, Dr. O. W. Richards has mentioned under each species the counties from which he has seen specimens ; in the following list his records are marked (Rch.).

Cypsela = *Copromyza* = *Borborus.*

Cypsela costalis Zett. (*opacifrons* Duda, *vitripennis* Hal.). S., Sharpham (A.), 22/8/22.

,, *equina* Fall. G. and S., common.

,, *geniculata* Mcq. (*hirtipes* R.D.). G. and S., common.

,, *glacialis* Mg. (*glabrifrons* Mg., *notabilis* Coll.). S., Tickenham (A.), 16/9/22.

,, *longipennis* Hal. (*vitripennis* Mg.). G., Shepperdine (A.), 6/8/24. S., Taunton (P.) ; Highbridge (C.) ; Wells (L.). (Rch.).

,, *nigra* Mg. G. and S., common.

,, *nitida* Mg. G. and S., common.

,, *pallifrons* Fall. S., Kewstoke (J.), 7/17.

,, *roserii* Rnd. S., Wells (L.), (Rch.).

,, *similis* Coll. G. and S. (Rch.).

,, *stercoraria* Mg. (*nigrifemorata* Mcq.). G. and S., common.

,, *suillorum* Hal. S., Shepton Mallet (C.), (Rch.).

Leptocera = *Colinella* = *Limosina.*

Leptocera breviceps Stenh. (*geniculata* Mcq.). G., Painswick (W.); Awkley (A.), 5/9/23. S., Tickenham (A.), 20/7/33.

,, *coxata* Stenh. G., Painswick (W.); Fishponds (A.), 7/5/27. S., Banwell Caves (A.), 20/10/28; Sharpham (A.), 22/4/24.

,, *crassimana* Hal. S., Prior Park, Bath (A.), 18/7/25; St. Audries (A.), 26/8/29, (Rch.).

,, *curvinervis* Stenh. (*roralis* Rnd.). S., Wells (L.) (Rch.).

,, *fenestralis* Fall. (*erratica* Hal.). G., Painswick (W.); Bristol (A.), on window, 29/9/27.

,, *fontinalis* Fall. G., Fishponds (A.), 24/3/22; Blaise Castle (A.), 16/3/24. S., Wells (L.).

,, *fuscipennis* Hal. G., Aust (A.), 6/9/23.

,, *grentedsti* Rich. S., Taunton (Rev. L. W. Grensted), 25/7/27.

,, *heteroneura* Hal. G., Bristol (A.), on window, 29/9/27.

,, *humida* Hall. (*pumilio* Verr.). S., Taunton (P.).

,, *leucoptera* Hal. S., Shepton Mallet (C.).

,, *limosa* Fall. G. and S., common.

,, *lugubris* Hal. G., Bristol (C.); Shepperdine (A.), 30/7/24. S. (Rch.).

,, *ochripes* Mg. S., Wells (L.) (Rch.).

,, *palmata* Rich. G. (Rch.).

,, *pusilla* Mg. (*acutangula* Zett.). S., Taunton (P.).

,, *rufilabris* Stenh. S., Shepton Mallet (C.); Wells (A.), 10/8/25.

,, *scutellaris* Hal. G., Olveston (C.) (Rch.). S., Leigh Woods (A.) 2/21.

,, *silvatica* Mg. G., Bristol (C.). G. and S. (Rch.).

,, *simplicimana* Rnd. (*luteilabris* Rnd.). S., Taunton (P.).

,, *vitripennis* Zett. (*fungicola* Hal.). G. and S., fairly common.

,, *zosterae* Hal. G., Aust (A.), 6/9/22. S., Clevedon (A.), 10/19 St. Audries (A.), 24/8/29.

Sphaerocera denticulata Mg. (*nitida* Duda). G., Hallen (B.), 16/7/26. G. and S. (Rch.).

,, *monilis* Hal. G., Cirencester (T.) (Rch.).

,, *subsultans* L. G. and S., common.

,, *vaporiarorum* Hal. G., Wotton-under-Edge (P.); Bristol (Cott.), 11/32.

XXVIII. CHLOROPIDAE.

Small to medium-size flies (1-7 mm.) of a yellow or black colour. The wing resembles that of a *Sphaerocera* but there are no basal cells. The hind metatarsus is normal, the frontal triangle is usually large and well defined, there are no vibrissae and no strong bristles on the legs. The larvae are leaf-miners chiefly on grasses, some are gall-makers and one or two are parasites on the eggs of Spiders and Acridians. Becker in *Arch. Zool.* (Budapest) I, 1910 and J. Collin in *E.M.M.*, 1911, p. 146 and 1932, p. 112.

Anthracophaga strigula Fab. G., Hallen (A.), 8/5/29. S., West Town (Wm.), 10/7/17; Leigh Woods (B.), 22/5/27. On *Brachypodium silvaticum* Beauv.

Cetema (*Centor*) *cereris* Fab. S., Clevedon (W.); Weston-super-Mare (J.).

,, ,, *elongata* Mg. (*nudipes* Lw.). G., Hallen (A.), 27/8/16. S. Shapwick (A.), 3/9/22; Sharpham (A.), 18/8/25.

,, ,, *myopina* Lw. G., Cirencester (T.). S., Wells (L.); Tickenham (A.), 19/7/24.

Chloropisca glabra Mg. G., Bristol (C.), 24/4/07; Cirencester (T.); Olveston (A.), 4/6/22. S., Wells (L.). On Wheat and Grasses.

,, *notata* Mg. (*cicumdata* Mg., *ornata* Lw.). G., Wotton-under-Edge (P.); Bristol (C.); Olveston (A.), 3/4/29; Kingsweston (A.), 13/3/26. S., Clevedon (W.). Larva is polyphagous. Kearns in *E.M.M.*," 1929, p. 205.

,, *rufa* Mcq. (*abbreviata* Zett.). G., Bristol (C.). S., Shepton Mallet (C.).

Chlorops brunnipes Zett. (*brevifrons* Lw.). G., Awkley (A.), 1/9/23; Kingsweston (A.), 30/3/29. S., Shapwick (A.), 20/5/23; Clevedon (A.), 14/5/27.

,, *fulviceps v.* Ros. (*brevimana* Lw.). S., Clevedon (W.), 25/8/02.

,, *hypostigma* Mg. (*minuta* Lw.). G. and S., common. On *Dactylis glomerata* L.

,, *interrupta* Mg. (*hirsuta* Lw.). G., Olveston (A.), 2/9/23; Hallen (A.), 12/7/24; Dursley (A.), 20/6/25. S., Wells (L.); Brockley Combe (A.), 31/8/33.

,, *nasuta* Schrk. (*umbelliferarum* Scop.). G., Bristol (A.), 20/10/21; Kingsweston (A.), 6/5/23. S., Dunster (A.) 8/16. On Cereals and Grasses.

,, *pumilionis* Bjerk. (*taeniopus* Mg.). G. and S., fairly common. Gout-fly on Cereals.

,, *rufina* Zett. S., Tickenham (A.), 23/8/22.

,, *scalaris* Mg. (*didyma* Zett.). G., Hallen (A.), 30-9-23. S., Wells (L.); West Town (Wm.), 10/7/27; Leigh Woods (A.), 22/5/26.

,, *speciosa* Mg. G., Olveston (A.), 20/8/23.

,, *troglodytes* Zett. (*humilis* Lw.). G., Awkley (A.), 1/9/23; Kingsweston (A.), 30/3/29.

Diplotaxa messoria Fall. G., Wotton-under-Edge (P.).

Elachyptera cornuta Fall. G., Painswick (W.), 18/7/91; Olveston (A.), 2/7/22. S., Taunton (P.); Sharpham (A.), 7/8/23; Tickenham (A.), 16/9/22. On Cereals.

,, *megaspsis* Lw. S., Taunton (P.). On *Nasturtium officinale* Br.

Epichlorops puncticollis Zett. G., Olveston (A.), 8/18.

Eurina lurida Mg. G., Hallen (A.), 24/9/27. On *Arundo phragmites* L.

Lipara lucens Mg. G., Avonmouth (R.), 1927. On *Arundo phragmites* L.

Meromyza femorata Mcq. (var: of *variegata* Mg.). G. and S., common. On Grasses.

,, *pratorum* Mg. G., Stroud (W.); Hallen (B.), 1/7/29. S., Burnham (Rd.); Taunton (P.); Berrow (A.), 19/7/25. On *Dactylis glomerata* L.

,, *saltatrix* L. G., Shepperdine (A.), 30/7/24. S., Burnham (A.), 8/21. On Cereals and Grasses.

,, *variegata* Mg. (*laeta* Mg.). G. and S., common. On Grasses.

Oscinosoma = *Oscinis* = *Oscinella*.

Oscinosoma frit L. (*pusilla* Mg.). G. and S., common. On Cereals.

,, *frontellum* Fall. G., Hallen (A.), 12/7/24. On eggs of Spiders.

,, *nitidissimum* Mg. (*atricilla* Zett.). G., Cleeve (St.), 29/7/24. S., Clevedon (W.), 27/8/02; Berrow (A.), 6/4/29. On *Arundo phragmites* L.

Platycephala planifrons Fab. S., Berrow (A.), 27/8/24. On *Arundo phragmites* L.

Siphonella pumilio Zett. (*pumilionis* Beck.). S., Berrow (A.), 22/6/25.

,, *palposa* Fall. G., Painswick (W.) in Wasps' Nest, 5/94; Shepperdine (A.), 13/8/24. S., Tickenham (A.), 16/9/22. On egg-capsules of Acridians.

Tricimba (*Notonaulax*) *cincta* Mg. S., St. Audries (A.), 18/8/22.

,, ,, *lineella* Fall. G., Awkley (A.), 11/9/23. S., Knowle (Ch.). On *Lycoperdon* (Puffball Fungus).

XXIX. AGROMYZIDAE.

(including PHYTOMYZIDAE.)

Small flies (1-4 mm.), caught by sweeping or, better still, bred from plants in which the mines of the larvae can be seen; most species seem to live in one particular genus of plants or in a group of closely allied genera; the configuration of the mine is typical for each species. Hering in *Tierwelt Deutschlands* Vol. 6, 1927, Hendel in *Fliegen der Palaearkischen Region* Vol. 39, 1931, and J. Collin in *E.M.M.*, 1911, p. 253. Wing like that of *Chloropidae*, but either two cross-veins and two basal cells present (*Phytomyza*), or one cross-vein near the base and two basal cells (most genera), or one cross-vein near the base and only the lower basal cell (*Pseudonapomyza*); costa with one break.

Agromyza alnibetulae Hend. (*albitarsis* Hend. nec Mg.). G., Cirencester (T.), 25/5/24. On Alder and Birch.

,, *humeralis* v. Ros. (*bellidis* Kalt.). S., Clevedon (W.), 8/02. On Aster and Daisy.

,, *nigripes* Mg. S., St. Audries (A.), 30/8/29. On Grasses.

,, *reptans* Fall. G. and S., common. On Pellitory and Stinging Nettle.

Cerodonta (*Ceratomyza*, *Odontocera*) *denticornis* Pz. G., Cirencester (T.); Aust (A.), 6/9/23; Hallen (A.), 11/9/28. S., Tickenham (A.), 16/9/22; Sharpham (A.), 22/8/22. On Grasses.

Dizygomyza flavifrons Mg. (*exigua* Mg.). S., Wells (L.). On *Caryophyllaceae*.

,, *geniculata* Fall. G., Olveston (A.), 30/7/22. Host unknown.

,, *lamii* Kalt. G., Painswick (W.), 12/6/93. On Dead Nettles.

,, *morosa* Mg. (*laterella* Zett.). G., Olveston (A.), 6/4/22. On Sedges.

Domomyza mobilis Mg. S., Sharpham (A.), 10/9/25. On Grasses.

Liriomyza flaveola Fall. G., Hallen (A.), 11/9/28. S., Sharpham (A.), 22/8/22. On Grasses.

,, *flavonotata* Hal. (*scutellata* Fall.). S., Taunton (P.); Long Ashton (A.), 2/6/34. Host unknown.

,, *perpusilla* Mg. G., Painswick (W.), 5/7/02. Host unknown.

,, *pusilla* Mg. G., Olveston (A.), 30/7/22; Aust (A.), 6/9/22. S., Tickenham (A.), 24/4/22. On Sow-Thistle and Hawkweeds.

Melanagromyza pulicaria Mg. G., Doverow (W.), 2/5/93; Cirencester (T.), 17/7/24. On Sow-Thistle and Dandelion.

Napomyza heringi Hend. G., Painswick (W.), 1899. On Ash.

,, *lateralis* Fall. G., Doverow (W.), 2/5/93. S., Wells (L.); Berrow (A.), 29/9/24. On heads of *Compositae*.

,, *nigriceps* v.d. Wulp. S., Backwell (A.), 25/4/26. Host unknown.

,, (*Phytagromyza*) *discrepans* v.d. Wulp. G., Kingsweston (A.), 2/5/26. Host unknown.

,, ,, *spinicauda* Hend. G., Shepperdine (A.), 30/7/24. Host unknown.

Phytomyza (*Chromatomyia*) *affinis* Mg. G., Bristol (C.); Cirencester (T.), 6/23. S., Wells (L.). On Thistle and Ox-eye Daisy.

,, ,, *albiceps* Mg. G., Bristol (B.), bred from *Cineraria*, 8/5/26; Bristol (A.), bred from Chrysanthemum, 8/1/22; Shepperdine (A.), 30/8/24. S., Tickenham (A.), 19/7/24. Polyphagous.

Phytomyza (*Chromatomyia*) *ilicis* Curt. G., Bristol (C.) bred from Holly, 30/5/04; Tockington (A.), 8/5/27. On Holly.

„ „ *obscurella* Fall. G. and S., fairly common. On Goutweed, Hedge Parlsey and Angelica.

„ *albipennis* Fall. S., Prior Park, Bath (A.), 8/5/26. Host unknown.

„ *anthrisci* Hend. S., Keynsham (A.), 14/5/32. On Hedge Parsley.

