FOURTH SERIES, VOL. VI., 1923-1927.

Annual Report

and

PROCEEDINGS

OF THE

Bristol Naturalists' Society

Edited by the Honorary Secretary.

"*Rerum cognoscere causas.*"—VIRGIL.

BRISTOL.

PRINTED FOR THE SOCIETY.

MCMXXVIII.

FOURTH SERIES, VOL. VI., Part I., 1923.
PRICE FOUR SHILLINGS.

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TABLE OF CONTENTS.

FOURTH SERIES. VOL. VI., PART I. (1923).

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MISS IDA M. ROPER,
4, WOODFIELD ROAD, REDLAND,
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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, 1923.

THE present year is the Diamond Jubilee of the Society, being the 60th anniversary of its formation, and although no functions were held to mark the occasion there have been a few changes in procedure in order to give members and others an opportunity to take a greater interest in the objects of the Society. In March an open lecture was given by Mr. E. E. Lowe, Director of Leicester Museum and Art Gallery, to which members were invited to bring their friends, and the meeting was honoured by the presence of Sir Ernest Cook, representing the Lord Mayor of Bristol (who was prevented from attending in person), by the Vice-Chancellor of the University and by the Director of Education of the City. Sir Ernest Cook congratulated the Society on its many years' activity, and spoke of the attractions which it offers to the residents of a big city.

In another direction it was decided to permit those who wished to follow up their knowledge of Natural History to join one or more Sections without membership of the Parent Society being required. They are thus brought into close companionship with the working members, and the fees are left at a nominal sum in the expectation that such students would be glad to become full members to obtain the advantages of the Library and to receive a copy of the " Proceedings."

Three Excursions were arranged, but the unsettled weather of the summer seemed to bring about a small attendance, but the indoor Exhibition meeting in November at the University was well attended, and much satisfaction was expressed at the varied subjects, which were being studied by the individual workers.

The newly-formed Ornithological Section showed by its exhibits that it had secured some good recruits.

It must, however, be frankly recognised that the Society is not receiving the support of the citizens, which might be expected to follow from the efforts of Council, and it seems probable that other interests fill up all spare time. Only 9 new members have joined in the year, whilst 15 resignations from various causes have brought the membership to 131, including 15 Associates under the old election.

The formation of the South-Western Naturalists' Union begun at the end of last year, was publicly inaugurated in May by the holding of its first Congress at Bristol. Our Society being affiliated to the Union members were able, as Associates, to take part in all its meetings and excursions, and Council was much gratified at the success, since a strong part of the Union's Executive is drawn from amongst our active members.

IDA M. ROPER,

Hon. Secretary.

THE HON. TREASURER in Account with THE BRISTOL NATURALISTS' SOCIETY.

Dr. GENERAL ACCOUNT FOR THE YEAR 1923. **Cr.**

Dr.	£	s.	d.	Cr.	£	s.	d.
To Members' Subscriptions—				By Subscriptions to Societies—			
Ordinary ...	50	0	0	Ray	1	1	0
Associated	4	15	0	Commons and Footpaths		10	6
Life Membership	5	0	0	S.W. Naturalists' Union		15	0
,, Entrance Fees	2	15	0	,, Cost of "Proceedings," 1922	38	8	0
,, Subscriptions in advance	2	15	0	,, Printing	9	4	3
,, Arrears collected	20	15	0	,, Fire Insurance		7	6
,, Donations	12	10	0	,, Postages	5	10	3
,, Sale of "Proceedings," etc.	2	15	6	,, Gratuities	1	0	0
,, Balance forward	75	18	3	,, Lecture Expenses and Library	3	13	9
,, Donations to Book-binding Fund	50	10	6	,, Books bought ...	29	18	1
				,, Book-binding ...	6	15	4
				,, Grant for cabinet	2	0	0
				,, Cash in hand ...	65	10	1
				,, Book-binding Balance, etc. ...	63	0	6
	£227	14	3		£227	14	3

Audited and found correct,

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

LIBRARIANS' REPORT.

For the Year 1923.

IT is gratifying to record that the Library is made more use of under the pleasant surroundings available at the Bristol Museum. Members who are actively pursuing Natural History work in connection with the Sections are the chief readers, and from this other members can recognise that the Library is of real value, and deserves still further attention both by consultation and by no opportunity being lost to increase the number of modern works of reference. In connection with this Council has voted a grant of £30, with which important books have been purchased under the advice of the different Sections.

A better method would be the presentation, by members, of modern books, since the low subscription will not permit of adequate outlay.

It was mentioned in last year's Report that many publications received in exchange could not be put on the shelves for want of binding, and were therefore not fulfilling the intention of placing the latest current views on scientific work at the disposal of our members. We are glad to say, however, this drawback is now being overcome through the generous gift of £50 for the purpose from Mr. Horace Gummer, who thus continues to show his active interest in the progress of the Library. It is hoped, therefore, that during the coming year a large amount of current literature will be bound and made available.

The following gifts have been received, and thanks are given to the donors for them :—

"Somerset Archaeol. and Nat. Hist. Soc. Proceedings," 1922, from Mr. T. Charbonnier.

"Boletin Annual da Sociedade Broteriana," 12 vols., 1884-1897, from Mr. J. W. White, F.L.S.

"Journal of Botany," 5 vols., 1912-1916, from Mr. R. V. Sherring, F.L.S.

"Quarterly Journal of the Geological Soc. of London," 52 vols., from the Society *per* the Geological Section.

Reynolds, "Geological Excursion Handbook for the Bristol District," 2nd edit., 1921, from Mr. H. Womersley.

"British Association Reports," 1920, 1921, 1922, from Miss Roper, F.L.S., and Dr. F. S. Wallis.

"An Æolian Pleistocene Deposit at Clevedon" (pamphlet), 1922, from the author, Dr. E. Greenly, F.G.S.

"Geological Magazine," 1923, from the Geological Section.

"The Entomologist" and "Entomological Monthly Magazine," 1923, from the Entomological Section.

"British Birds," 1923, from the Ornithological Section.

By subscription we have received :—

The Ray Society, "British Marine Annelids," vol. IV., pt. 2, by Prof McIntosh.

"British Desmidiaceæ," vol. V., by West and Carter.

"Zoological Record," vol. 58, 1921.

ARTHUR B. PROWSE, Lt.-Col. R.A.M.C. (Ret.),
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IDA M. ROPER, F.L.S., *Hon. Sub-Librarian.*

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Cotteswold Naturalists' Field Club
Croydon Natural History and Scientific Society
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Edinburgh Geological Society
————— Royal Botanic Society
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———— Survey and Museum, London
Geologists' Association
Glasgow, Geological Society of
———— Natural History Society of
———— Philosophical Society
Hertfordshire Natural History Society and Field Club
Isle of Wight Natural History Society
Liverpool Geological Society
———— Literary and Philosophical Society
———— Botanical Society
Manchester Literary and Philosophical Society
———— Microscopical Society
———— Museum Library
Marlborough College Natural History Society
Norfolk and Norwich Naturalists' Society
North Staffordshire Field Club
Nottingham Naturalists' Society
Plymouth, Marine Biological Association of the United Kingdom
———— Institution and Devon and Cornwall Natural History Society
Quekett Microscopical Club
Royal Irish Academy
Royal Microscopical Society
Rugby School Natural History Society
Torquay Natural History Society
Yorkshire Geological and Polytechnic Society
———— Naturalists' Union
———— Philosophical Society

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ARGENTINE REPUBLIC.

Buenos Aires, Muses National de Historia Natural

URUGUAY.

Montevideo, Museo Nacional de

MEXICO.

Mexico, Sociedad Cientifica

ENTOMOLOGICAL SECTION,

1923.