„ *atricornis* Mg. (*geniculata* Mcq.). G., Bristol (A.), bred from Sow-Thistle, 22/6/30. Polyphagous.

„ *conyzae* Hend. G., Edgehill (W.), 19/6/04. On Fleabane.

„ *flavicornis* Fall. G., Cirencester (T.), 12/5/24. S., Portishead (A.), 15/10/22. On Stinging Nettle.

„ *milii* Kalt. (*cinereifrons* Hardy). G., Cirencester (T.), 3/8/23. On Grasses.

„ *ranunculi* Schrk. var: *albipes* Mg. G., Cirencester (T.), 17/8/23; Olveston (A.), 10/6/22; Hallen (A.), 12/7/24. S., Clevedon (W.), 29/8/02.

„ „ var: *flava* Fall. (*terminalis* Mg.). G., Bristol (C.); Stone (A.), 30/7/28. S., Wells (L.).

„ „ var: *flavoscutata* Fall. (*notata* Mg.). G., Bristol (C.); Blaise Castle (A.), 4/21; Olveston (A.), 2/5/22; Stone (A.), 1/5/27. S., Sharpham (A.), 22/4/24.

„ „ var: *praecox* Mg. (*zetterstedti* Schin.). S., Nailsea (A.), 21/4/27. All on Buttercups and Anemone.

„ *rufipes* Mg. G., Painswick (W.). On Cabbage.

XXX. CARNIDAE.

(Agromyzidae part.)

Very small flies (1-2 mm.). The genus *Meonura* contains flies whose larvae are saprophagous, the genus *Carnus* has only one species of which the larvae are parasitic on Birds. The 4th vein (MA_1) is very faint; the costa is broken in two places. There are only two cross-veins and no basal cells in *Meonura*, and only one cross-vein in *Carnus* in which the wing is reduced. J. Collin in *E.M.M.*, 1930, p. 82.

Meonura vagans Fall. G., Shepperdine (A.), 30/7/24.

XXXI. MILICHIDAE.

(Agromyzidae part.)

Very small flies (1-3 mm.). Costa broken in two places, costa reaches the apex of the 4th vein (MA_1), two basal cells present and the three normal cross-veins. Some attach themselves to larger Insects and Spiders to travel from place to place (phoresic). The larvae are coprophagous. J. Collin in *E.M.M.*, 1911, p. 233.

Desmometopa sordida Fall. (*m-atrum* Mg.). G., Shepperdine (A.), 11/8/24.

Madiza glabra Fall. G., Bristol (A.), on window, 17/9/33.

Phyllomyza securicornis Fall. G., Hallen (A.), 8/6/29. S., Sharpham (A.), 16/8/25.

PUPIPARA.

(Hippoboscidae and Nycteribiidae.)

These form an aberrant group of the Diptera Cyclorapha. The imagines feed on the blood of warm-blooded vertebrates. The larvae live inside the female until they are about to pupate, so that the female practically brings forth pupae. The imagines are apterous or have reduced wings; they are flat and horny; the eyes, which are large in some species, are reduced to ocelli in others, and disappear altogether in one genus; the antennae have only two short segments ; the legs may be long, short or absent. They are caught by hunting through the fur of mammals, the feathers of birds or their nests ; occasionally they may be caught in flight. Falcoz in *Faune de France*, Vol. 14, 1926 and Scott in *E.M.M.*, 1934, p. 255.

Crataerhina (*Oxypterum*) *pallida* Lat. G., Bristol (C. Alden), 27 /6 /07 ; Clifton (W. R. Taylor), 15 /7 /31. S., Clevedon (Wm.), 4 /7 /27. On Swifts.

Melophagus ovinus L. G., Painswick (W.). S., Banwell (Wm.), 6 /6 /25. The Sheep Tick. Has been found on Horse and Man (C.).

Nycteribia (s.g. *Celeripes*) *biarticulata* Hermann (*hermanni* Leach). G., Henbury (Miss Selman). S., Dundry (A.), 2 /21 ; Cheddar (Coward and A.). On various species of Bats.

Ornithomyia avicularia L. G. and S., fairly common on various species of Birds. G., Dursley (A.), caught in flight, 20 /6 /25.

Stenopteryx hirundinis L. G., Painswick (W.). S., Shepton Mallet (C.), 24 /8 /07 ; Cannington (Sl.), 2 /9 /26 ; Crewkerne (A. R. Hayward), 6 /8 /26. On House Martin and Swallow.

CORRECTIONS.

Part III, p. 202, l. 34, for *pennaria* Fall. (*vernalis* Mg.) read *nuntia* Mg.
Part VI, p. 434, l. 50. Delete G. Hallen (A.), 1 /8 /29.
Part VI, p. 440, l. 34-5. Delete records.

ADDITIONS.

TENDIPEDIDAE.

Endochironomus impar Wlk. G., Tortworth (A.), 27 /4 /27.

LARVAEVORIDAE.

Sarcophaga teretirostris Pand. S., Long Ashton (A.), 2 /6 /34.

MUSCIDAE.

Lispocephala erythrocera R.D. S., Shapwick (A.), 15 /4 /34.

PALLOPTERIDAE.

Palloptera umbellatarum Mg. (*parallela* Lw.). G., Hallen (A.), 1 /8 /29.

RECENT LITERATURE.

1. Séguy, E. Muscides Acalyptères et Scatophagides, *Faune de France*, Vol. 28, 1934. This monumental work (832 pages, 903 figures in text, 27 plates each showing 12 photographs of wings) is essential to all who wish to study the Acalyptrate Diptera.
2. Audcent, H. British Liriopeidae (Ptychopteridae), *Transactions of the Society for British Entomology*, Vol. I, Part 2, 1934.
3. Niblett, M. Some notes on British Trypetidae, *Ent. Rec.*, 1934, pp. 66-69.
4. Grimshaw, Percy H. Introduction to the study of Diptera, with a Key for the Identification of Families. *Proc. Roy. Phys. Soc.*, Edinburgh, Vol. XXII, Part 4, 1934. The booklet that has been needed for years to help the beginner in the collection and study of Diptera.

The list of the records of Diptera for the Bristol District, begun in these *Proceedings* in 1928 and completed in this number, contains about 1,750 species. A rough computation gives about 4,000 known species of British Diptera. There should be at least 3,000 species in this district, so favoured with various habitats (moor, marsh, woods, meadows, seashore). The compiler of this list is the only collector of Diptera domiciled in this district. He would welcome colleagues, and would be delighted to help collectors in every possible way. Flies can be sent him for determination, and for that purpose he appends his address :—

45 Belvoir Road,
St. Andrew's Park,
Bristol, 6.

Carboniferous Cephalopods from Shipham, Somerset.

By F. S. Wallis, D.Sc.

FOLLOWING the lead of the late Dr. Arthur Vaughan, fossil collecting in the Avonian rocks of the South-Western province has been concerned almost entirely with corals and brachiopods. Occasionally, examples of other classes of organisms have been found and noted. Amongst the cephalopods are a few isolated records of the presence of *Orthoceras*, the distribution of which is apparently restricted to the Lower Avonian rocks. Apart from the specimens of *Orthoceras* there are only two other known examples of cephalopods from the Carboniferous Limestone of the South-Western province. Both of these, which are fragmentary, are in the collections of the Bristol Museum and Art Gallery.

One (Reg. No. Ca 7351) has been identified as a fragment of *Solenocheilus pentagonus* (J. Sow.). This was found in the Avon Gorge and quite possibly is from the *Zaphrentis* zone. The other fragment (Reg. No. Ca 8992) is probably a septate chamber of *Solenocheilus dorsalis* (Phill.). The siphuncle is marginal, whilst a small notch on the other side of the septal plate indicates the position of the narrowly rounded periphery on the impressed area. This specimen was found in the Black Rock Quarry, Avon Gorge, and is definitely of *Zaphrentis* age.

During the last few years, a remarkable faunal assemblage of large cephalopods has come to the notice of the writer, through the gift of specimens to the Bristol Museum and Art Gallery and the Geological Department of the University of Bristol, by those interested in the L. W. Bryant (Quarries), Ltd. The quarry from which they have been obtained is situated on the east of the Shipham-Cheddar road about 1 mile S.S.E. of Shipham Church (O.S. 6 in. map Sheet 18 S.W. Somerset). Dr. F. B. A. Welch, in surveying the Black-down pericline,* maps the quarry at the base of the *Syringothyris* zone.

The rock consists of thinly-bedded, dark, dolomitised limestone, with many calcite "nests" and veins, dipping 30° S.S.W. Shaly partings are very subsidiary and silicification occurs at a few levels. Much of the rock is crinoidal and this character is more marked when corals and brachiopods are also present. The fossils include *Orthotetes crenistria* (Phill.), *Spirifer tornacensis* de Kon., *Caninia cylindrica* (Scouler) mut. γ Vaughan, *Caninia patula* Mich., *Caninia cornucopiæ* Mich. and small Zaphrentids. These coral- and brachiopodal-bearing limestones are especially well seen on the northern bank of the approach to the southern part of the quarry. The quarry is in the lower *Syringothyris* Zone and both horizon γ and subzone C_1 are represented.

ACTINOCERAS GIGANTEUM (J. Sow.). Plate 2, Fig. 1.

The largest straight shell in the fauna is *Actinoceras giganteum* (J. Sow.). This specimen, which is in the collections of the University of Bristol, has a total length of 28·0 cms. of which the body chamber measures 12·0 cms. The rate of tapering is 1 in 10 and the diameter of the last septal chamber is 11·5 cms. In section the shell is circular or nearly so. The septa are fairly concave and become slightly oblique as the living chamber is approached. The siphuncle is small and nearly central. The test is smooth.

MELOCERAS APICALE (Foord). Plate 2, Fig. 2.

The most striking of the cephalopods found has been determined as *Meloceras apicale* (Foord). This species is represented by two specimens given to the Bristol Museum and Art Gallery, in 1932 (Reg. No. Cb 2413) and in 1934 (Reg. No. Cb 2414 and Pl. I, fig. 2) respectively.

* *Proc. Bristol Nat. Soc.*, 4 Ser., Vol. VII, 1933 for 1932. Pt. V. Map.

FIG. 1

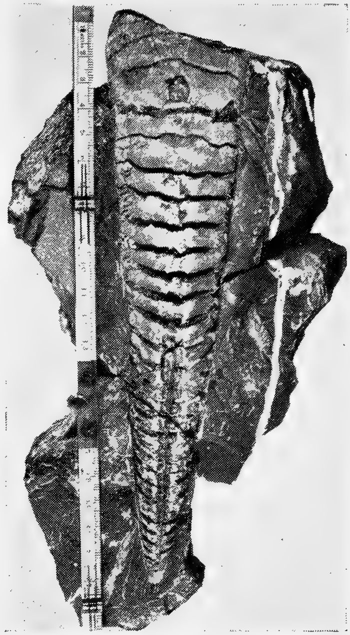


FIG. 2

FIG. 3

FIG. 4

CARBONIFEROUS CEPHALOPODS FROM SHIPHAM, SOM.

Photo Miss P. M. James [*To face p.* 538

The specimens—measuring 4·9 cms. and 22·5 cms. in length respectively—are wholly septate and so weathered as beautifully to expose the structure of the siphuncle. No traces of the shell are present and the inner exposed layer is smooth. The major portion of the shell is straight and it is only the earlier part which is slightly curved. The rate of increase in width is between 1 in 4 and 1 in 5. The extreme apex is unfortunately missing in both specimens. The section is distinctly elliptical at the apical end but becomes almost circular as the living chamber, of which there is no trace, is approached. The septa are numerous and moderately concave towards the aperture, the distance between them increasing rapidly—in one specimen varying from an interval of 0·3 cms. to that of 1·3 cms. in 19·0 cms. length. The sutural lines are horizontal when the shell is viewed from either the ventral or dorsal aspects, but are tilted in a ventro-dorsal direction and thus show a strong obliquity when seen on the side of the shell.

The siphuncle, always in the plane of symmetry of the shell, is situated close to the convex or ventral border of the shell. It is much inflated between the septa and characteristically exhibits a frilled, nummuloidal appearance resembling a string of beads. These spherical elements are pierced by an irregularly compressed, longitudinally ridged, ◊ -shaped tube. This swells at the point of connection with the thin calcareous horizontal membranes which partially cross the siphuncle at intervals and are continuous with the septa. Two of the angles of the irregularly shaped tube are oriented dorsally and ventrally.

AIPOCERAS GIBBEROSUM (DE KONINCK). Plate 2, Fig. 3.

One very large specimen (Reg. No. Cb 2418 and Pl. I, fig. 3), together with a fragment (Reg. No. Cb 2412) exhibiting portions of four gas chambers, have been found at Shipham; both are in the collections of the Bristol Museum and Art Gallery.

In the large specimen, slightly more than half a volution is represented whilst in the other the slightly quadrate, circular septal chambers represent part of an individual detached from a position fairly near the apex. The test is smooth and the true whorl shape is obscured by compression. The curvature of the shell is not regular, being less pronounced in the adult than in the earlier portions. About one half of the shell is occupied by the living chamber. The whorl section is compressed, increases rapidly in size and is roughly oval though more quadrangular in the early stages of growth. The dorsal area is broad, flat and always completely visible. The lateral areas are at first flat, but soon rapidly slope towards the rounded periphery.

The septa are moderately spaced. The sutures curve slightly backwards on the sides of the shell, bend forwards on the peripheral margin and then cross the periphery with a slight backward curvature; they also bend a trifle backwards on the dorsal part of the shell. The siphuncle is extremely small, ventral and close to the convex border; in the early stages of growth it is distinctly more central.

Diameter of shell	40·5 cms.
Height of whorl at anterior end of body chamber	10·5 cms.
Height of posterior whorl	21·0 cms.

Such an evolute form of the Solenocheilidae is interesting because it forms a link between the straight shells and the involute forms such as *Solenocheilus*. In whorl section, marginal siphuncle and suture line, *Aipoceras* is similar to *Solenocheilus*, only differing in its uncoiled form.

VESTINAUTILUS PAUCICARINATUS (FOORD). Plate 2, Fig. 4.

Only one specimen (Reg. No. Cb 2416 and Pl. I, fig. 4) of this species has been found. This has been split naturally at right angles to the median plane. The shell is absent and the specimen consists of about three loosely coiled volutions which increase rapidly in diameter and are exposed in a deep funnel-shaped umbilicus. The whorl is roughly trapezoidal in section and the peripheral area is broadly convex in outline with no indication of the usual keels, except a trace on the youngest portion of the shell which produces a well-defined indentation of the impressed region. The umbilical area has steep, sloping sides and, except near the aperture, is divided into two portions by a well-defined inner keel. The upper portion of this area in the Mendip example is less flat than in the type specimen; the umbilical slopes are slightly inflated below the inner keel. The keel entirely dies out as the body chamber is approached and in this specimen does not even persist as long as in the holotype. The septa are fairly close to each other, and the sutures, both on the umbilical slopes and the peripheral area, have a slight concavity directed towards the aperture. The siphuncle is small and sub-central.

Diameter of shell	11·2 cms.
Diameter of umbilicus	7·7 cms.
Height of outer whorl	4·1 cms.

Two other fragments, both consisting of the basal portions of body chambers, can only be specifically identified with doubt.

One of these, now in the collection of the University of Bristol, is elliptical in section but is constricted in diameter as the mouth is approached. The maximum diameter of the living-chamber is 3·8 cms. It should be placed in the genus *Meloceras* and possibly belongs to Foord's species, *arcuatoseptatum.*

The other specimen (Reg. No. Cb 2415), in the collection of the Bristol Museum and Art Gallery, may probably be identified as *Poterioceras fusiforme* (J. de C. Sow.). This body-chamber contracts fairly rapidly, and the base, diameter 6·5 cms., arches upwards in the dorsal region. The siphuncle is ventral, about half-way between the centre and the test.

No references to original or subsequent descriptions have been cited in this paper. Full descriptions of all the above species may be found in two works of Mr. A. H. Foord; either the Catalogue of the Fossil Cephalopoda in the British Museum (Natural History) Part I (1888) or Part II (1891), or the Monograph of the Carboniferous Cephalopoda of Ireland published by the Palæontographical Society between the years 1897 and 1903. A description of *Aipoceras gibberosum* (de Kon.) will be found in Annales du Musées Royal d'Histoire Naturelle de Belgique. Tome V. Faune du Calcaire Cabonifère, Part II, 1880.

We thus have the following forms occurring at Shipham :—*Actinoceras giganteum* (Sow.); *Meloceras apicale* (Foord); ? *Meloceras arcuatoseptatum* (Foord); ? *Poterioceras fusiforme* (J. de C. Sow.); *Aipoceras gibberosum* (de Kon.) and *Vestinautilus paucicarinatus* (Foord). In addition, several Orthoceratidae, *Solenocheilus pentagonus* (J. Sow.), and ? *Solenocheilus dorsalis* (Phill.), are known from the Lower Avonian rocks in other parts of the Bristol District.

Without giving details, it can be stated in general terms that such faunal assemblages are well known in many parts of Ireland, Southern Scotland and Northern England and always occur in Lower Avonian beds. A somewhat similar assemblage in the Isle of Man is of Upper Avonian age.

It appears that this is the first record of such cephalopods in the Avonian of the South-Western province and furthermore that these remains occur at the same general level as in other parts of the British Isles.

Their occurrence in one quarry on the Mendip Hills is certainly puzzling and it is hoped that future collecting will reveal a rich fauna of such forms. It seems difficult to visualize conditions which made this area particularly favourable for such organisms, as lithological characters reveal no special ecological factor. The type of rock found at Shipham is similar to that of the same horizons in other parts of the Mendip Hills.

Palæontologically, the assemblage is an interesting one in that it includes straight shells or orthocones, slightly curved shells or cyrtocones, an open spiral or gyrocone and a spiral with whorl-contact or ophiocone ; the genera representing these stages being *Orthoceras*, *Cyrtoceras*, *Aipoceras* and *Vestinautilus* respectively. It would be tempting to link all these forms together and show that the stock was gradually coiling. No such deduction is, however, possible, as several lineages are included in the genera, and difference in whorl section and position of siphuncle are fundamental and indicate more than a generic distinction.

In conclusion, my best thanks are due to Dr. W. D. Lang, F.R.S. and Dr. L. F. Spath, F.G.S., of the British Museum (Natural History), for advice and permission to compare these specimens with those in their charge ; to Professor A. E. Trueman, D.Sc., for permission to examine the specimens deposited in the Geological Department of the University of Bristol, and for his ready help and encouragement at all times, and to Mr. L. W. Bryant and his colleagues at Shipham for their courtesy in collecting and forwarding these interesting and unique specimens to the Bristol Museum and Art Gallery and to the University of Bristol.

Plate 2.

Fig. 1. *Actinoceras giganteum* (J. Sow.). x 0·25. University of Bristol collection.

Fig. 2. *Meloceras apicale* (Foord). x 0·3. Bristol Museum and Art Gallery collection. Reg. No. Cb 2414.

Fig. 3. *Aipoceras gibberosum* (de Koninck). x 0·13. Bristol Museum and Art Gallery collection. Reg. No. Cb 2418.

Fig. 4. *Vestinautilus paucicarinatus* (Foord). x 0·3. Bristol Museum and Art Gallery collection. Reg. No. Cb 2416.

A centimetre scale is included in each photograph.

All specimens are from L. W. Bryant (Quarries), Ltd., quarry at Shipham. Lower Syringothyris Zone (C_1 and horizon γ).

Insect Pests of Gardens in the Bristol District and How to Control Them.

By H. G. H. Kearns, B.Sc., Ph.D.

Introduction.

THE number of insect pests in the vicinity of Bristol is considerable, on account of the comparatively large area of land devoted to the production of a wide variety of crops in market gardens.

Bristol is unique in that gardens, allotments and market gardens can be found adjacent to densely populated areas. The presence of fairly extensive crops of different varieties of plants has enabled a number of insect pests to become firmly established. Many of these are increasing rapidly, as little effort is made to control them effectively. Thus, to quote one example, the Codling Moth, popularly known as the Apple Maggot, is responsible for appreciable losses of crop in nearly every garden. Unless steps are taken to control this pest or a biological check occurs, it may in time become impossible for the private gardener to obtain satisfactory apple crops in gardens.

Insect pests of gardens, particularly small and medium sized ones, present a number of difficult problems. The popular habit of growing green crops beneath fruit trees renders it almost impossible to suggest an effective spray programme for the trees without causing damage to the undercrops or rendering them unsuitable for human consumption. Another difficulty is the limited range of effective insecticides that can be purchased or used by amateur gardeners. Added to these difficulties is the fact that many control measures must be carried out at critical times, and this attention cannot always be conveniently given to garden plants.

Bearing in mind the difficulties under which the amateur gardener works and the wide range of plant pests, it is proposed to deal with a few of the major pests attacking :

Fruit crops,
Vegetable crops and
Flowers.

Fruit Pests.

The pests of fruit can be conveniently divided into two groups according to the time that control measures are put into practice to control them.

(*a*) Winter Control Measures.
(*b*) Spring Control Measures.

(*a*) *Winter Control Measures :* The Apple and Plum are subject to severe foliage injury by such pests as Aphides and Winter Moths. The Blackcurrant is attacked by Aphides and Green Capsid bugs.

The Apple and Plum pests can be easily controlled by a combination of grease banding and winter spraying with a tar oil emulsion. The grease banding should be carried out in October and early November. It is important that a reliable proprietary tree banding grease be purchased which will remain tacky during the coldest and wettest evenings in November. The material is best applied direct to the bark of established trees as a complete band of 4 in. diameter. In the case of young stock, less than 4 years old, it is desirable to protect the bark by means of a grease paper band, the grease being applied to this paper. Banding is best confined to established trees, especially as nursery stock is easily sprayed in spring on account of its small size. At regular intervals the surface of the grease should be raked over with a metal comb or stiff bristle brush in order to expose a fresh surface, thus ensuring that the maximum number of wingless female moths are caught and thereby prevented from laying eggs on the young wood.

The tar oil emulsion should be applied at 6 per cent. concentration during late December and early January on plums, and even later on apples, in weather that permits of rapid drying of the wash on the bark. Particular attention must be given to spraying the youngest shoots on the trees.

Blackcurrants are very subject to injury by Aphides and Capsid bugs, and if the latter pest is present it is necessary to apply during late February a special winter wash containing both tar and petroleum oils, taking care to wet new wood thoroughly.

Details are given below of the concentrations of washes and dates of application to various fruit crops.

WINTER WASHES.

Winter Washes are of three types :—

(1) Tar Oil Distillate Emulsions.
(2) Petroleum Oil Emulsions.
(3) Mixtures of (1) and (2).

The following table indicates the results that should be obtained with the above-mentioned washes :—

Pest.	(1) Tar Oil Emulsion.	(2) Petroleum Emulsion.	Mixtures of (1) and (2).
Apple Aphid	High control @ 5%	No control	*High control @ 6–7½%
Plum Aphid	High control @ 5%	No control	*High control @ 6–7½%
Currant Aphid	High control @ 5%	No control	*High control @ 6–7½%
Apple Sucker	High control @ 5%	No control	*High control @ 6–7½%
Winter Moth	75% control @ 10%	75% control @ 10%	75% control @ 10%
Apple Capsid	†Some control @ 10%	‡Good control @ 5–7½%	§Satisfactory control @ 10%
Currant Capsid	No control	‡Good control @ 5–10%	§Good control @ 10%
Red Spider	No control	Some control @ 5%	Some control @ 10%

* Provided the concentration of the tar oil in the wash (ready for spraying) is not less than 3½%.
† Provided the oil is a neutral high boiling fraction.
‡ Provided the content of petroleum oil in the wash (ready for application) is not less than 4½%.
§ Provided the content of high boiling neutral tar oil and petroleum oil is sufficiently high. The wash must be used in favourable climatic conditions.

Recommended Concentrations and Time of Application of the Washes.

Crop.	Concentration.	Time.
Apples	6–10% tar oil wash.	Depends on variety and condition of buds—not later than mid-March.
In cases of severe infestation of Apple Capsid	5–7½% tar oil wash.	January.
	5–7½% petroleum wash.	Mid- to end March, and in some seasons later. Suitably refined petroleum oils may be safely used after bud burst.
Plums	6% tar oil wash. (Higher concentrations damage buds.)	End December—Mid-January.
Pears	7½% tar oil wash.	End December.
Blackcurrants ..	10% mixed tar oil–petroleum wash.	Mid-February.
	5–7½% petroleum wash.	
	5% tar oil wash.	
Redcurrants	5% tar oil wash.	Early December (may cause some bud damage).
	5% petroleum wash.	Mid-February.
Gooseberry	5% tar oil wash.	January.
	10% mixed tar oil–petroleum wash.	Early January (may cause some bud damage).
Peach	3% tar oil wash.	December — In some seasons severe bud damage may be caused.
Nectarines	3% petroleum wash.	December — In some seasons severe bud damage may be caused.
Cherries	7½% tar oil wash.	January.

Composition of the Washes.

A. *Tar Oil Washes.*

(1) *Anthracene or ordinary Tar Oil Washes.*

Consist of a tar oil distilling approximately between 200°-360°C. The oil is emulsified by various reagents, such as sulphonated castor oil, oleic acid soap, resins, etc. The concentrate usually consists of 80-90% by volume of tar oil, and 20-10% of the emulsifier.

(2) *High Boiling Tar Oil Washes.*
The tar oil fraction used in these washes has a boiling range between 280°-360°C., and a low percentage of tar acids.

B. *Petroleum Washes.*

Consist of high boiling oils of medium viscosity. The more highly refined oils must be used after bud burst to avoid damage.

C. *Mixed Tar Oil Washes.*

The most satisfactory mixed washes consist of high boiling tar oil and petroleum oil. The final dilution of these washes must be adjusted carefully to ensure that a sufficient amount of each oil (tar oil and petroleum oil) is present to be of ovicidal value.

B. and C. are emulsified by similar reagents as used for A.

Winter washes cause an appreciable amount of damage to grass and a number of soft garden plants, and therefore it is important to protect them from the spray fluid which unavoidably drifts and drips from the sprayed trees. A protection is easily arranged by spreading out sacking or even newspapers around the trees.

The small amount of tar oil emulsion that soaks into the soil does not poison it and plants may be set out in it with safety about a month after the application.

(*b*) *Spring Control Measures : Apples.* The principal pests dealt with effectively by means of spring washes are the fungus disease Apple Scab and the insects Codling Moth, Apple Sawfly, Red Spider (*Acarina*) and, to a less degree, Aphides.

Commercially, apples are sprayed at least four times in spring with combined washes that possess both insecticidal and fungicidal properties. In gardens, good crops of clean fruit may be obtained by spraying at two periods of blossom development, the first period being the stage of the blossom buds just turning pink, and the second 3-10 days after full petal fall. Petal fall is determined as the date when most of the petals fall on giving the tree a sharp jar.

The following washes are recommended :

" Pink bud " stage :	* ¾ fl. oz.	Nicotine (98 per cent.).
	2½ pints	Lime sulphur.
	A proprietary	wetting preparation (not soap).
	10 galls.	Water.
After " Petal fall " stage :	* ¾ fl. oz.	Nicotine (98 per cent.).
	¾ pint	Lime sulphur.
	A proprietary	wetting preparation (not soap).
	* 3½ oz.	Lead arsenate powder.
	10 galls.	Water.

It is important to remember that certain varieties of apples are readily damaged by sulphur compounds, particularly after petal fall. Thus the variety Lane's Prince Albert cannot be sprayed with any wash containing sulphur without considerable risk of causing nearly complete defoliation.