NOTWITHSTANDING the drawbacks of the season of 1923 from an Entomological point of view, the members recording it as the worst within their recollection, with insects generally very scarce, increasing interest has been taken in the Meetings and valuable contributions to local captures in the field have been made, especially as regards new and rare species.

Mr. H. J. Charbonnier communicated a paper upon "Mimicry," which was illustrated by examples of lepidoptera supplied by the President, and hymenoptera, diptera and coleoptera by the Hon. Secretary.

Dr. B. N. Blood gave a very instructive paper upon the sub-family *Trichogrammatinae* (Fairy flies) of the *Chalcididae*, and exhibited specimens mounted as microscopic slides, including the following species recorded in the Society's "Proceedings" for 1922, pp. 253–8, *Oligosita collina*, from King's Weston Down, Glos., and *Brachista nigra* from Shapwick, Som., new to Britain; and *Ophioneurus signatus* from Henbury, Glos., also new to Britain, associated with the beetle *Rhynchites betulae*.

Mr. G. C. Griffiths read notes upon the migrant butterfly *Anosia plexippus*, illustrated with examples of its various local races from different parts of the World, together with their mimics.

Mr. J. V. Pearman reported it was his good fortune to secure specimens of a Bark fly new to Science, and two others new to Britain. The new species of Psocid, not known at the British Museum, had been named *Caecilius corticis* Pearman, male winged and female apterous, one taken in Leigh Woods, Som., and one at Winterbourne, Glos., in June and July. Also, two other species of *Psocidae*:—*Pseudopsocus Rostocki* Kolbe, at Winterbourne, Glos., completely wingless, which had previously been found only in 1881 in Germany; and *Psyllipsocus Ramburii* de Selys, at Brean, Som., fully winged.

Mr. C. Bartlett read some notes upon the British species of *Zygaena* and *Procris*, exhibiting specimens or every species, including an example of the very rare black variety of *filipendulae* and yellow varieties of *filipendulae* and *hippocrepidis*.

A large number of other specimens of all Orders have been exhibited and remarked upon by the Members, of which the following are worth recording:—*Hydrophilus piceus*, Nailsea Moors, Som., by Mr. W. Griffiths; *Osmylus pulvicephala*, Blaize Castle Woods, Glos., by Mr. H. Womersley; *Ranatra linearis*, Nailsea, Ibid. *Acidalia immutata*, Weston-in-Gordano, Som., by Mr. C. Bartlett.

The membership has decreased by three, and now numbers twenty-six.

CHARLES BARTLETT,

Hon. Secretary and Treasurer.

GEOLOGICAL SECTION,

1923.

WITH a net increase during the year of two members the membership of the Section now stands at 28. By a new ruling of the B.N.S. Council it is now permissible for persons to join the Section at the nominal subscription of 2s. 6d., without being enforced to also join the parent Society and pay an entrance fee. It is hoped that members will do their best to obtain recruits under this new regulation. Owing to a welcome grant of money from the parent Society, the Geological Magazine is now up to date, and by a further annual grant of 15s. from the same source we shall be able to continue to subscribe to the Geological Magazine and Palæontographical Society.

At the first meeting of the year, Dr. S. Smith, M.A., gave an original lecture indicating the slow way in which geological ideas have crystallised through the centuries. Geology is generally regarded as a young science, but the lecturer claimed great antiquity for our cult.

The President (Prof. S. H. Reynolds, M.A., Sc.D.) gave a very interesting account of the Geologists' Association excursion to Norfolk, dealing with a phase of geology that is unfortunately not seen in our own district.

Mr. J. W. Tutcher gave an account of his work in the Keynsham district, which has been printed in the last number of our " Proceedings."

Other papers of local interest were read by Mr. F. B. A. Welch and Mr. T. A. Ryder on the Inferior Oolite of the Cheltenham District and the Avonian of the Forest of Dean respectively. Both these lectures presented a number of facts from their own observations in the field.

Mr. W. W. Jervis struck a novel note in his lecture on the action of Man and his Environment, showing that man's status as a geological agent is often neglected. He is, however, an agent of a fairly high magnitude and should be included in all our calculations.

During the year a very successful exhibition meeting was held in the winter and excursions to Clevedon and the Low Level Road in the summer. By kind invitation of the Geological Section of the Bristol Field Club members were also invited to excursions to Burrington Combe and the Avon Gorge.

Attention is again drawn to the geological note book, which was initiated and presented by Mr. J. W. Tutcher. It is felt that with such a number of new roads being constructed there must be numerous temporary exposures known to members of which it is important and desirable to make a record to form a valuable book.

FRED. S. WALLIS, Ph.D ,

Hon. Secretary and Treasurer.

ORNITHOLOGICAL SECTION, 1923.

THE same Officers continue to assist the working of the Section, and during 1923 six meetings were held at private houses of the Members or at the Museum. Papers were read on Reptilian characters in Birds, on Migration, Peculiar Qualities of the Trachaea of various Ducks and Geese, and on Collecting ; also one meeting was devoted to affording information about general questions of Bird life, of which notice had been given, and another at Midsummer to talking over jointly with the Bristol Field Club the observations and results obtained during the past season.

The President, Prof. C. Lloyd Morgan, gave his inaugural address on " Some recent observations of Bird Life " at the University in February, to which an invitation was extended to the Parent Society. Apart from these indoor meetings the Members have carried on independently a good deal of field work, and the following list gives some of their results, which have been discussed at the meetings. These include various photographs illustrative of the life history of Birds ; a compact and light electrical appliance for releasing a camera at any distance instantaneously ; exhibits to prove the Food of Birds ; examples of the Curlew-Sandpiper, Knot, Arctic Tern, Redshank and Dunlin ; Greater and Lesser Horseshoe and Long-eared Bats, including one albino specimen of the Lesser Horseshoe Bat. As an opportunity offered for examples of these Bats to be brought forward, they were gladly included to overcome the drawback of no special Section devoting itself to Zoology as a whole.

In other directions the Section has started to keep observational records of Migration, and to extend this work it is intended to do some bird " ringing " next year.

It has also purchased, thanks to the generosity of certain members and Council, a cabinet, with the intention in the years to come to make part of its work the formation of a type collection of local Birds.

COLDSTREAM TUCKETT,

Hon. Secretary and Treasurer.

Account of the Annual and General Meetings.

THE 60TH ANNUAL MEETING.

January 18th, 1923.

Mr. H. Womersley was elected President for the second year, and Sir Ernest Cook, D.Sc., and Prof. O. V. Darbishire, Ph.D., F.L.S., Vice-Presidents, with minor alterations in Council.

Mr. Womersley gave his first Presidential Address on the "Chemistry of the Cell," and the effect it has to produce living organisms.

He pointed out that whilst a cell may exist alone, they are not isolated entities in general, but are connected by filaments of protoplasm ; and the separate units become differentiated by their position and environments. In every instance each cell is controlled by its nucleus amongst both animals and plants, and dealing only with those of animals, variations are to be found in the size of cells, as for example in eggs, or caused by growth, as in some Infusoria and Protozoa ; then the single nucleus may be distributed or remain distinct by dividing itself during cell increase. These changing groups of cells are what constitute in one aspect living organisms, from which Science sets out separate species.

Another character that is regarded as establishing "Life" is the chemical contents of the cells. These consist of special materials called Proteins, which are complex compounds of nitrogen, carbon, oxygen and hydrogen, with traces of iron and phosphorus. Proteins, as was fully explained, whether simple or joined in special ways, have properties very easily altered by the interchange of molecules of oxygen and hydrogen, from which result the formation of smaller molecules of ever varying compounds. In like manner the nucleus is chemically complex and its recurrent activity depends on a supply of suitable liquid food from the proteins.

In one set of cells, such as yeast and the ferments, reaction in this manner is not common amongst all the organisms, but is confined to one or two special groups of substances, as demonstrated in saliva, pepsin, rennet and the like.