In view of the numerous and often incorrectly named garden varieties of apples, it is difficult to give accurate information as to their susceptibility to sulphur damage. It is desirable before applying the post blossom wash to ascertain if the trees are sulphur " shy." This is conveniently determined by means of a preliminary test in which a small portion of each tree is sprayed with the correct concentration of the wash a few days before the actual spraying. Usually, if the variety of apple is liable to damage, the injury will be apparent within 2-3 days after the application.

The sulphur " shyness " varies to some extent from season to season, but the concentration given in the above formulae has been found satisfactory for a wide range of varieties over a period of years.

It is highly desirable that at least the " Pink bud " application of a fungicide be given, as an attack of scab, particularly in a wet season, will entirely spoil the quality of the fruit.

* May be substituted by derris, see text.

The inclusion of a wetter in the wash ensures that the toxic materials are spread over all surfaces of the leaves, etc., and enables them to come into intimate contact with the insects. Spray soaps are extensively used for this purpose, especially in conjunction with nicotine and derris, but they cannot be used in washes containing lead arsenate or lime sulphur, on account of deleterious chemical reactions and the formation of insoluble metal soaps. Recent research has shown that certain compounds employed in the textile industry have none of the disadvantages of spray soaps and are effective substitutes. Various proprietary wetting preparations can be purchased such as Agral " 2," Lethalate Wetting Preparation, Sulpholeum Powder, Spreadite, etc., and they should be used at the concentrations recommended by the makers.

Nicotine and lead arsenate are highly poisonous and must be used and stored with care. If the poisonous nature of these insecticides precludes their safe use in the fruit tree washes, they may be substituted by a reliable proprietary ground derris root.* It is suggested that 4 oz. (containing 1·5 per cent. crystalline rotenone) should be used to each 10 gallons of the wash. Unfortunately, derris will not provide a very high control of the Codling Moth and the following wash is recommended for those gardens requiring a satisfactory Codling control with ingredients that can be readily obtained on account of their less poisonous properties.

Colloidal sulphur.† Colloidal Barium Silicofluoride.‡ Soap or Wetter. Water.	In proportions according to makers' instructions.

To each 10 gallons of wash add 4 oz. derris root (containing 1·5 per cent. crystalline rotenone).

Plums. Plums should be sprayed, in addition to winter washing, with a 1·0 per cent. concentration (1 gallon per 100 gallons water) of lime sulphur, 2-3 weeks after blossom fall in order to control Red Spider (*Oligonychus ulmi*). This pest is frequently responsible for the scorched up appearance of the foliage in June and July of dry summers, and a severe attack reduces the vigour of the trees for the following season.

Currants. One of the commonest pests of currants is Big Bud Mite (*Eriophyes ribis*), which may be effectively controlled by the application of a 6 per cent. concentration of lime sulphur. The wash must be applied when the leaves in early spring are about the size of a shilling. Some varieties, particularly the " Edina " group, cannot safely be sprayed with a stronger concentration than 4 per cent. In most cases some foliage damage will result, but the injury will have no effect on the cropping of the bushes. Currants should be sprayed each season, thereby preventing the pest from becoming well established in a garden. If Capsid bug is present and has not been controlled by a winter wash, it may be checked by the application of either a nicotine or a derris wash.

Gooseberries. The principal summer pest of gooseberries that is not controlled by winter washing is the Goosebery Sawfly (*Pteronus ribesii*) which frequently defoliates the bushes. The caterpillars are readily controlled by the application of a derris or pyrethrum wash.§ There are three broods of larvae in a season, and it is desirable that the first, occurring in May, should be controlled.

Strawberries. There is an increasing difficulty in growing good crops of strawberries from the same bed for more than three seasons, due to the sudden failure of the plants. This degeneration has been partly caused by the propagation from weak strains of parent plants and of the attacks of various pests. The most important of these are Aphid (*Capitophorus fragariae*), Red Spider (*Tetranychus telarius*) and Tarsonemid Mite (*Tarsonemus fragariae*). The for-

* " Polvo," Murphy's 100 per cent. Derris, etc.
† " Ialine," " Solsol," etc.
‡ " Flosol."
§ Pysect Concentrate.

mer two pests can be controlled by the application of the following combined wash before the flowering period and again after picking.

¾ pint.	Lime sulphur.
½ oz.	Nicotine.
2 oz.	Agral " 2 " *or* Lethalate Wetting Preparation.
10 galls.	Water.

An alternative wash is a pyrethrum emulsion.* Tarsonemid Mite cannot be controlled by spraying and at the moment can only be dealt with by planting out runners that have been treated with hot water. The hot water treatment of runners consists of placing the runners, preferably taken in spring, in hot water at 110°F., and keeping them immersed with the temperature maintained for 20 minutes. It is important that a reliable thermometer be used and in no circumstances should the temperature exceed 110°F. The runners after treatment should be planted out as soon as possible in well prepared soil. These treated runners are best regarded as nursery stock from which clean runners can be obtained in the following season. The treatment incidentally provides a control of red spider and aphid, but it must be remembered that both these pests can rapidly re-infest the plants from other strawberries; the Mite, on the other hand, is considerably slower in its rate of distribution.

Raspberries and Loganberries. The two common insect pests of raspberries and loganberries are the Raspberry Moth (*Incurvaria rubiella*) and the Raspberry Beetle (*Byturus tomentosus*). The former causes a number of the shoots to wither and die off in early spring, when a red grub may be found within the dead shoot. This pest may be checked by watering the canes with a 7½ per cent. concentration of a tar oil emulsion in spring just before bud burst.

An attack of the Raspberry Beetle may be readily detected by the presence of larvae wandering over the freshly picked fruit and floating in the syrup of preserved berries. The beetles lay their eggs in the flowers, and the pest is readily controlled by applying a derris wash to the maturing berries at two and three weeks after the date when the majority of the flowers have lost their petals. If the attacks have not been severe one application three weeks after petal fall will suffice. The wash should consist of the following:

4 oz. ground derris root (containing not less than 1·5 per cent. crystalline rotenone).
½ lb. spray soap or a proprietary wetter.
10 gallons water.

Vegetable Pests.

The most prevalent insect pests of vegetables in the Bristol district are Greenfly, White Fly, Root Fly, Carrot and Onion Flies, Flea Beetles and Potato Eelworm.

Greenfly may be successfully controlled provided that suitable washes are applied before the infestations are extensive. If the attacks are of long standing, particularly in the case of sprouts, it is extremely difficult to get the insecticides into intimate contact with the aphides in the curled up leaves. A nicotine wash provides good results, particularly if it is applied on a warm day in order to increase its fumigant action.

The following wash is recommended:

½ oz. Nicotine.
Proprietary wetter.
10 galls. Water.

Most of the Brassicae have waxy leaves and it is important that sufficient wetter be added to the wash in order to obtain an adequate wetting of the foliage. A Nicotine wash may be used provided that about three weeks are allowed to elapse before the crop is picked. A non-poisonous wash such as pyrethrum emulsion* will provide satisfactory results.

White Fly (*Aleurodes brassicae*) (a different species from that occurring in greenhouses), has become very troublesome during the past two seasons. An established infestation cannot be controlled except at considerable expense. Two or three applications of a nicotine or pyrethrum wash during August and September will materially reduce the chances of a severe attack. The wash must be applied liberally to the lower surfaces of the lower and outside leaves.

Cabbage Root Fly (*Chlorotophila brassicae*) is responsible for the sudden wilting and death of large numbers of recently set out cruciferous plants. The most effective method of control is the application of a mercuric chloride solution to the plants at 7 and 21 days after setting out. The solution is prepared by dissolving 1 oz. in 1 gallon of hot water and diluting this concentrate with 9 gallons of water for use. The solution is extremely poisonous and must be mixed, used and kept in glass, enamel, or wooden containers. A galvanised bucket painted inside with a cellulose lacquer makes a satisfactory vessel. About ¼ pint of diluted solution is required for each plant.

Whizzed naphthalene† broadcast around each plant immediately after setting out, and again at 7 and 14 days later, will provide a control, but a less satisfactory one than mercuric chloride.

Naphthalene applied in a similar manner will provide a control of the Carrot and Onion Flies.

The Flea Beetles (*Phyllotreta* sp.) during hot dry weather in May frequently destroy whole beds of cruciferous seedlings, particularly where they are in the two leafed stage. The beetles may be materially checked by one or more applications of a derris dust‡ to the rows of seedlings as soon as they come through the soil. The dust is readily applied by shaking it through a muslin bag.

Potato Eelworm (*Heterodera schachtii*) is prevalent in many allotments and gardens where continuous potato cropping is carried on in the same soil. There is not a satisfactory method of control but naphthalene dug into the soil at the rate of 4 oz. per sq. yard and liberal applications of farmyard manure sometimes make it possible to grow satisfactory crops on infested soil.

The larvae of the Cabbage Butterfly often completely defoliate Brassicas in Autumn. The pest is very easily controlled by the application of a derris or pyrethrum wash.

Flower Pests.

The pests of flowers are numerous and they may be conveniently divided into (*a*) those attacking outside plants, (*b*) those attacking greenhouse plants and (*c*) soil insects.

One of the most widespread pests is greenfly and it causes considerable damage to the foliage and buds of a wide range of plants. Control measures must be carried out before the infestations become severe, and excellent results may be obtained from the thorough application of a nicotine wash or of the non-poisonous washes, such as derris or pyrethrum emulsion. The concentrations recommended previously, for Aphides on vegetables, are satisfactory for all kinds of flowers. Roses and honeysuckle may be safely sprayed in winter with a 3 per cent. concentration tar oil emulsion as a means of controlling greenfly.

Red Spider and Thrips are often troublesome pests in greenhouses and frames, and at times Red Spider does considerable damage to carnations grown in the open. Both pests may be controlled by the regular application

* Pyrethrum emulsions should be used the same day as mixing. It is advisable to purchase fresh stocks of the insecticide each season as the toxic principles, the pyrethrins, tend to break down on storage.

† Whizzed naphthalene may be purchased at about 4d. per lb. or 12s. per cwt.

‡ Proprietary derris dust "Drymac No. 1," "Rotomort," etc.

of a pyrethrum emulsion. It is important that the lower surfaces of the leaves be thoroughly sprayed. Both pests are prevalent in houses in which the atmosphere is very dry and an increase in the humidity often results in marked reduction in the intensity of the attacks.

Chrysanthemum Eelworm is well established in nearly every greenhouse and it causes the lower leaves of the plant to blacken and die prematurely, with consequent reduction in the crop of flowers. The only satisfactory method of control is obtained by propagating cuttings from stools that have been hot water treated (see strawberries) and growing the plants in eelworm free soil.

A number of soil pests, such as the larvae of the Cutworm Moths, Chafers, Leather Jackets, Millepedes, etc., may be controlled by digging naphthalene into the soil at the rate of 4 oz. per square yard and by broadcasting a poison bran bait of the following composition :—

1 lb. Paris Green (very poisonous).
4 lb. Bran.
1 lb. Sugar.
1-1½ gallons water.

The bran and the Paris Green are thoroughly shaken together and, as required, mixed with sufficient sweetned water to make the bran just moist. Sodium fluoride may be substituted for the Paris Green if the poisonous nature of the latter precludes its safe use. More than one application of the poison bait may be necessary.

Insecticides and Methods of Application.

Amateur gardeners have the greatest difficulty in obtaining small quantities of effective insecticides and as a result purchase very high priced preparations of an undeclared composition and of unproved efficacy. In order to obtain a satisfactory control of insects the correct insecticides must be used, and it is strongly recommended that, if it is impossible to purchase such poisons as nicotine and lead arsenate, then they should be substituted by ground derris root and pyrethrum emulsions of reputable make. These two insecticides have a wide range of toxicity and may be used safely on all plants, consequently they are of great value to the gardener.

It is important that the insecticidal washes be applied thoroughly and this is most conveniently carried out by means of an efficient hand sprayer. The type of pump that sucks the liquid from a pail by means of a length of rubber hose is recommended and may be purchased from about 15s. Hand syringes are wasteful of the fluid and inefficient.

This article deals only with some of the most widely distributed insect pests, but there are many others that are not mentioned which cause considerable losses of plants in gardens. If there is any doubt concerning the identification and method of control of a plant pest, Long Ashton Research Station will be pleased to attend to enquiries.

The Lower Lias at Hock Cliff, Fretherne.

By I. J. Henderson, M.Sc.

Introduction.

HOCK CLIFF is situated on the left bank of the River Severn about nine miles south of Gloucester. It is important in that it is the only locality in the Vale of Gloucester where an extensive natural section of the Lower Lias can be seen. There are now practically no other exposures of the Lower Lias in this area except the smaller cliff section at Maisemore (Richardson, 1906, p. 259) and the brickpits at Gloucester (Robin's Wood Hill) and Cheltenham (Webb's Pit, Battledown), in all of which higher beds are exposed. Many of the old sections in which the lower part of the Lias was seen, as for instance those at Purton, are now overgrown.

The exposure at Fretherne consists of a low cliff more than half a mile in length. Some of the bands form reefs in the foreshore, where the lower ones can be examined only at low tide.

From this locality the type specimens of *Gryphæa incurva* J. Sowerby, *Lima antiquata* J. Sowerby, and several species of Cardinia, namely *C. cuneata* (Stutchbury), *C. ovalis* (Stutchbury) and *C. imbricata* (Stutchbury), were obtained.

The section has been studied with a view to obtaining definite evidence concerning the extent of the zones represented. Unfortunately, material in situ was not common and was frequently poorly preserved ; therefore, loose material was also collected as this would help in determining the horizons exposed.

I wish to record here my sincere thanks to the Colston Research Society for a grant towards the cost of publication, to Mr. J. W. Tutcher for the loan of specimens, and especially to Professor A. E. Trueman for his help and advice throughout.

Historical.

The section was first described by George Cumberland in 1822. In 1853, the Rev. P. B. Brodie in a short account of the cliff said that the beds consisted of the Lower Lias overlying the Ostrea bed. W. C. Lucy in 1883, gave a more detailed account of the stratigraphy and palaeontology and illustrated his paper by sections. In 1893, H. B. Woodward described the section and said that the beds belong to the zones of *Ammonites angulatus* and *A. bucklandi* and perhaps include higher stages.

In 1908, the exposure formed the subject of a paper by Mr. L. Richardson. Concerning the horizon of the beds he stated : " Provided the identifications are correct, the ammonites found by previous investigators indicate that the date of the clays and limestones exposed in this cliff is *megastomatos-obtusi*. I have obtained specimens of *Schlotheimia charmassei* (d'Orbigny) from the clay deposit, bed 23, exposed in the shore at the western end of the cliff, while Mr. S. S. Buckman, F.G.S., has found evidence of deposits of *gmuendensis* hemera. *Arnioceras bodleyi* (J. Buckman) is not uncommon, and probably indicates *Birchi* hemera, so that the date *marmorea-Birchi* at least may be accepted, with the possible extension to *megastomatos-obtusi*."

In 1910, Mr. Richardson wrote that : " The topmost limestones of *Marmorea* hemera are just visible at low tide, and are succeeded by nodule-lined clays of *Rotiformis-gmuendensis* and possibly later hemerae."

In 1922, Professor A. E. Trueman, in a note on the section stated that : " It appears from recent observations that no beds lower than the *bucklandi* zone are present. Large *Arietid* ammonites are found in the lowest reef on the foreshore (No. 24 on Mr. Richardson's section)."

General Description.

The Lower Lias at Fretherne consists of a series of alternating shales and limestones. The shales are dark grey in colour, except in bed No. 1 and the top part of bed No. 3, where they are yellowish, probably owing to surface weathering; in bed No. 23 they are almost sufficiently well laminated to merit the term paper shales.

The limestones, which are grey except in the highest band, occur as thin beds dividing the shales, and, being harder, form prominent bands in the cliff and ledges in the foreshore. They are frequently nodular in character, especially in the higher beds, so that the upper surface when exposed is irregular in appearance; the lower beds are generally more even, though some show slight evidence of nodular structure. Joints are well developed, the principal set running almost due north and south; they are best seen in the lowest limestone bed, which forms a flat platform, but can be seen in any of the limestone bands exposed in the foreshore.

The beds lie almost horizontally throughout most of the section, but there are two slight anticlinal folds, one at the N.W. end and the other near the middle of the section. In the latter the fold is cut by a thrust fault with a small throw. In the foreshore some of the lower beds are seen to be turned up against the fault. The limestone bands on either side of the fault can be readily correlated by the thicknesses of the intervening shales.

Section.

In the following section the numbering used by Mr. Richardson is retained; that is, the beds are numbered from the top downwards.

		ft.	ins.
1.	Yellowish loamy shale.	1	6
2.	Limestone, yellowish and rather earthy. This bed is seen only at the S.E. end of the section. The fossils in it are found throughout the whole thickness of the bed, unlike the lower limestones. *Rhynchonella* (*Piarorhynchia*) *gryphitica juvenis* (Quenstedt), *Cardinia lanceolata* (Stutchbury), *Gryphæa incurva* Sowerby, *Arnioceras* sp.		2–6
3.	Shale, yellowish above becoming more grey in colour lower down.	2	0
4.	Limestone.		2–4
5.	Shale. When washed this shale was found to be rich in crystals of selenite. From the washed material, Foraminifera (common), Echinoid spines (fairly common), spicules and Ostracoda (both abundant) were obtained. *Arnioceras bodleyi* (J. Buckman).	8–10	0
6.	Limestone.		4
7.	Shale. A fresh surface shows numerous light coloured spherical bodies which proved to be calcareous. Samples of this shale when washed yielded Foraminifera (fairly common), Echinoid spines, spicules and Ostracoda (common). *Arnioceras bodleyi* (J. Buckman).	2	0
8.	Limestone nodular.		6
9.	Shale. Washings of this shale yielded Foraminifera (not very common), Echinoid spines, spicules, Ostracoda (common), and Holothurian plates (rare). *Arnioceras obliquecostatum* Zieten, *Astarte* sp., *Mactromya* sp.	8	0
10.	Limestone very nodular and not very fossiliferous. *Lima gigantea* Sowerby, *Gryphæa incurva* Sowerby.		8
11.	Shale with intermittent limestone. This shale has yielded Foraminifera (very common), Echinoid spines, spicules, Ostracoda (common) and spat of Gryphæa; also nodules of pyrites.	4–6	0

12.	Limestone very nodular. For the most part it is unfossiliferous, but there are on the upper surface richly fossiliferous patches. Pentacrinus (stem only), *Lima gigantea* Sowerby, *L. duplicata* Sowerby, *Pecten textorius* Schlotheim, *Oxytoma inaequivalve* (Sowerby), *Gryphæa incurva* Sowerby, *Nautilus* sp.		5–10
13.	Shale with intermittent median limestone band which is richly fossiliferous. The fossils are spread through the limestone. Pentacrinus (calyx), *Lima gigantea* Sowerby, *L. duplicata* Sowerby, *L. punctata* Sowerby, *Oxytoma inaequivalve* (Sowerby), *Gryphæa incurva* Sowerby, *Nautilus* sp. and pyritised wood. From the shale *Arnioceras* sp.	4–5	0
14.	Limestone nodular and richly fossiliferous in patches on the surface. *Lima gigantea* Sowerby, *L. punctata* Sowerby, *L. pectinoides* Sowerby, *Pecten textorius* Schlotheim, *Oxytoma inaequivalve* (Sowerby), *Gryphæa incurva* Sowerby, *Modiola hillanoides* Chapuis and Déwalque, *Nautilus* sp.		6
15.	Shale. *Pinna* sp.	1	9
16.	Limestone with fossiliferous patches on the upper surface. *Rhynchonella* (*Piarorhynchia*) *deffneri* Oppel, *Pecten textorius* Schlotheim, *Oxytoma inaequivalve* (Sowerby), *Gryphæa incurva* Sowerby.		5
17.	Shale with occasional limestone nodules. This has yielded *Oxytoma inaequivalve* (Sowerby) and a few other small Lamellibranchs too crushed to be identified and also some very young stages of an ammonite.	3–3	6
18.	Limestone slightly nodular.		5
19.	Shale with an intermittent limestone band near the top. Poorly preserved fragment of *Charmasseiceras charmassei* (d'Orbigny).	2	0
20.	Limestone rather irregular. *Lima punctata* Sowerby, *Pecten calvus* Goldfus, *Gryphæa incurva* Sowerby.		0–6
21.	Shale with an intermittent limestone band near the middle. Patches of jet in the shale with calcite developed along the cracks. *Gryphæa incurva* Sowerby.	1	8
22.	Limestone. *Pecten calvus* Goldfus, *Gryphæa incurva* Sowerby.		3
23.	Shale finely laminated ; it might almost be termed a paper shale. *Inoceramus pinnaeformis* Dunker, *Gryphæa incurva* Sowerby.	1	2
24.	Limestone. This bed is exposed at low water as a level platform ; joints are well seen, dividing the surface into rectangular blocks. Fossils occur in patches on the surface, frequently raised above the general level of the bed. Pentacrinus (stem only), *Lima punctata* Sowerby, *Pecten calvus* Goldfus, *Vermiceras scylla* (Reynès).		

Fossils Not Found in Situ.

This list includes only those forms of which no example was found in situ ; numerous other forms were found loose but were also seen in place. The fossils found loose only may be divided according to their mode of preservation into those which are probably from the limestone and those from the shale.

Limestone :

Lima antiquata Sowerby, *Coroniceras bucklandi* (Sowerby), *Eucoroniceras sinemuriensis* (d'Orbigny), *Coroniceras* sp., *Paracoroniceras* sp.

Shale:

Myoconcha sp., *Pleurotomaria* sp., *Arnioceras spirale* Fucini, *Epammonites isis* (Reynès), *Eucoroniceras sinemuriensis* (Quenstedt non d'Orbigny, 1883, Pl. II, fig. 20).

FORAMINIFERA.

Samples of shale from four beds, Nos. 5, 7, 9, and 11, were washed in order to examine them for Foraminifera. The shale was covered with water and allowed to stand overnight, a small quantity of potassium hydroxide was then added and the whole boiled till the shale was broken up into a fine deposit; this was strained through fine muslin and washed. The residue was dried and examined under the microscope; Foraminifera and other organisms were separated out and mounted.

The Foraminifera thus obtained belong to the Families Lagenidae, Ophthalmidiidae, Silicinidae, and Globigerinidae (Cushman, 1928); of these the last two are represented by one genus only, the Ophthalmidiidae by two genera, while the Lagenidae are represented by several genera and are by far the most abundant group.

FAMILY LAGENIDAE.

Nodosaria.

These forms show considerable variation in the number and strength of the ribs, the shape of the chambers, and the strength of the sutures. The chambers are in most cases globular but in some specimens they are almost rectangular. The sutures are usually fairly deeply incised but in a number of specimens they are almost obliterated in the earlier part of the test so that the margin is entire. The aperture is on a short rostrum.

Dentalina.

This genus is the most abundant in the shales examined. The Dentalinae show considerable variation in form, straight and curved forms are both common; the chambers are sub-cylindrical, ovate and rectangular in shape, while the sutures are straight in some forms and oblique in others. Smooth forms are most numerous but a few ribbed forms were found. The aperture is in most cases on a short rostrum which is generally central but in a few forms is marginal.

Saracenaria.

This genus includes some of the forms which were previously grouped under Cristellaria. The forms which are included in the genus Saracenaria by Cushman are distinguished from those placed in the genus Robulus by one character only, viz., the uncoiling in the later stages. All the " Cristellarias " found at Fretherne show such uncoiling, but, in some other characters, they would be more conveniently grouped with the genus Robulus.

FAMILY OPHTHALMIDIIDAE.

Spiropthalmidium acutimargo (Brady).

(Cushman, p. 165, Pl. 20, fig. 7; Pl. 21, fig. 5.)

Spiroloculina (part) H. B. Brady (non d'Orbigny).

This species is represented by only two examples. They show the characteristic features of the species; a globular proloculum followed by tubular chambers coiled loosely in one plane, the chambers being connected by a plate which is yellowish-brown by transmitted light. This species is almost unknown in the Lias and is very rare in Britain, but was recorded by Mr. J. Wright in the shales of the Maisemore section, as *Spiroloculina acutimargo* Brady (Richardson, 1906, p. 261).

Cornuspira.

It is difficult to separate the species of this genus from Ammodiscus, which it closely resembles in form and general character, differing chiefly in having a calcareous test, while the latter is finely arenaceous ; the surface in both genera is frequently smooth, however, and it is not unlikely that they are in reality more closely allied than the present classification would suggest. Chapman has suggested that most records of Cornuspira from the Mesozoic actually refer to Ammodiscus (1902, p. 99), although Cornuspira is abundant in the Tertiary (Jones, Parker and Brady, 1866, p. 1; 1895, p. 126).

FAMILY SILICINIDAE.

INVOLUTINA.

The shell is similar in form to that of Cornuspira, but has the tubular chamber partly divided by incomplete walls, and the test partly arenaceous.

DISTRIBUTION OF FORAMINIFERA.

Bed No.	5	7	9	11
FAMILY LAGENIDAE.				
Lagena laevis Montagu	FC			
sulcata (Walker and Jacob) ..	R			
Nodosaria raphanus Linnaeus	C	C	FC	C
raphanistrum Linnaeus	FC		FC	
mutabilis Terquem				R
Dentalina brevis d'Orbigny	FC			
communis d'Orbigny	FC	FC		
rapa d'Orbigny				R
cf. *brevis*	FC	FC		FC
cf. *communis*	FC			FC
cf. *fragilis* Terquem		FC		
cf. *nodosa* d'Orbigny	FC		FC	
cf. *pyriformis* Terquem ..	R			
cf. *simplex* Terquem		FC		
spp.	C	C	C	C
Lingulina tenera Bornemann	C	C	C	C
Marginulina inaequistriata Terquem ..	R			
porrecta Terquem				FC
spp.	FC	R		C
Saracenaria crepidula Fichtel and Moll ..				R
varians Bornemann				R
sp.	R			
FAMILY OPHTHALMIDIIDAE				
Spiropthalmidium acutimargo (Brady) ..		R		
Cornuspira infima (Strickland)	C	C	C	C
FAMILY SILICINIDAE				
Involutina liassica Jones				FC
FAMILY GLOBIGERINIDAE				
Orbulina liasica Terquem			R	

In the above table the following abbreviations are used:—

C—the species is common in the bed indicated.
FC—fairly common.
R—rare.

ECHINODERMATA.

ECHINOIDEA.

Numerous small Echinoid spines were obtained from the residue of the shales after washing. These were mostly broken. They are marked by strong longitudinal ribs, and in many specimens tubercles are developed. Spines of several types were obtained, but they are not comparable with any figures available (Wright, 1857-1878).

CRINOIDEA.

Fragments of Crinoid stems are common, large numbers being found loose on the foreshore, having apparently been washed out of the shales, while they are also found in situ in a number of the limestone bands. Only one calyx was found (in the limestone band in bed No. 13) and this was not well preserved. The fragments of stem may be referred to the genus Pentacrinus, and the calyx probably belongs to the same genus.