These chemical changes of proteins within the cells, usually with the aid of ferments, combined with the power of growth of the cells, form together the two essential attributes of living matter

THE 500TH GENERAL MEETING.

February 1st, 1923.

"Some Recent Observations of Bird-life," by Prof. C. Lloyd Morgan, F.R.S.

The Society having revived the Section of Ornithology this was its inaugural meeting, and the address by the Honorary President of the Section was also regarded as the paper to the Society for this meeting.

Prof. Lloyd Morgan first described the stages of progress of the born naturalist, who began with what he might term without offence superficial observation and eventually reached the stage when he held the whole in something like an evolutionary picture. Drawing an analogy, he said that the chapters in the life-history of birds might be entitled immigration, mating, nesting, care of young and emigration. Of late a fresh paragraph had been inserted in that series. It came between immigration and mating. It was a stage that had been very largely overlooked until lately, and it might involve—he thought it did involve—a re-interpretation of the meaning of many of the sentences in those chapters. After a brief reference to the work of Mr. Edgar Chance in tracing the history of the cuckoo—a work on which he thought Mr. Chance ought to be congratulated—the speaker dealt at length with Mr. Elliott Howard's observation of the period between the immigration of the male birds from the south and their mating with the females which arrive in this country anything from 5 or 6 days to three weeks later. He spoke of the nature, disposition, impulse and instinct of birds, and warned his audience against erecting any of these into a metaphysical entity. A point of general interest arising from Mr. Howard's re-interpretation of the chapter on mating was his discovery that the best period of singing was before the arrival of the females. After the male had secured his mate in his "territory" his song fell off. He was not, therefore, singing to please the lady! Rather, as Mr. Howard suggested, after the male had selected his "territory," the female arrived and was attracted by his song.

A number of slides bearing on the subject was shown.

THE 501ST GENERAL MEETING.

March 8th, 1923.

"What is Bred in the Bone," by Mr. E. E. Lowe (*Director of the Leicester Museum and Art Gallery*).

It was pointed out that physical and mental characters shown by man and animals were of two distinct kinds :—(1) congenital ones, e.g., lop-ears in certain rabbits, or a crooked finger in a child, and the mane, horns or whiskers at a due age—each bred in the bone ; and (2) those acquired during life by special efforts and training of body or mind, e.g., great enlargement of muscle, or activity of fingers in piano playing, and the education of the mind to its highest attainments—each acquired during a life time, and not transmitted to the offspring.

At one time it was held by scientists that the inherent or congenital characters were acquired as the result of successive generations gradually adding a small step towards the present physical state, as the giraffes lengthening their necks, or wading birds their legs by securing more food thereby. Nowaday opinion is against this view, as experiments of constantly cutting off the tails of mice for many generations have no effects on the offspring, nor has the custom practised by a tribe of Red Indians of flattening the skulls of their children produced any sign of permanent change. Rather it is held that natural selection is the operating cause, that is, the variations from the average which occur amongst offspring, are present at the moment of birth, and inherent in the mixture of characters which takes place at the fertilization of the nucleus of the female egg. The offspring best fitted for the battle of life survives, and similar results are obtained in following generations, from the fresh variations that arise and are best able to overcome the life conditions prevailing. Examples of such slow changes are found in whales losing their hind legs, man his tail, leaf butterflies and many insects securing mimicry of their surroundings.

The lecturer admitted it was a sad fact to be faced, that all the education now being acquired had no direct beneficial effect on our children, and only indirectly benefited the race. It should be clearly realised that education, valuable as is the highest study for the individual, cannot bring about what it is popularly supposed to do, transmit an increased mental endowment to our children. The truth of this is manifest by reason of the extremely early age at which the reproductive cells of all animals are set aside in one definite part of the body long before sexual maturity is attained. It is likely that the theories of Mendel and Weismann may point the track along which variations arise, by certain characters proving to be dominant over others in human beings, as for instance, red hair is " recessive " and may appear at intervals only, being usually kept down by the dominant brown colour, or the artistic or musical abilities of parents may be long suppressed. Mental and physical defects on the other hand seem to be dominant, so as to constantly recur, and to this unfortunate power the presence of defective children appears to be due, from the union of one mentally deficient or tainted parent.

Amongst ordinary healthy families variations occur from the inborn nature of the children, even though all are brought up with similar surroundings and equally good education, and this cannot be altered, but to assure improved health, and to obtain long life, it is needful to take care through the generations to mate together only healthy stocks, and in short we " must choose our parents properly."

THE 502ND ANNUAL MEETING.

April 5th, 1923.

"Giants," by Prof. E. Fawcett, F.R.S.

The occurrence of a man of a height in excess of ordinary stature is not restricted to any special race or colour, as on occasions giants may be met with amongst them all. From history, however, it is to be noticed that certain races appear to furnish more examples, such as the Irish, "where men of uncommon stature are often seen," the people of Patagonia, the northern races, who furnished the celebrated Prussian Guards, and other people whose skeletons have been measured. A table to show the height of giants brought out clearly the different nationalities.

Height gave advantages to a man as well as having drawbacks, and incidents were related how giants had been known to light their pipes from street lamps, or to shake hands with people in the boxes of theatres, or to cause companions to resort to running in order to keep pace with the giant on an ordinary walk. On the other hand giants were not always well formed, or intelligent or healthy.

Although rumour magnified the height of some giants to between 8 and 9 feet, it may be considered certain 7 to 8 feet is near the true mark. Lantern slides to illustrate details were shown, and a number of questions answered.

THE 503RD GENERAL MEETING.

May 3rd, 1923.

"The Intelligence and Sense Organs of Dragonflies," by T. F. Hewer.

(Printed in full on page 38).

Exhibits by Mr. W. Griffiths of four examples of the Comma butterfly, Polygonia c-album, and the water beetle, Hydrophilus piceus, taken early in April, and new to the district; by Mr. Coldstream Tuckett, of a whiskered bat, Myotis mystacinus.

FIELD EXCURSIONS.

Three excursions were arranged during the Summer of 1923, but the July one was not held on account of the weather.

June 9th. Ramble from Mangotsfield to Pucklechurch across the fields through Syston. There were only nine members present, and during the enjoyable walk the following special plants were noticed:—The white flowered *Trifolium pratense* and its variety *parviflorum*, *Barbarea arcuata*, and the fine example of *Buxus balearica* planted on the Syston Court estate. The ancient churches on the way were also visited and aroused much interest.

September 8th. Ramble from Keynsham to Bitton, keeping near the River Avon. The attendance again proved disappointing and only numbered ten. The chief object was to pay a visit to the Vicarage garden made so celebrated by the fifty years labour of the late Canon H. N. Ellacombe. In the absence on holiday of the present Vicar, Rev. F. H. W. Taylor, the gardener delighted the members by describing the many foreign shrubs and herbs that still flourish under his fostering care.

THE 504TH GENERAL MEETING.

October 4th, 1923.

"The Rice Plant of India," by David Hooper, LL.D.

The lecture dealt with rice from three points of view, i.e., historical, agricultural and chemical. The lecturer said that rice was probably used first by the Aboriginal tribes of India, and is noticed in the Athana-Veda along with barley and beans. The earliest mention of its cultivation was connected with China, a ceremony being established in 2,800 B.C. by the Emperor Chin-nung. The chief wild habitat of the plant was roughly from Southern India to Cochin China. The Karens of Burma believed that every rice plant had its spirit, and offered prayers whenever the crop was bad. Rice played an important part in the marriage ceremonies of Hindus, being poured over the head of the bride as an emblem of life, regeneration, etc. This was probably the origin of rice-throwing at weddings. Rice was also used at a birth, when naming a child, for the purpose of averting evil, from witches, and at funeral ceremonies. There were three harvests of rice in India every year, and a harvest festival for each, when the rice was worshipped. The different kinds of rice might be classed as follows :—The awned and awnless, the coloured and colourless. It was calculated that in India 89 million tons of rice were prepared at a value of £190,000,000. The paddies are first dried in the sun, then husked in hullers, the cuticle is next removed by friction, and the white rice is then put through a polishing machine. The average period rice took to mature was two months, but some varieties took three, four, or even five to grow. The names given to some rices have reference to the size, shape, colour or scent of the grain, but in others it denotes the nutritive quality, or may refer to the fact that they are sacred to some deity. Rice is always held in great veneration, special rices being offered to dieties, others are regarded as food fit for royal tables, and poetic and humane instincts are revealed by the names of rices which signify moon over the mountains, horse rice and ant rice, the little insect not being forgotten. The lecture concluded with a chemical analysis of rice, and the disease beri-beri.

Exhibit by Mr. H. Womersley of living Hymenopterous parasites on a Coleopterous larva.

THE 505TH GENERAL MEETING.

November 1st, 1923.

Exhibits of Natural History by the Members.

All sections were well represented, even excelling in quality those of last year. Amongst the exhibits were :—The President, Mr. H. Womersley, dragonflies, beetles, a rare lacewing, various spring tails, and the Berlese apparatus for collecting same ; humble bees' nest, with inquilines, scavengers, &c., abnormal gulls' eggs, female butterflies with male coloration by Mr. W. Griffiths ; water-colour drawings of Hemiptera, by Mr. A. D. R. Bacchus, and chalcidae and new specimens of mymaridae by Dr. Blood ; photographs of sea birds from Scilly Isles and bird life in the garden, Mr. R. P. Gait and Mr. G. R. Mountfort ; bats and various small mammals, Mr. C. Tuckett ; the food of owls and herons, Miss Selman ; various forms of vegetative reproduction, Miss Roper, Prof. O. V. Darbishire, and Mr. C. Hunter ; a collection of beautiful local fungi, Mr. H. J. Gibbons and Mr. C. Wall ; British alpine flowers, Mr. F. W. Evens ; floral sports, Mrs. Sandwith ; vertebrate remains, Prof. S. H. Reynolds ; evolution and development of the lobes of fossils, Mr. J. W. Tutcher ; fossils shown at the Geological Association, Mr. H. F. Barke ; flint implements found locally, made by Palaeolithic man, Mr. R. H. FitzJames.

Coffee was served during the meeting.

THE 506TH GENERAL MEETING.

December 6th, 1923.

"The Story of the Geological Science," by Dr. S. Smith, M.A., F.G.S.

We were apt to think that geology was one of the youngest of the sciences, whereas it was really the oldest. Every child was born a scientist and asked questions about his surroundings. Primitive man did likewise, asked these questions, and answered them in his own crude fashion ; he expressed his ideas as a tale of the struggle between giants and beasts. Man passed from the hunting stage to the pastoral ; he saw the miracle of seed time and harvest, and attempts to solve the universe soon became a religion. Then came the ancient Greek philosophers, who, though acquainted with physics and mathematics, contributed little to geology, the earliest philosophers indulging in poetic and yet brilliant flights of fancy that often came very near the mark. Thales thought that there must have been an all-prevailing substance forming heat and cold, and that water might have been the originator of all living things. Eratosthemes recognised the double movement of the earth. The Greeks were, however, philosophers and not scientists. After the Greeks came the Romans, who were more practical than the Greeks ; they applied the principles of geology, without being aware of the fact, by constructing roads and laying water pipes. They were, however, more fond of games than science. By the fall of the Roman Empire the whole world fell into chaos. Then came the Dark Ages, people trusting their possessions to strong walls and their learning to the Church. There came several great events which contributed greatly to revival of learning :—(1) The conquering Arabs, who were Alchemists ; (2) the Crusaders, who returned bringing with them glass windows and rugs ; (3) the Turk, who broke into Europe, scattered the monks, who fled and spread their knowledge ; (4) the Renaissance ; (5) the discovery of America, opening up new thought as well as new lands. Several men assisted greatly about this time—Galileo, Dante, Leonardo de Vinci, and Palassy, who studied fossils. Afterwards Berringer wrote books on fossils and later John Woodward collected them. In 1670 the world accepted the origin of fossils, as we do to-day. Then, coming to more modern time, two schools arose, one thinking the earth had been formed by action of water only, the other by volcanic means as well. The penny post, the railways, and sea steamboats in the early 19th century, shortening distances and rendering exchange of ideas easier, accelerated scientific progress.

Exhibits by Mr. W. Griffiths and Miss Griffiths of larva of the carniverous water beetle Dytiscus marginalis ; unusually small eggs of the Guillemot and the vocal chords of the Widgeon.

THE DIAMOND JUBILEE: A RETROSPECT.

The 60th year of this society's existence was completed on May 8th, 1923. Early in 1862 the late Prof. Adolph Leipner (who had made Bristol his home in 1854) and six other Bristol citizens —Mr. Stephen Barton, Dr. John Beddoe, Mr. W. J. Fedden, Dr. Henry E. Fripp, Mr. C. T. Hudson, and Mr. W. W. Stoddart— formed themselves into a Provisional Committee, and proceeded to sound the scientific mind of Bristol upon the question of forming a society, with the aim and object of investigating " every branch of science that finds culture amongst us." No fewer than 168 gentlemen replied favourably, and on 24th April invitations were sent, asking their attendance at the inaugural meeting in the Philosophical Institution, Park Street, on Thursday evening, May 8th, 1862. In the absence of the Rev. Canon Mosely, who was to have presided, the Rev. Canon Guthrie was voted to the chair. The report of the Provincial Committee was read, and, together with the proposed rules, adopted after full discussion. Officers were then elected on the proposal of the Rev. W. James, seconded by Dr. Beddoe—the former remarking that " there could be no real opposition between the truths of science and of religion." Thanks were voted to the committee of the Philosophical Institution, which, in reply to an application, had resolved " that this committee has heard with real pleasure of the formation of the Bristol Naturalists' Society, and that the rooms of the institution be placed at its disposal during pleasure."

Mr. W. Sanders, F.R.S., the first President, held office until his death in 1875. Mr. Leipner, really the " Father " of the society, acted as hon. secretary until 1893, when he became President, but his lamented death took place only a few months later. His wonderful zeal enabled him to fulfil the duties of hon. librarian also, until 1879.

THE LIBRARY.

The first list of books, printed in 1866, included 14 volumes. The present library, which contains many works to be found nowhere else in the city, consists of about 3,000 bound volumes and periodicals of corresponding societies all over the world come regularly in exchange for our annual " Proceedings "—48 from Great Britain and Ireland, 10 from other parts of the Empire, 28 from the United States, and also a few from France, Norway, Switzerland, Argentina, Uruguay, Mexico and Peru. Until 1871 the library was housed in the Philosophical Institution. From that date until 1884 the books were in Prof. Leipner's own house.

Then University College kindly found space for them ; but, with the steady growth in numbers, another home was found needful in 1890, and this was in the Literary and Philosophic Club House in Berkeley Square. Since the spring of 1922 the committee of the " Bristol Museum and Art Gallery " has kindly provided accommodation.

The place where the ordinary meetings have been held since we left the Philosophical Institution in 1871 was for some years the " Bristol Museum and Library," and then the hospitable doors of " University College " opened to us in December, 1883. This kindly welcome has been continued by the " University " ever since it came into being.