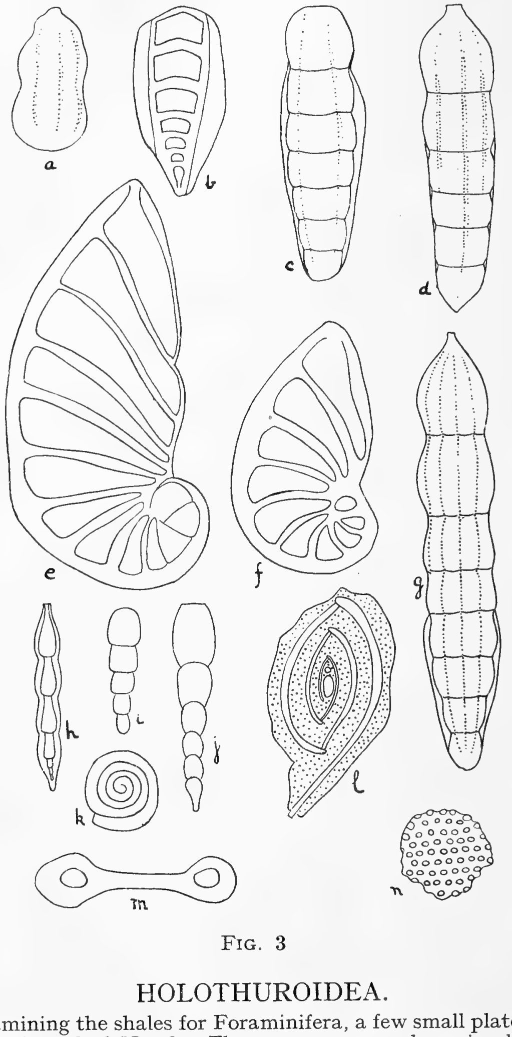


FIG. 3

HOLOTHUROIDEA.

While examining the shales for Foraminifera, a few small plates were found in the residue from bed No. 9. These are more or less circular in outline and are covered with hexagonal perforations. Diameter of plates 0·2 mm. Diameter of perforations about 0·018 mm.

These are considered to be plates of Holothuria. They resemble the plates of Synapta and the perforations agree approximately in size with those of the modern forms which have been measured for comparison. Microscopically they also agree with modern plates, showing between crossed nicols a finely granular structure of similar character.

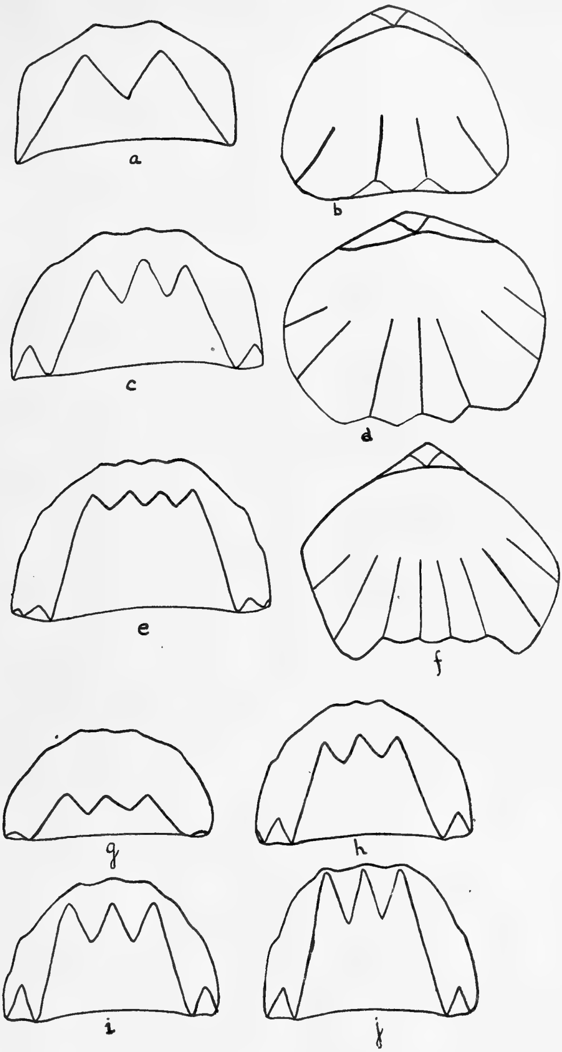


FIG. 4

? HOLOTHUROIDEA.

In the course of washing the shales for Foraminifera, numerous small spicules were found in each of the beds examined. These spicules are calcereous in composition. They are short straight rods with a ring at either end, having an average length of 0·432 mm.

Similar spicules, of approximately similar size, were figured by Terquem and Berthelin (1875, Pl. IX, fig. 9a) and along with others were regarded by these authors as derived from the ambulacral tubes of Cidaris, although it was admitted that similar spicules were unknown in living forms. Tate and Blake illustrated a spicule from the Lower Lias with a ringlike process at one end (1876, Pl. XVII, fig. 43).

These spicules are tentatively referred to the Holothuroidea since it is not clear to what other group they may belong. They do not, however, show the distinctly fibrous structure exhibited by the spicules of modern Holothuria, but have between crossed nicols a finely granular appearance.

BRACHIOPODA.

Rhynchonella (*Piarorhynchia*) *gryphitica juvenis* (Quenstedt).

Terebratula gryphitica juvenis Quenstedt, 1868, p. 40, tab. 37, figs. 11-29.

The test is sub-trigonal to oval in shape; both valves are convex, but the ventral one only slightly so. There is a wide sulcus on the ventral valve with a corresponding fold on the dorsal valve. The shell is ornamented by

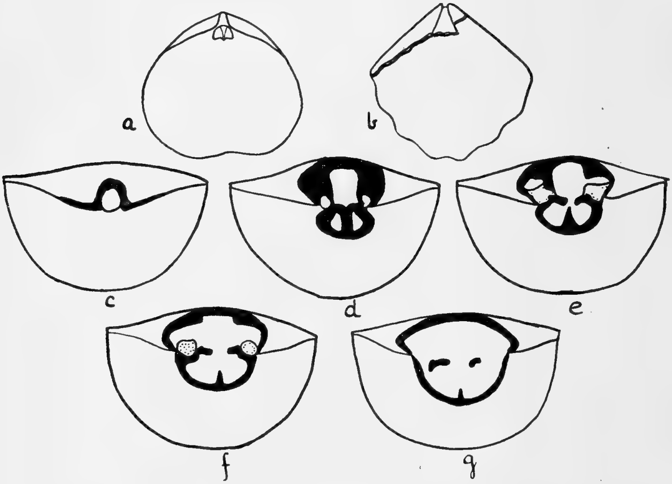


FIG. 5

radial ribbing, the ribs not commencing until about half-way between the umbo and the margin of the shell. The ribs vary in number from one to three in the sulcus with two to four on the fold, while there are, in all the specimens, two ribs on either side of the fold. The depth of the sulcus varies greatly; it may be only very slight or nearly as deep as the valves; the majority of specimens lie about half-way between these two extremes.

Quenstedt's figures of *T. gryphitica juvenis* cover a greater range of forms than the specimens from Fretherne. The majority of the Fretherne specimens resemble most closely his figures 11 and 12, the remaining figures showing specimens quite different from any among the variants studied from Fretherne. It may be suggested that the specimens represented in Quenstedt's figures 11 and 12 should be chosen as lectotypes of this species; if some of the other specimens figured by him are correctly referred to this species, they represent extreme variants. S. S. Buckman (1917, p. 34) included *R. gryphitica juvenis* in his genus Piarorhynchia.

Two specimens were obtained in which part of the shell is missing, thus showing some of the internal structure; in one specimen the dorsal valve is missing and in the other the ventral valve. The specimen in which the dorsal valve is missing shows the outer edge of the median septum, while the other specimen shows the dental plates, which deviate slowly from the umbonal region.

A complete specimen was measured and was ground down from the umbo and drawn at various stages. These sections show the presence of a short but stout dorsal septum, two relatively large teeth in the ventral valve fitting into sockets in the dorsal valve, and, at one stage, a stout dental plate.

A number of specimens were selected and the height, breadth, depth and thickness (according to the nomenclature suggested by Simpson, 1933) were measured accurately; percentages were worked out and the following results obtained.

The percentage $\frac{\text{height}}{\text{breadth}}$ ranges from 83%-111%, with a maximum number of specimens between 98% and 102%. The percentage $\frac{\text{depth}}{\text{breadth}}$ ranges from 47%-75% with a maximum between 56% and 60%, while the percentage $\frac{\text{thickness}}{\text{breadth}}$ gives almost the same results. Graphs and scatter diagrams drawn from these factors show that the specimens represent a homogeneous group.

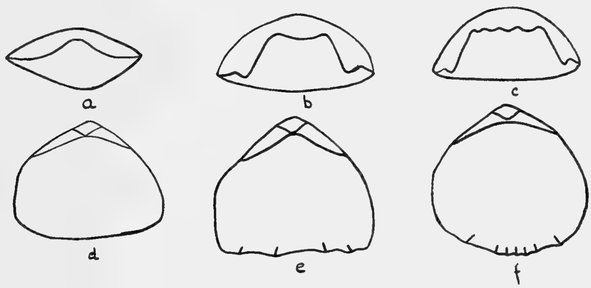


FIG. 6

Rhynchonella (*Piarorhynchia*) *deffneri* Oppel, 1861, p. 525.

Terebratula triplicata juvenis Quenstedt, 1852, tab. 36, fig. 2.

The shell is sub-trigonal in shape and is usually broader than high. Both valves are slightly convex. Most of the specimens are marked with slight plications which extend only a short distance from the margin of the shell, but a few smooth forms were found. There is a wide sulcus on the ventral valve; this varies greatly in depth; in the smooth forms it is very shallow, while in some other forms it reaches a considerable depth. The plications vary in number from two to five on the dorsal valve but forms with two only are most common.

Quenstedt's figure of *T. triplicata juvenis* differs from the Fretherne specimens in that it is higher than broad, whereas most of the Fretherne specimens are broader than high. In other characters, Quenstedt's figure resembles the more normal specimens from Fretherne rather than the extreme variants.

This species occurs in clusters on the surface of the limestone, and it was, therefore, difficult to obtain complete uncrushed examples. A few were obtained and these were measured as in *R. gryphitica juvenis*. It was found that the percentage $\frac{\text{height}}{\text{breadth}}$ varies from 82%-112%; while the percentage $\frac{\text{depth}}{\text{breadth}}$ varies from 47%-62%.

LAMELLIBRANCHIA.

Few of the Lamellibranchia call for special comment. On the whole, *Gryphæa incurva, Oxytoma inaequivalve, Lima duplicata* and *Lima* (*Plagiostoma*) *gigantea* are the only forms which are very abundant. Species of Cardinia are at present very rare, which is rather remarkable in view of the fact that holotypes of several species of this genus are reputed to have been collected at Fretherne.

Gryphæa incurva Sowerby.

Gryphæa incurva is the commonest fossil at Fretherne, being represented by numerous complete individuals, often of large size. In the large specimens, the umbo of the left valve is often coiled so as to press against the flat right valve. In these highly coiled examples no trace of an early attached stage is visible.

In the course of washing the shale, several small Ostrea-like shells were obtained ; and since the Ostrea group is only represented in these beds by *Gryphæa incurva*, it appears probable that these represent the spat of that species. They range from 0·6 to 1 mm. in length, and show a marked lateral twist in the umbonal region, somewhat as in Exogyra, and as in the spat of *Ostrea liassica* (Trueman, 1922, p. 266, fig. 7). It is noteworthy that in these small Gryphæas no trace of an attached stage is visible, and it is, therefore, not unlikely that in these forms the attached stage was omitted altogether.

CEPHALOPODA.

Coroniceras bucklandi (Sowerby).

This species is represented only by fragments, the largest representing an ammonite which cannot have been less than 500 mm. in diameter, the whorl thickness being 170 mm. Thus this specimen is comparable in size with that figured by S. S. Buckman (1919, Pl. CXXXI) from Keynsham. *C. bucklandi* was formerly regarded as being widely distributed, but recent work has shown that it rarely occurs except near Keynsham, though Dr. Spath has noted its occurrence on the Dorset coast (1924, p. 205). There is no trustworthy record of its occurrence in Gloucestershire previous to its discovery at Fretherne. Unfortunately, none of the specimens were collected in situ.

Coroniceras spp.

Both loose and in situ in the limestone bands a number of other specimens referred to *Coroniceras* spp. have been found. They are much more slender than *C. bucklandi* and have in general the proportions of *C. rotiformis* and *Ammonites bisulcatus* ; they are likewise carinate and bisulcate but differ in the absence of any tubercles.

Paracoroniceras sp.

Paracoroniceras is represented by a single body-chamber fragment with a tendency towards a trigonal whorl shape and with moderately strong ribs.

Arnioceras bodleyi (J. Buckman).

This is a large Arnioceras. Ribs are present at an early diameter, certainly by one of 12 mm., the smallest diameter shown in any of the specimens obtained. None of these exhibit the smooth stage, which must have been very short.

Arnioceras spirale Fucini.

A large number of incomplete specimens of Arnioceras, generally of small size, are referred to this species. They have a slender whorl with a strong keel and distinct sulci. The ribs are almost straight and often reclinate. The smooth stage extends only to about the diameter of 6 mm. The suture is well marked in many specimens and appears to be very variable. In some the external saddle is tripartite, in others bipartite, while in others it is scarcely divided ; the first lateral lobe is usually shorter than the external lobe, but in occasional specimens it is practically as deep. This variability in the suture line adds to the difficulty of satisfactorily grouping the species of Arnioceras (Spath, 1923, p. 70).

Arnioceras sp.

From the highest bed of limestone a single ammonite fragment was collected. This is clearly an Arnioceras, with rather widely spaced and sharp, narrow ribs, which are straight on the sides of the whorl but swing sharply forwards and form the feeble ridges which lie very close to the moderately high keel, the sulci being extremely faint. In many respects it resembles *A. hartmanni* Oppel (d'Orbigny, 1844, Pl. 51, figs. 1 and 2), but it cannot definitely be identified with this species from the specimen available.

Vermiceras scylla Reynès.

From the lowest limestone several small slender ammonites have been obtained. They exhibit some variation but are all identified with *V. scylla* Reynès (1879, Pl. XIV, figs. 13-25). Crushed examples greatly resemble Caloceras, with their many coils and weak ribs, but the presence of a distinct but faint keel definitely places them with Vermiceras and allows the lowest horizon to be fixed beyond doubt as being within the Bucklandi zone in the broad sense. It is probable that similar forms led to the recording of "*Ammonites johnstoni*" (Caloceras) from these beds (Lucy, 1883, p. 132).

Eucoroniceras sinemuriensis d'Orbigny.