Excursion meetings have always been a feature of the society's work, though, of late years, the multiplicity of engagements of all kinds has greatly diminished the numbers attending these pleasant outings. At the first one, July 8th, 1862, botany, entomology and geology were all represented. At the second (20th August) archæology claimed a considerable share of attention—the account printed in the local papers recording that " the main halt was at Coaley hill tumulus," into which a few ardent souls " dexterously wriggled their way." As has always been the case with local societies, resembling ours, the fascinating subject of archæology has invariably been a great attraction ; though an ill-judged attempt to exclude it, and certain other subjects, from our sphere of activity was made many years ago. The idea in the minds of the revolutionists was, seemingly, to limit our work to " Natural History " pure and simple.

SPECIALISING.

During the 60 years' life of the society various sections have been formed from time to time for special study of different branches of science—not only botany, zoology, and geology, but also chemistry and photography, physics, microscopy, engineering, and others. Directly due to the broad basis wisely laid by the founders of the society, the papers printed in the annual " Proceedings " have included some dealing with a wide range of subjects—anatomy (human), archæology, astronomy, chemistry, cosmography, electricity, engineering, epidemiology, ethnology, folklore and superstitions, histology, magnetism, mental science, meterology, microscopy, philology, photography, physics, physiology, sanitary and social science, technology, etc., in addition to those upon botany, zoology and geology.

LADIES AS MEMBERS.

In regard to membership, the numbers reached 250 in 1887 ; but from the first there have been considerable fluctuations. At present the total is about 150, and this smaller number is probably mainly the result of the multiplication in recent years of competing societies, each limiting its work to one special branch of science; but is undoubtedly partly due to the unwholesome craving by the younger generation for mere amusements.

At its foundation, membership was limited to "mere man," but only five months after the Society's birth, the Council, in accordance with the wish of many members arranged an excursion "suitable for" the gentler sex. The 'Fairy Queen' was chartered, and took members and their guests to Portishead and back, leaving Cumberland Basin at 11 a.m., and returned at 7 p.m.

The very next month the Council was authorised to invite ladies to the evening meetings,—"whenever the subjects are likely to be of a nature to interest a female audience!" This hazardous experiment seems to have succeeded; but nearly five years more elapsed before ladies were admitted to membership, though only as "Associates"; and the right to the equality of full membership was not gained until October 1872. No official position was held by any lady until 1896, when Miss M. K. Moore was appointed Reporting Secretary; and for five years carried out her duties in an exemplary way. Since then we have had a lady, Miss Roper F.L.S., as President, who filled the position in a most able manner. It should be mentioned that we still have with us one of the original members,—our highly esteemed fellow-citizen, Mr. Augustine F. Woodward,—who joined 1862, and remained on the roll until 1882.

A third class of members, paying only one quarter the full subscription was started in 1895, in response to representations by certain members of the Geological Section, who said that there was a large number of "working men" geologists and others, who would willingly subscribe half-a-crown a year though they could not afford either the full subscription (10s.) or that of the Associates (5s.). Five years experience sufficed to prove the untrustworthiness of these representations; for only a very limited number of people joined at this reduced rate, and the difficulty of obtaining payment from members of all classes was always in inverse ratio to the size of the subscription. The half-a-crown membership was, therefore, wisely abolished.

PAPERS AND PUBLICATION.

The first paper read to the Society was upon "Insect respiration," at the inaugural meeting. Dr. Brittan was the author; and lantern illustrations were given by Dr. C. T. Hudson. At the second meeting there were papers on Geology, Histology, and Zoology; and a "Giant Puffball" was exhibited. From the first the evening meetings have been regularly held in the winter months; and in the summer one or more general excursions have been arranged. For some years the meetings were closed at an early hour, e.g., the Minutes of the 22nd meeting record that "A discussion ensued, which was cut short by the announcement from the chair at half-past nine, that it was time for the meeting to separate." Among the publications of the Society have been the "Flora" of the district, the "Fungi," and certain sections of the "Fauna"—the Birds, the Diptera, the Lepidoptera, etc. There have been also many valuable papers on local Geology—especially worthy of mention being the classic one upon the Avon Gorge by the late Arthur Vaughan, D.Sc., whose zonal classification of the carboniferous limestone has been adopted by all geologists.

The Society has undoubtedly fulfilled to a large extent the aims of its founders; and the volume of really good scientific work which it has accomplished forms a very strong claim for a more widespread and generous local support than it has hitherto received.

A. B. P.

PRESIDENTIAL ADDRESS, 1923.

"THE MODERN STUDY OF ENTOMOLOGY.

By H. Womersley.

IN order to interest members in the relationship from the evolutionary aspect of the Orders of Insects to each other and to the other branches of the Arthropoda, the metamorphic life histories of many families were sketched in detail, special attention being given to such parts of the bodies as were likely to rank as primitive or directly derived from generalized forms, towards which fossils contribute only a small amount of information.

The basis of many descriptions was from local examples studied by the lecturer, chiefly from the lower forms of Insects, such as the Spring-tails, Bristle-tails, and such like. A list of Mr. Womerley's captures amongst these wingless Insects in the South-West of England is appended as an encouragement to study them.

These closely reasoned details of anatomy served to show how evolution forged the connecting links up to the Hymenoptera and Diptera. It was considered probable that to a primitive worm, living in water and coming to the land, the origin of the Arthropoda and all its classes must be placed.

THE APTERYGOTA OF THE SOUTH-WEST OF ENGLAND.

With the exception of Marquand's paper on "The Penzance Collembola and Thysanura" in the *Trans. Penzance Nat. Hist. Soc.*, 1881, and Parfitt's "List of Devon Thysanura," *Trans. Devonshire Assoc.*, Vol. 23, 1891, no one has to my knowledge worked on these insects in the S.-W. Counties of England.

In the present list, besides my own records, I have endeavoured to incorporate the species recorded in the papers referred to, but under their present names.

This list enumerates some five certain species of Thysanura, and 57 species and eight varieties of Collembola. Of these several of the older records, owing to changes of nomenclature and subdivision of species, need to be confirmed. My own records number 41 Collembola and 3 varieties and 5 species of Thysanura.

The nomenclature followed has been chiefly that of Börner and Linnaniemi.

Finally, it is with the greatest pleasure that I acknowledge my indebtedness to Mr. J. Meikle Brown, B.Sc., F.L.S., F.E.S., for his help in naming or confirming most of my captures, etc.

Class	—	INSECTA.
Sub-Class	—	Apterygota (Oudemans).
Order	—	**Thysanura** (Latreille).
Family	—	**Machilidae.**
I. Genus	—	**Præmachilis** (Silv.).

1. **P. hybernica** (Carp.).

The Machilis polypoda of Lubbock's Monograph occurs fairly plentifully amongst stones at the roots of trees in Leigh Woods, Somerset (January and February, 1923); also at Cadbury Camp, Tickenham, and is not uncommon on the rocks in Blaise Castle Grounds, Glos. (August, 1923). Recorded by Marquand for the Land's End District under M. polypoda. Sidmouth, 1890; *Parfitt.*

II. Genus — **Petrobius** (Leach).

2. **P. Carpentari** (Bagn.).

Occurs plentifully, but localised under railway arches on Somerset side of Avon Gorge, and also on the cliffs between Weston-super-Mare and Kewstoke.

Whether the species recorded as M. maritima by Marquand for Land's End is this species, I am unable to say, not having handled specimens from there.

Parfitt records Machilis maritima from Ilfracombe, Torbay, Babbacombe, etc., but the correct species must await re-determination.

Family — **Lepismatidæ** (Burmeister).
III. Genus — **Lepisma** (Linn.).

3. **L. saccharina** (Linn.).

The common silver fish occurs practically everywhere, and occasionally does slight damage to paper, books, etc. I have records from Glos., Somerset and Cornwall. Exeter; *Parfitt.*

[**L.** sp. ? near **parisiensis** (Nic.)].

Recorded by Parfitt in numbers in old woodwork, North Devon.