A single small specimen not much over 25 mm. in diameter is clearly to be referred to this species. It shows the linking of the ribs in pairs characteristic of this species. The specimen is valuable as affording some evidence concerning the development of ornamentation in this species, which is incompletely known. It is apparent that at a diameter of about 4 mm. the shell is ornamented by longitudinally elongated knobs (clavi) which rise sharply at their hinder margin and fade away gently in front. On the succeeding whorl, very weak ribs extend across the whorl from each end of the clavi, and it is not until a diameter of about 14 mm. is attained that this has developed into the typical ribbing of the species. Even at that diameter, the sharp hinder borders of the clavi are clearly marked.

A further specimen of Eucoroniceras is represented by only part of an adult whorl. It appears to be more slender than d'Orbigny's species, and may be compared with a specimen figured by Quenstedt (1883, Pl. XI, fig. 20).

Charmasseiceras charmassei (d'Orbigny).

The specimens found at Fretherne are all small, none exceeding about 30 mm. in diameter. All are strongly ornamented, the venter being marked by a narrow unornamented band. The ribs are numerous, some bifurcating not far from the umbilical margin, while others are inserted at about the same position. There is some variation in strength of ribbing, but it appears that all the available specimens may be referred to one species.

OSTRACODA.

In the course of washing the shales for Foraminifera, Ostracoda were found in each horizon examined. The following species are represented, *Cytheridea ellipsoidea* Jones, *Bairdia dispersa* Blake, and *B. redcarensis* Blake. There are also a number of forms which appear to be intermediate between *B. redcarensis* Blake and *B. lacryma* Blake ; these include several different types, some of which show greater agreement with *B. redcarensis* and others with *B. lacryma.* It is possible, therefore, that these two species are not really separable, especially when it is borne in mind that only a few specimens can be definitely referred to either species, while the intermediate forms are numerous.

Discussion of Horizons Represented.

The evidence collected in the course of this work appears to prove conclusively that the horizons now exposed at Fretherne are all to be referred to the Bucklandi and Semicostatus zones. It is clear that no part of the Angulata zone, or even of the lowest portion of the Bucklandi zone, is included in this section.

The most important fact on which Mr. Richardson relied for his conclusion that the Angulata zone and lower zones were present was the record of *Waehneroceras* sp. from bed No. 23. This specimen, through the kindness of Mr. Richardson, was available for examination ; it was named for him many years ago by the late S. S. Buckman. It is a small specimen, about 9 mm. in diameter, with the characteristic ornamentation of an immature Charmasseiceras, the ribs being rather weak but leaving a plain band along the venter. Certainly there is no ground for identifying this small shell with Waehneroceras rather than with Charmasseiceras. Moreover, Mr. Richardson himself recorded *Coroniceras* sp. from bed No. 24 (that is, from the bed immediately below that in which he recorded Waehneroceras). Since the latter genus would indicate a horizon at the base of the Angulata zone (of which he gave no other evidence), the occurrence beneath it of an ammonite which must indicate the Bucklandi zone makes the record improbable.

Lucy's record of "*Ammonites johnstoni*" was presumably based on *Vermiceras scylla* (see note on *V. scylla*). So far as ammonite evidence is concerned, therefore, there is no ground for supposing that any part of the Angulata zone is now exposed.

The record of the occurrence of certain Lamellibranchs at Fretherne has lent some support to the view that the Angulata zone may be present there. This is especially true of *Cardinia ovalis* which has been regarded as a typical form in the Angulata zone of Somerset and South Wales (Trueman, 1920, p. 96). It may be noted, however, that *C. ovalis* has not been found in the course of this work, the only specimen of Cardinia being *C. lanceolata* which occurred in the upper part of the section where it clearly cannot have any reference to the Angulata zone.

In this connection it must be borne in mind that the section may be less extensive now than it was formerly, possibly owing to the increase in the amount of Severn mud. There has, however, been no substantial change in the section since Lucy described it in 1883, for the beds he noted are readily identified with those now visible. It is possible, however, that a more extensive section was available earlier in the century, although Cumberland's statement, that the limestone platform visible at low water in 1822 showed ammonites four feet in diameter, appears to indicate that the Bucklandi zone extended to low water even at that date ; his estimate of the size of the ammonites is not improbably exaggerated, but it is almost certain that his large ammonites, even if they were not much over two feet in diameter, must have been members of the Arietidae.

In order to facilitate discussion of the sequence represented, the various sub-zones recognised by different authors within the lowest part of the Lias are tabulated below. On this table the horizons known to be represented at Fretherne are also indicated.

	After Tutcher and Buckman, 1917.	After Spath, 1923, 1924.	After Buckman, 1925.
Turneri, or Semicostatus zone.	*turneri.* *birchi.* Arnioceras.	*turneri.* *birchi.* *hartmanni.* *brooki.* *sulcifer.* *Arnioceras* sp. *alcinoe.*	*turneri.* *inflatum.* *plotti.* *birchi.* *semicostatum.* *brooki.* *sulcifer.* *nodulosum.* *alcinoe.**
Bucklandi zone.	*sauzeanum.*	*Euagassiceras* sp. *striaries.* *pseudokridion.*	*sauzeanum.* *striaries.* *pseudokridion.*
	scipionianum.	*colesi.* *acuticarinatum.*	*scipionianum.* *semicostatum.*
	gmuendense. *vercingetorix.*	*gmuendense.* *meridionalis.* *charmassei.*	*gmuendense.** *meridionalis.* *charmassei.**
	bucklandi. *rotiforme* (*rotator*). *conybeari* (Vermiceras).	*kridion.* *rotator.* *schloenbachi.* *brevidorsale.* *longidomus.*	*bucklandi.** *kridion.* *rotator.* *scylla.** *brevidorsale.* *longidomus.*
Angulata zone.	*angulata.* *liasicus.* *megastoma* (Waehneroceras)		

The occurrence of the sub-zone of *bucklandi* is clearly indicated by the specimens found loose on the shore, but many of the remaining specimens of Coroniceras cannot be assigned to any definite horizon. Dr. Spath has suggested that some species of Coroniceras may have had a fairly wide vertical range (1924, p. 205). Presumably the specimens of *Charmasseiceras charmassei* represent the *charmassei* horizon and may have come from a level above that of *bucklandi* but it has recently been shown that Charmasseiceras occurs at other horizons in the Bucklandi zone (Trueman, 1930, p. 155). Paracoroniceras, indicating the horizon of *gmuendense*, is also known only from loose specimens, but the horizon is no doubt represented.

Epammonites cf. *isis* represents a horizon near that of *C. bucklandi* while Eucoroniceras also probably comes from a similar level (Spath, 1924, p. 204). Fragmentary specimens may also include representatives of Agassiceras.

The base of the section is fortunately marked by the occurrence of fairly abundant ammonites definitely identified as *Vermiceras scylla* (Reynès). These forms indicate the uppermost of the Vermiceras horizons noted by Spath (1924) and Buckman (1925), but since *Coroniceras rotator* and allied forms have not been found at Fretherne, and since *V. scylla* is almost immediately followed by beds with *Charmasseiceras charmassei*,† it appears, either that there is a non-sequence between the horizons of *scylla* and *bucklandi* or *charmassei*, or that *V. scylla* occurs at Fretherne at a horizon above that of *C. rotator*. In any case, the base of the section is clearly not lower than the Vermiceras beds of the Bucklandi zone.

* Horizons known to be represented at Fretherne.

† If Mr. Richardson's small specimen from bed No. 23, wrongly named as Waehneroceras, is interpreted as a Charmasseiceras, the latter occurs in the bed above *V. scylla*.

Unfortunately, the horizon of the upper limit of the section is less satisfactorily fixed. The presence of *Arnioceras bodleyi* must be taken to indicate a horizon above that of *sauzeanum* ; Dr. Lang has recorded it in Dorset from the *Pararnioceras alcinoe* bed (1923, p. 61). The absence of records of *Euagassiceras sauzeanum*, or of any other species of that genus, is rather puzzling, but it is possible that the horizons of *striaries* and *sauzeanum* may be absent at Fretherne.

The record of " *Coroniceras vercingetorix* Reynès " by Mr. Richardson (1908, p. 142) is of interest. The record is based on a specimen from Fretherne figured by Wright (1878, Pl. 111) as *Arietites bisulcatus* which Buckman identified with Reynès' species. That species has lately been referred to Pararnioceras (Tutcher and Trueman, 1925, p. 640), a genus found with *Arnioceras bodleyi* at Lyme Regis. It has been impossible to examine the figured specimen, which was formerly in the Gloucester Museum but does not now appear to be available, but if it is correctly referred to Pararnioceras it affords some support to the view that the section extends up into the horizons above *sauzeanum*. It may be noted, however, that S. S. Buckman referred the *vercingetorix* horizon to a position between *gmuendense* and *bucklandi* (1917, p. 274), although he does not appear to have had any actual evidence as to the sequence in Gloucestershire, his record referring to the Fretherne specimen figured by Wright, while the Yorkshire sequence to which he refers contains no actual data on which the position of *vercingetorix* can be fixed (Tate and Blake, 1876, pp. 58-62).

Since the Arnioceras from the highest limestone is not accurately determinable, the range of the section cannot be ascertained more exactly at present but, if the specimen proves to be *Arnioceras hartmanni*, it indicates an extension to a horizon well up in the Turneri zone, although *Arietites turneri* and related forms are unknown.

It may, therefore, be concluded that (1) the section does not extend into the lower part of the Bucklandi zone (a conclusion which is supported by the characters of the Gryphæas present) and (2) the section includes much of the upper part of the Bucklandi zone and the lower part of the succeeding zone.

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DESCRIPTION OF FIGURES.

Fig. 3. Foraminifera and Echinodermata. all x 54.

(*a*) *Nodosaria mutabilis* Terquem.
(*b*) *Lingulina tenera* Bornemann.
(*c*) *Marginulina* sp.
(*d*) *Nodosaria raphanus* Linnaeus.
(*e*) *Saracenaria crepidula* Fichtel and Moll.
(*f*) ,, *varians* Bornemann.
(*g*) *Marginulina porrecta* Terquem.
(*h*) *Dentalina* cf. *pyriformis* Terquem.

(*i*) *Dentalina* cf. *brevis* d'Orbigny.

(*j*) ,, ,, ,, ,,

(*k*) *Cornuspira infima* (Strickland).

(*l*) *Spiropthalmidium acutimargo* (Brady).

(*m*) ? Holothurian spicule.

(*n*) Holothurian plate.

Fig. 4. *Rhynchonella* (*Piarorhynchia*) *gryphitica juvenis* (Quenstedt). all x 2.

(*a-f*) To show the variation in the shape of the shell and the number of ribs.

(*g-j*) To show the variation in the depth of the sulcus.

Fig. 5. *Rhynchonella* (*Piarorhynchia*) *gryphitica juvenis* (Quenstedt).

(*a-g*) Internal structure. all x 2.

(*a*) Specimen with dorsal valve missing.

(*b*) Specimen with ventral valve missing.

(*c-g*) Stages in the specimen ground down.

Height of complete specimen 14 mm.

(*c*) Height 13·6 mm.

(*d*) ,, 12·8 mm.

(*e*) ,, 12·2 mm.

(*f*) ,, 11·6 mm.

(*g*) ,, 10·6 mm.

Fig. 6. *Rhynchonella* (*Piarorhynchia*) *deffneri* Oppel. all x 2.

(*a-f*) To show the variation in the shape of the shell, the number of ribs, and the depth of the sulcus.

Notes on a Section near West Town Lane, Brislington, Bristol.

By G. A. Kellaway.

THE following notes were compiled from information obtained from a trench recently excavated along the course of a road which is now (January, 1935) in process of construction.* The line of the section commenced on the south side of West Town Lane at a point nearly half-way between the railway bridge (carrying the G.W.R. line from Bristol to Frome) and Imperial Road. The direction taken by the trench was approximately North-South and parallel to that of Imperial Road. The Tea Green Marls and Rhætic rocks described below were seen at the southern end of the exposure where the ground is more elevated ; these beds were dipping at about 4 degrees to the South.

The Succession

		ft.	ins.	
Upper Rhætic	(22) Cotham Marble. Thickness variable (3-5 ins.) ; sometimes of "Crazy Cotham" type, arborescent markings not well developed.	0	4	*Modiola lævis* Sow. *Pseudomontis fallax* (Pflucker).
	(21) Marl and Shale. Greenish-yellow	2	0	
	Gap ?	3	0	
	(20) Limestone. Whitish and sometimes banded	0	3	
	(19) Shale. Creamy	0	2	
	(18) Limestone. Grey, horizontally banded(the upper 2 or 3 inches frequently contains small scales and teeth and may be brecciated).	0	10	*Chlamys valoniensis* (Defr.). *Darwinula liassica* (Brodie). *Gyrolepis alberti* Ag. *Naiadites lanceolata* Brodie.
	(17) Marl. Soft, yellowish-green	1	3	
	(16) Limestone. Dark, crystalline, impersistent	0	9	*Chlamys valoniensis* (Defr.). *Gyrolepis alberti* Ag.
	(15) Marl, brown, weathering whitish	0	2–6	

* This road is to be called Hazlebury Road.

		ft.	ins.	
Lower Rhætic	(14) Limestone. Grey, crystalline, thickening at the expense of bed (15), much decalcified in places, 8 ins. to 1 ft. 6 ins.	1	0	*Cardinia regularis* Tate. *Cardium cloacinum* Quenstd. *Chalmys valoniensis* (Defr.). *Gyrolepis alberti* Ag. *Ostrea* sp. *Placunopsis alpina* (Winkler). *Pleurophorus elongatus* Moore. *Sauricthys acuminatus* Ag.
	(13*b*) Shales. Grey, ochre-stained	3	7	[A few small limestone nodules replete with "*S.*" *ewaldi* found in the excavated material may come from beds (12) or (13).]
	(13*a*) Shales. Sandy and ochreous	0	3	
	(12) Shales. Black and grey, ironstained and micaceous	1	8	
	(11) Sandy layer. Small lenticles of yellow sandstone and patches of purple sand in a yellow or brown sandy clay.	0	4	
	(10) Shales. Grey and black, very wet and rather crumbly	1	4	*Protocardia rhætica* (Mer.). *Pteria contorta* (Portlock). "*Schizodus*" *ewaldi* Born.
	(9*b*) Shales. Hard, barren, black, strongly fissile, with "Bone-bed" at the base.	1	4	
	(9*a*) "Bone-bed." A calcareo-arenaceous layer containing bones, teeth, scales, coprolites and quartz pebbles.	0	2	"*Schizodus*" *ewaldi* at top. *Gyrolepis alberti* Ag. Cochliodont tooth ?* *Hybodus* sp. *Hybodus cloacinus* Quenstd. *Plesiosaurus* sp. *Sauricthys acuminatus* Ag.
Tea Green Marls	(8) Marl. Ochreous, crumbly	0	9	Keuper.
	(7) Marl. Greenish-yellow	8	6	
	(6) Calcareous nodules.	1	0	
	(5) Marl. Soft green	1	0	
	(4) Calcareous nodules in marl.	0	6	
	(3) Marl. Green and yellow, hard in places with small bands of limestone nodules.	2	0	
	(2) Sandstone. Yellow, friable, speckled with brown	2	6	
	(1) Red Marl.			