Family — **Campodeadae** (Lubb.)
IV. Genus — **Campodea** (Westwood).

4. **C. lankesteri** (Silv.).

Fairly plentiful under stones around Bristol.

5. **C. lubbocki** (Silv.).

Also plentiful and generally distributed around Bristol in similar localities to above.

Marquand records C. staphylinus for Land's End, but whether true staphylinus, or another of the now recognised species, is uncertain without fresh captures.

My remark *re* Marquand's record of Campodea staphylinus equally applies to Parfitt's records.

Order — **Collembola** (Lubb.).
Sub-Order — **Arthropleona** (C. Borner).
Section — **Poduro-morpha** (C.B.).
Family — **Poduridæ** (C.B.)
I. Genus — **Podura** (Linn.) Tlbg.

1. **P. aquatica** (Linn.) Nic.

Abundant everywhere around Bristol on the surface of stagnant ponds. Probably occurs throughout the S.-W. area. Marquand records it for Land's End. Common, Devon ; *Parfitt.*

Family — **Hypogastruridæ** (C.B.).
Sub-family — **Hypogastrurinæ** (C.B.).
II. Genus — **Hypogastrura** (Bour. C.B.) (**Achorutes,** Temp. Lubb. L.).

2. **H. armata** (Nic.).

Taken under bark Combe Dingle, Bristol, Feb., 1922 ; Blaise, Nov. 18, 1923 ; and Leigh Woods, Nov. 18, 1923 ; Heathfield and Shaldon, Devon, June, 1923.

3. **H. purpurascens** (Lubbk.).

On embankment wall Somerset side of Avon Gorge, Nov. 17, 1922, and under bark Blaise Castle, Feb. 24, 1923, on face of cliffs, Kewstoke, Soms., Oct. 21, 1923, also at Land's End, *Marquand,* Dartmoor, 1890. *Parfitt.*

4. **H. viaticus** (Linn.) Tullb.

Abundant on rotting potatoes, Stoke Bishop, Bristol, Feb. 14, 1923. Recorded by Marquand for Land's End under the name Achorutes murorum. Between tide marks on banks of Exe at Exeter ; *Parfitt.*

The use of this insect in clearing sewage filter beds is of great interest, and it is to be noted that the spot where I found this species is only a field away from the site of an old sewage farm. This possibly has something to do with the presence of these insects.

5. [**H. unungviculatus** (Tullb.)].

Marquand's Podura Tullbergi may be this species. It requires confirmation.

6. **H. rufescens** (Nic.), Exeter 1890–91 ; *Parfitt.*

7. [**H. ? assimilatus** (Nic.)].

Marquand records Achorutes assimilatus (Nic.) as occurring plentifully in a beer cellar in November.

III. Genus — **Xenylla** (Tlbg.).

8. **X. grisea** (Axels.).

Under bark Kewstoke Woods, Weston-super-Mare, Aug. 25. 1922.

Sub-family — **Achorutinæ** (C.B.).
Tribe — **Pseudachorutini** (C.B.).
IV. Genus — **Pseudachorutes** (Tlbg.).

9. **P. asigillatus** (Born.).

Under bark Blaise Castle, Feb. 24, 1923, and also in similar habitat Leigh Woods, Bristol, March 30, 1923.

V. Genus — **Anurida** (Laboulb.).

10. **A. maritima** (Guer.).

Plentiful under stones on shore between high and low water mark at Weston-super-Mare and Portishead, also from Land's End ; *Marquand.* The clusters of large yellow eggs may be found in April in similar situations. Plymouth ; *Parfitt.*

Tribe — **Achorutini** (C.B.).

VI. Genus — **Achorutes** (C.B.) Templ.

Neanura (Macgily.).

11. **A. muscorum** (Templ.).

Generally distributed under bark or stones, Flax Bourton, Bristol, Feb. 24, 1923 ; Blaise, Feb. 4. 1923 ; Weston-super-Mare March 25, 1923. Land's End ; *Marquand.*

Family — **Onychiurinæ** (C.B.)

VII. Genus — **Onychiurus** (Gerv.).

12. **O. burmeisteri** (Lubbk.).

Generally distributed under stones. Land's End; *Marquand.* Exeter ; *Parfitt.*

13. **O. ambulans** (Linn.) Tullb.

Equally common. Heathfield, Devon, June 6, 1923. Land's End ; *Marquand.* Chudleigh, 1878 ; *Parfitt.*

14. **O. armatus** (Tullb.).

In the stem of an agaric, Blaise, Feb. 4, 1923. Plentiful in moss, Blaise, Nov. 1923.

15. **O. fimetarius** (Lubbk.).

From Land's End ; *Marquand.*

Section — **Entomobryomorpha** (C.B.)
Family — **Isotomidæ** (Schffr.).
Sub-family — **Isotominæ** (Schffr.).
VIII. Genus — **Anurophorus.**

16. **A. laricis** (Tullb.).

Under bark of living Scotch firs and larch, 1883, Devon ; *Parfitt.*

IX. Genus — **Isotoma** s. str. (Bourl. C.B.).

17. **I. viridis** (Bourl.).

Common everywhere amongst moss and under stones. Marquand records it under the names of viridis, viaticus and anglicana, now considered varieties.

Linnaniemi regards Parfitt's records of I. palustris, vars. viridis and aquatilis as referable to this species. His palustris, viaticus and anglicana should also belong to this species.

18. **I. olivacea** (Tullb.) var. **griscescens** (Schaffr.).

The I. grisea of Marquand from Land's End is probably this variety of olivacea (Tullb.).

Parfitt's grisea var. intricata is probably this species.

19. **I. maritima** (Tullb.).

Parfitt took this species under marine rejectamenta, Babbacombe, 1890.

X. Sub-Genus **Isotoma** (Vertagopus) (C.B.).

20. **V. arborea** (Linn.) Agren.

Common under bark during the winter. Land's End ; *Marquand.* Devon ; *Parfitt.*

21. **V. sensibilis** (Tullb.)

Under bark Blaise Castle Woods, March 17, 1923.

22. **V. cinerea** (Nic.).

Under bark Weston-super-Mare, March 25, 1923.

XI. Genus — **Proisotoma** (C.B.).

23. **P. minuta** (Tullb.).

Under rotten bark Heathfield, Devon, June 6, 1923.

XII. Genus — **Archisotoma** (Linnaniemi).

24. **A. besselsi** (Pack)=Isotoma spitzbergensis=Lub.

An extremely interesting species of northern habitat, common under stones on shore between high and low water mark at Weston-super-Mare, March 25, 1923. Also at Shaldon, Devon, June 7, 1923. Easily distinguished by its characteristic mucro. The only previous record from the South of England is "coast near Beachy Head ; *Brown,* 1921 (E.M.M.)."

XIII. Genus — **Folsomia** (Willem.).

25. **F. fimetaria** (Linn.) Tlbg.

Under bark Shapwick, Aug. 26, 1923, Weston-super-Mare, Jan. 20, 1922.

Do. var. **caldaria** (Axels.).

A large specimen 3 mm. approx. taken at Weston-super-Mare same date could be referred to this variety.

26. **F. quadrioculata** (Tullb.).

A single specimen of this interesting and delicate creature was taken under dead leaves in Leigh Woods, Jan. 14, 1923. Plentiful amongst dead leaves Blaise, Nov. 10, 1923.

XIV. Genus — **Isotomurus** (C.B.)

27. **I. palustris** (Miall.).

On surface of water at Shapwick in the Spring of 1921. Later under stones Durdham Downs and in my garden ; Henbury, March 31, 1923. Heathfield, Devon, June 6, 1923. Marquand records it for Land's End.

Family — **Tomoceridæ** (Schffr.).
Sub-family — **Tomocerinæ** (C.B.).
XV. Genus — **Tomocerus** (Nic.).

28. **T. minor** (Lubbk.).
,, **plumbeus** (Lubbk.)=tridentiferus (Tullbg.).

Common everywhere under stones, bark, etc. Heathfield, June 6, 1923. Land's End ; *Marquand.*

29. **T. vulgaris** (Tullb.), Dartmoor ; *Parfitt.*

30. **T. (Pogonognathus) longicornis** (Lubbk.)
,, plumbeus (Linn.) Tullbg.

Has a remarkably long coiled antennæ. Under bark almost everywhere. Blaise Castle, etc., Heathfield, June 6, 1923. Land's End ; *Marquand.* Devon ; *Parfitt.*

31. **T. (P.) plumbeus** (Templ. Agr.).

Parfitt records it from near Sidmouth as T. niger (Bourlet).

Family — **Entomobryidæ** (C.B.).
Sub-family — **Entomobryinæ** (C.B.).
Tribe — **Entomobryini** (C.B.)
XVI. Genus — **Entomobrya** (Rond.)
= **Degeeria** (Nic.)

32. **E. nivalis** (Linn.).

Common everywhere in herbage bushes, etc. Marquand's D. annulata is probably this species. Devon ; *Parfitt.*

33. **E. multifasciata** (Tullb.).

Equally common. Marquand's D. nivalis is most likely this species. Devonshire ; *Parfitt.*

E. multifasciata var. **brooki,** Babbacombe, 1890 ; *Parfitt.*

34. **E. muscorum** (Nic.).

Fairly plentiful. Recorded by Marquand for Land's End as D. nicoleti.

35. **E. intermedea** (Brook) recorded for Dartmoor; *Parfitt.*
E. intermedea var. **elongata** Exeter, 1891; *Parfitt.*

36. **E. lanuginosus** (Nic.).
Recorded from Exeter as a variety of multifasciata; Parfitt

37. **E. arborea** (Tullb.) Devonshire; *Parfitt,* as a variety of multifasciata.

38. **E. nicoleti** (Lulb.). Generally distributed in Devon; *Parfitt.*

39. **E. albocincta** (Temp.).

Common under every piece of loose bark. Heathfield, Devon, June 6, 1923. Marquand for Land's End, D. cincta. Exeter; *Parfitt.*

XVII. Genus — **Lepidocyrtus** (Bourl.).

40. **L. cyaneus.** Tulbg.

Very abundant and generally distributed under stones. Heathfield, Devon, June 6, 1923. Recorded for Land's End by Marquand under L. violaceus and purpureus.

Parfitt records this as L. violaceus and purpureus.

41. **L. lanuginosus** (Gomel.).

Leigh Woods, Dec. 1922. Land's End, *Marquand,* as L. lignorum and gibbulus; Devon, *Parfitt* as L. lignorum, gibbulus and æneus.

42. **L. curvicollis** (Bourl.).

In my own garden May, 1923. Land's End; *Marquand.* Sidmouth; *Parfitt.* Not uncommon Blaise, Nov. 10, 1923, Leigh Woods, Nov. 18, 1923.

XVIII. Genus — **Willowsia** (Shoe.)
= **Sira** (Lubk. ad. part).

43. **W. buskii** (Lubb.).

Under elm bark Exeter, 1891; *Parfitt.*

XIX. Genus — **Sara** (Lbk.) Shoebthm.

44. **S. nigromaculata** (Lbbk.), taken by Parfitt under chips, Exeter, 1890.

Recorded for Land's End by Marquand.

Tribe — **Orchesselini** (C.B.).
XX. Genus — **Orchesella** (Templ.).

45. **O. cincta** (Linn.) Lbk.

Plentiful everywhere in herbage. Heathfield, Devon, June 6, 1923. Land's End; *Marquand.* Exeter District; *Parfitt.*

O. var. **vaga.**

Equally common.

46. **O. villosa** (Geoff.), Lubk.

Equally plentiful, but under stones. Heathfield, Devon, June 6, 1923. Land's End; *Marquand.* Exeter District; *Parfitt.*

47. **O. flavescens.**

Amongst bracken and dog's mercury in Flax Bourton Combe in Spring, 1921.

XXI. Genus — **Heteromurus (Wankil.).**

48. **H. nitida** (Templ.).

The Templetonia crystallina of Lubbock's Monograph; generally plentiful under stones. Land's End,; *Marquand.*

Sub-family — **Cyphoderinæ** (C.B.).
Tribe — **Cyphoderini** (C.B.).
XXII. Genus **Cyphoderus** (Nic.)

49. **C. albinos** (Nic.).

The Beckia albinus of Lubbock occurs everywhere in nests of ants, especially A. (D.) flava. Heathfield, Devon, June 6, 1923, B. argentea of Marquand is probably this species. Exeter; *Parfitt* as C. argentea.

B.

Sub-order — **Symphepleona** (C.B.).
Family — **Sminthuridæ** (Lbk.).
Sub-family — **Sminthuridinæ** (C.B.).
Tribe — **Katiannini** (C.B.).
XXIII. Genus **Sminthurinus** (C.B.).

50. **S. aureus** (Lbk.).

Recorded by Marquand for Land's End.

Sub-family — **Sminthurinæ** (C.B.)
Tribe — **Bourletiellini** (C.B.).
XXIV. Genus **Bourletiella** (Bank) C.B.

51. **B. insignis** (Reut.).

Common in a meadow at Shaldon, Devon, June 4, 1923. Almost certainly in the Bristol District.

52. **B. bicinctus** (Kock.).
— cinctus (Tullb.)

Amongst herbage at Blaise, June 23, 1923. A small yellow species with two dark brown bands.

var. **repanda** (Agr.) Axels.=sulphurea (Kock.).

Amongst herbage with above at Blaise, June 23, 1923.

Tribe — **Sminthurini** (C.B.)
XXV. Genus — **Sminthurus** (Latr.) C.B.

53. **S. viridis** (Linn.).

Common in every short grassy meadow during summer. Very variable. Heathfield, Devon, June 6, 1923. Land's End ; *Marquand.* Exeter ; *Parfitt.*

XXVI. Genus — **Allacma** (C.B.)

54. **A. fusca** (Linn.).

Common in Blaise Castle Woods, late summer. Land's End ; *Marquand* as Smynthurus fuscus.

Sub-family — **Dicyrtominæ** (C.B.).
XXVII. Genus — **Dicyrtoma** (C.B.).

55. **D. fusca** (Lbk.).

Common amongst herbage and under stones and bark. Heathfield, Devon, June 6, 1923. Land's End ; *Marquand.*

XXVIII. Genus — **Dicyrtomina** (C.B.).

56. D. **minuta** (O.F.) var. **ornata** (Nic.) Lubk.=Papirius ornata of Lubk.

Both light and dark forms are equally common amongst herbage under stones, bark, etc. Land's End ; *Marquand* as P. ornatus and nigromaculatus.

Parfitt records this species under the old names of P. ornatus and P. nigromaculatus from Sidmouth and Exeter.

D. minuta var. **flavosignatus** (Tullb.), taken by Parfitt, Duryard, Exeter, and recorded as Papirius flavosignatus.

XXIX. Genus — **Ptenothrix** (Börn.).

57. **P. atra** (Linn).

Parfitt records this as Papirius polypodus (Linn) for Exeter, 1891.

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The Intelligence and Sense Organs of Dragonflies.

By T. F. Hewer.

(Read May 3rd, 1923).