The rocks described above may be grouped as follows :—

UPPER RHÆTIC
LOWER RHÆTIC
——————— (unconformity)
TEA GREEN MARLS
RED MARLS

The unconformable junction between the Lower Rhætic and the Tea Green Marls was well exposed in the sides of the trench. Examination of the base of the black shales shewed little pellets and lenticular masses of Tea

* "the speckled white plate . . . resembles a part of a Cochliodont tooth, but it is very doubtful." Dr. E. I. White (in *litt.*).

Green Marls incorporated in the " bone-bed." The plane of unconformity is strikingly even. The " bone-bed " was observed to be richest in vertebrate remains in that part of it which is actually in contact with the underlying Trias.

The Upper Rhætic.

An item of palæobotanical interest is the discovery of pieces of bed (17) bearing numerous small circular bodies of a chocolate-brown colour which are probably the sporangia of *Naiadites lanceolata* Brodie.* They are found in association with the leaves and stems of *Naiadites* though none appear to be attached. Similar specimens have been found in Bristol at Pylle Hill and Southmead, and at Cranbrook Road, Redland.

Sun-cracked layers similar to those described in the *Proceedings* for 1933† are present in the limestones (18) and (20). The top of bed (18) shews signs of having been disturbed shortly after deposition.

The Lower Rhætic.

This is very similar to beds on the same horizon at Pylle Hill railway cutting, an account of which was given by E. Wilson in 1891‡; this description was published again with additions in the *Proceedings* in 1894. Wilson's description of the " bone-bed " of Pylle Hill§ might equally well be applied to the " bone-bed " of Brislington.

The Tea Green Marls.

These are some five feet thicker than the equivalent strata at Pylle Hill and shew one or two unusual features : space will not permit of more than a mention of these.

Limestone is of rare occurrence in the Trias of the Bristol district and the discovery of bands of large limestone nodules in the Tea Green Marls at Brislington was unexpected. These calcareous bands yielded no fossils and are probably of secondary origin. The yellow sandstone at the base, which awaits further examination, has been included in the Tea Green Marls. It is interesting to note that Wilson did not record the presence of either the limestone or the sandstone at Pylle Hill.

Comparison with Pylle Hill.

	Pylle Hill.	West Town Lane, Brislington.
Upper Rhætic	7 ft. 7 ins.	about 9 ft. ?
Lower Rhætic	9 ft. 5 ins.	9 ft. 9 ins.
T.G.M.	9 ft. 0 ins.	16 ft. 3 ins.

The writer is indebted to Mr. T. R. Fry and Prof. A. E. Trueman for directing his attention to this exposure, to Messrs. W. J. Kew, Ltd., for permission to examine the trench, and to Prof. S. H. Reynolds, Mr. J. W. Tutcher, M.Sc., and Dr. E. I. White for identifying certain of the fossils.

* Sollas, I. B. J., 1901. *Quart. Journ. Geol. Soc.*, pp. 307-12.
† Kellaway and Oakley, 1933. *Proc. Brist. Nat. Soc.*, 4S., Vol. VII, Pt. VI, pp. 480-481.
‡ Wilson, E., 1891. *Quart. Journ. Geol. Soc.*, pp. 545-549.
§ Wilson, E., 1894. *Proc. Brist. Nat. Soc.*, New Series, Vol. VIII (1892–94), pp. 213–231.

Field Notes and Observations.

A MORNING ON THE FLATS

THE grass and mud flats above Avonmouth are particularly interesting in autumn and winter from an Ornithological standpoint, in view of the variety of birds that are seen in that district only at those times of year. They form partly a line of migration and partly a winter resort for a number of species, and are best examined when the tide is high or nearly so, as then the area over which such birds as Waders can wander is very much restricted.

If one goes down often enough, a day will come which will live in the memory of the observer. It may be because some very unusual bird has been seen, or because one has had a particularly striking view of those that were there, or possibly a combination of the two.

At the end of November, 1933, the writer and a friend spent some time on the flats on a day which started with a beautiful morning, later became cloudy, and again cleared up completely. A cold north wind, while helping visibility considerably, made the manipulation of a telescope rather a chilly job at times.

Almost at once we saw some large birds coming over which on closer acquaintance turned out to be White-fronted Geese. They came up the river, fairly high up and went straight on, no doubt bound for the New Grounds above Sharpness bridge.

There were two skeins, one of eleven, and the other of seven birds, and as they went they often gave out a nasal call-note which sounded like " Kak-kak, Kak-kak." " Grey " geese are notoriously difficult to identify when in flight, but in this case we were fortunate in seeing the characteristic white patch on the forehead of these birds before they turned away. As has been seen on other occasions, during the flights one bird suddenly dived down, then went up again and resumed its place in the skein.

These Geese nest in high latitudes in Northern Europe and further east, and come to Britain in winter.

Almost as soon as we reached the flats, a party of thirty Mallard, quacking loudly, came from inland and joined, on the edge of the water, a dozen Wigeon and three Teal. The drakes of these three species were all in their full plumage and made a fine picture in their various colours.

Moving higher up, we soon came on a large number of Waders on the mud. There were odd Curlew, and some Redshank, but these were far outnumbered by the Dunlin of which three large flocks were present, and amongst them we were particularly pleased to find three Purple Sandpipers. The latter we distinguished by their darker colour above, dark streaked flanks and yellow bill and legs, and they were also slightly larger than the Dunlin. One of these Sandpipers was busily feeding on the mud, as the Dunlin were. Slightly apart from these were six Ringed Plover, running along, and not mixing with the other birds.

A short distance from the shore were one or two patches of stony mud, and on these we saw a number of Turnstones busy feeding and running about actively. There were about twenty in this party and with them another Purple Sandpiper, and their distinct black and white scheme of colour, orange legs, and smaller size as compared with that of a Redshank, were sufficient to identify them. Later, seventy others were counted on a shingly bank.

Turnstones and Purple Sandpipers are often associated in winter and are usually birds of a rocky coast where the tide-wrack and seaweed afford shelter for the animals on which they feed. So it is unusual and of particular interest to find them on such a muddy shore where rocks are almost non-existent. Still, there they were and their presence on this occasion was not unusual, as other observations have shown.

The tide was coming in and was keeping the shore-birds on the move, and later, the flocks of Dunlin, possibly numbering 1,000 altogether, gave a magnificent display of evolutions in the bright sun. The characteristic flight of these birds in winter, when the flocks constantly turn as one bird, was shown to the greatest advantage. At one moment they looked like a smoky cloud, then as a misty white haze, and then strikingly white as the sun shone full on their undersides. About a dozen Sheldduck, a handsome duck which, though usually to be seen at most times of the year, is, in the late summer and early autumn, almost or entirely absent, added colour to the scene.

And on this occasion there were only a few Gulls. A solitary adult Great Black-backed Gull, the largest and finest of those Gulls that breed in Britain, was, as usual, there, as was a single Common Gull, a bird which can only be said to be common in this district during the winter months. And, as a contrast to these, a number of Carion Crows were busy, feeding on anything they could find.

H. TETLEY.

NOTES AND COMMENTS FROM DIARIES COMMENCED IN JANUARY, 1932, CHIEFLY RELATIVE TO BIRDLIFE IN THE STAPLETON DISTRICT.

THIS district is an interesting one, as may be seen from the following list of birds less commonly found in areas partly covered by so large a city as Bristol. Indeed, it is somewhat remarkable that such birds as the Kingfisher and the Wheatear should be found in situations within a couple of miles of the centre of the city. The present writer has seen the former fly under the arch over the Frome at Lower Ashley Road, and in the harbour at the bottom of Castle Ditch, and the latter on the paved pathway in St. Philip's and St. Jacob's Churchyard. Further, those very dainty creatures, the Grey Wagtails, have been seen feeding in the Frome, at a considerable distance below the bridge mentioned, in water which appeared to be anything but clean, and also at the old lock in St. Philip's Marsh.

Birds, which can be seen on almost any day favourable to their activities in the open country in this district, are the Woodpeckers, the most common being that great ant-eater the Green Woodpecker whose hearty call-notes ring through the woods and over the slopes of Purdown.

The great Spotted Woodpecker frequents the old and decaying trees round about Wickham Bridge, his loud drumming being a feature of this spot in early Spring. It is difficult to catch sight of this bird in order to ascertain exactly how the drumming effect is produced, as it deliberately keeps the tree or branch between itself and the observer. It seems probable, however, that the noise is produced by the mandibles hammering rapidly on a dry or decaying portion of the tree. It has not had the effect of attracting a mate to the spot, so far as my observations have gone.

The Lesser Spotted Woodpecker is more rarely seen than either of the others mentioned, and, partly on account of its smallness, may easily pass unnoticed.

The river Frome from Wee Lane (now Glenfrome Road) right through the Stapleton district may be regarded as the haunt of the Kingfisher. Scarcely a day passes, winter or summer, but this gaily feathered bird may be seen streaking along under the bridges, or just above the surface of the stream, and at other times waiting patiently on an overhanging willow or alder, displaying either its bright chestnut breast or its turquoise back to the admiring observer. After dropping with a resounding splash into the water for its prey, it returns to a branch, gulps the fish with a shake of the head and a stretching of the neck, all with obvious relish !

Dippers, which frequent the old Snuff Mill waters, are rarely seen now, and for some reason have departed further up stream.

Those charming and frail looking members of the Tit family, the Long-tailed Tits, are ever searching the trees for insects in this neighbourhood, occasionally accompanied by Goldcrested Wrens ; both will come within arm's length of a perfectly stationary observer, calling, calling and unafraid.

Marsh and Cole Tits are also observed here, and in early winter the active Siskins visit the black, or water, alders near Wickham Bridge, finding food in the seeds of those water-loving trees.

Duchess' Pond is a rare place in winter time to see such aquatic birds as the Mallards, Little Grebes, Coots, Waterhens, and occasionally Teal and Tufted Duck. The Heron also visits this pond, chiefly at night, although one solitary Heron remained there permanently for a few years until the water was drained off, when it moved away and never returned to stay as before. The Common Sandpiper and Wagtails frequent the pond ; and among those that breed here, one of the most interesting is the Little Grebe, or Dabchick, which makes its nest of decayed, muddy-looking débris near enough to the bank for clear observation.

Brown and Little Owls are common here, and occasionally the White or Barn Owl may be seen. A pair of Nuthatches came to the trees surrounding the pond a couple of years ago and would probably have built here, but tree-felling took place and they appear to have been scared away for the time being.

Wheatears pass the uplands of Purdown in late summer, but it is doubtful if they build here now, while a stray Redstart may be observed as a rare visitor.

Foxes are observed from time to time in this district ; there are Otters and Water Shrews, in addition to the rather common Water Voles, along the banks of the Frome. Jays, Magpies, Kestrels and Sparrow Hawks are common, and the Carrion Crows appear to be increasing numerically every year.

One regrets the absence of those delightful summer migrants, the Sand Martins, from the nesting holes in the village of Stapleton. They were a feature of the place a few years ago, but these birds no longer breed here, although they may be seen, with the Swallows and Housemartins, flying over the pond on almost any summer's day.

G. MOGG.

NOTE ON ARUM ITALICUM.

LAST September, I noticed, on a waste patch of ground near Ashton Avenue, a bunch of red berries which I took to be an unusually large specimen of Arum Maculatum. I was considerably surprised, however, to see that in October it had begun to send up leaves. Two of these have now developed (end of November), and their white veinings prove the plant to be Arum Italicum. The ground mentioned lies near the river and it is the place where the exhibition called the " White City " once was held. There are allotments at one end of it.

As a comment on Professor White's " Flora of Bristol " (under " Arum Maculatum "), I might mention that I have seen in this district plants of the common Arum which had a broad spathe hanging in the form of a flap over a yellow spadix—hardly to be distinguished, in fact, from A. Italicum except for their vernal leaves. But the present plant is quite different, and I have seen no previous record of the occurrence of genuine A. Italicum in this district.

G. E. LOVELL.

NOTE ON BEE ORCHIS

THE year 1934, as far as my observations go, has been a bad year for the Bee Orchis. Visiting, in June, localities where I had seen the plant sprouting vigorously in the early part of the year, I could not find a single flower. Most books seem content to refer to the " Mysterious irregularity " of the appearance of the flowers of this species ; but may not the observed irregularity be explained without recourse to mysteries ?

I believe drought is primarily responsible for this failure to produce flowers. I noticed in May that when the buds were as yet scarcely visible, they became shrivelled and brown owing to the dry conditions. When June arrived, nothing was left of the plants above ground except a few black remains. It is obvious that water is essential at the critical period when the scape is developing, and if there is no rain at this time, there can be no flowers.

G. E. LOVELL.