Before dealing with the Sense Organs of Dragonflies it will be necessary to give some brief outline of the nervous system of these insects. In the Dragonfly, as in other insects, there is a so-called brain lying above the oesophagus ; that is in reality only the first three of the series of ganglia, which are so closely fused together as to be indistinguishable in the adult. From the first of this group of three are given off the extremely large optic ganglia, one on either side. The ganglion of the second segment gives off nerves to the antennae ; and the third is the origin of the sympathetic system. The first ganglion of the brain gives off the nerves to the lateral ocelli, or simple eyes ; the paired nerves to the single median ocellus are said to arise from the second ganglion, but in close relation to the first.

Below the oesophagus and connected with the brain by two commissures, which pass on either side of the oesophagus, is the second ganglion of the head region ; this like the brain represents the ganglia of three segments combined. It gives off three pairs of nerves, one to the mandibles, one to the maxillæ, and one to the labium ; it narrows posteriorly and finally gives origin to the two exceedingly slender ventral nerve cords, running very close together backwards in to the neck and thorax. It becomes continuous with the first thoracic ganglion, which is in its turn connected with the second, and that with the third. All three give off nerves to the muscles of their corresponding segments.

The nerve cord continues double to the end of the abdomen, and is enlarged into eight abdominal ganglia, which give off motor nerves supplying the muscles.

In some insects, or at any rate in their larvæ, there is a peripheral nervous system, quite unconnected with the central one, but forming a kind of general nerve network beneath the cuticle and the muscle layer. In dragonflies, however, these are all apparently connected with the ventral ganglia ; many of them supply small sense organs such as minute sensillæ, cones or tympanulæ on special parts of the cuticle ; others end in special enlarged cuticular cells, and serve to produce the effect of general sensation over the body surface.

We may now turn our attention to the sense organs of the Dragonfly. The first and chief of these are the eyes. The sense of sight is extraordinarily well developed, as might be imagined from a consideration of the great size of the optic ganglia. This sense alone suffices for the chase and capture of prey ; it is, however, supplemented by a well-developed sense of taste, located in the labium and epipharynx. The sense of touch is well developed in most parts of the body, but particularly in the mouth parts and abdominal appendages.

Correlated with the great powers of sight is the almost entire absence of any sense of smell. The antennæ, which were originally the seat of this sense, if indeed it was ever well developed in these insects, are much reduced and incapable of anything beyond feeble sensation.

The sense of hearing, as we understand it, is also practically absent, though there are certain minute organs in the legs which are capable of receiving vibrations, and may be looked upon as feeble auditory organs. These are dealt with below.

The eyes are of two kinds, simple eyes or ocelli, and compound or facetted eyes, made up of various separate elements. The ocelli are used for near vision, their range probably lying between a few millimetres and about one inch. The compound eyes on the other hand observe objects from an inch or so up to several feet off; while their perception of movement, as distinct from form, ranges very much further, probably up to 50 feet, or more in some cases.

The ocelli are three in number and are so placed on the epicranium that they isolate a small triangular area called the vertex; the median ocellus lies at the apex of the triangle, which is anterior, while the two lateral ocelli occupy the base angles. The median and lateral ocelli differ considerably in structure. The former is always the larger and is oval, with its major axis placed transversely; the lateral ocelli are smaller, simple oval bodies.

The median ocellus consists of a thick convex corneal lens, made up of a very large number of delicate layers of chitin, all of which are transparent, but not all colourless. Below the lens is a layer of very elongated corneagen cells continuous with the cuticle cells of the head, but colourless and transparent. These cells actually secrete the corneal lens and support it. And lastly a retina, formed by two series of visual cells or retinulæ, distal and proximal; these latter are surrounded by a layer of black pigment.

In the median ocellus the retina forms a thick half ring with two ends directed forward. This is strong evidence in favour of the generally accepted view that this organ is formed by the fusion of two originally separate ocelli.

The visual cells of the retina are arranged in sets of three. Each set gives rise, along the inner junctions of its compound cells, to a very remarkable organ called the rod or rhabdome, which is consequently, in transverse section, of triradiate form. It is semi-transparent and of a pale yellow colour; it is generally believed to be a light transmitter, that is, an organ which turns the energy of the light waves into nervous energy, and conveys impressions to the brain.

The visual cells of the proximal group appear to be much better developed than those of the distal group, the latter being considerably shorter. Mr. R. J. Tillyard, the eminent Australian entomologist, has failed to detect any rhabdomes in the visual cells of the distal group in the genus *Austrolestes*, but has found them in *Æschna.*

This may mean that Dragonflies, which only have rhabdomes in the proximal series of cells, can only focus their ocelli on objects at two fixed distances. In both cases the form of the lens show that objects viewed must be brought very close up to become visible.

The lateral ocelli possess a structure exactly similar to that of the median ocellus, except that they are symmetrical in all sections.

It is a matter of common knowledge that the compound eyes of all insects are made up of an enormous number of small divisions, distinguishable externally by means of the hexagonal facets. In the Dragonfly the number of these ranges from about 10,000 in the smaller *Zygoptera,* to 28,000 or more in the larger *Æschninea.*

Each of these hexagonal facets on the outer surface of the cornea corresponds with a single element of the compound eye, known as an ommatidium. This element has been compared with an ocellus, but we shall see there is sufficient difference in structure to make this comparison inadvisable.

It was, moreover, until recently quite generally held that the compound eye arose as an aggregation of simple eyes, similar to the ocelli, and that the hexagonal form of the facets was produced by mutual pressure between numerous originally rounded elements crowding closely together. Such crowding would certainly produce hexagonal form, but the previous assertion as to such an origin of compound eyes is refuted on palæontological grounds, if on no other ; for the compound eye is an exceedingly archaic structure, found well developed right back to the Lower Cambrian.

Moreover, in the Dragonflies at any rate, the compound eyes develop in the embryo, whereas the ocelli do not begin to develop until near or at the close of the larval life.

Each unit or ommatidium of the compound eye has a corneal lens, the external surface of which constitutes the hexagonal facet. This lens is deposited by the agency of the corneagen cells, which are easily made out in the eye of a freshly emerged adult dragonfly. The corneal lens is slightly biconvex and is made up of a thinner outer layer, representing the original cuticle, and a thicker inner layer of several fine laminæ superimposed one upon another. The inner laminæ are formed as a series of definite strata secreted by the corneagen cells; these latter appear to degenerate rapidly after the completion of the lenses, and their nuclei cannot be made out in the eyes of the mature insect.

Beneath the corneal lens lies the crystalline cone. This is a highly refractive body formed from four elongated transparent cells, the nuclei of which lie close to their outer or distal ends, and are known as Semper's nuclei. These very peculiar nuclei appear to be filled with small clear refractive bodies closely packed between large pigmented granules. The inner end or apex of the cone does not end in a point, but the ends of the four cells stand slightly apart, forming a slight hollow into which the distal end of the retinula, or group of visual cells, of the retina, is inserted. Each of the cones is surrounded by a number of darkly pigmented cells, which form the iris.

Below each crystaline cone there lies the exceedingly long portion of the ommatidium, known as the retinula. This is formed of four visual cells, placed close together with their long axes parallel. These cells are considered to be highly specialized unipolar nerve cells, placed with the pole or nervous end in contact with the fenestrate membrame.

Each of the four visual cells composing the retinula bears a row of exceedingly fine fibrils, arranged like the teeth of a fine comb; these fibrils pass inwards to the centre and unite to form the great rod or rhabdome, which is supposed to receive a stimulus from the rays of light focussed on it by the dioptric apparatus of the eye, that is, the lens and crystalline cone, and to transmute this into the form of a nervous stimulus, which is transmitted to the brain.

The visual cells are pigmented throughout, but especially thickly for about one-fifth of their length; this portion is the retinal pigment.

The bases of the retinulæ rest upon the fenestrate basement membrane, which forms the inner boundary of the eye proper. This membrane is formed of a peculiar fibrous connective tissue It is pierced at regular intervals by the nerve fibres, which pass from the retinulæ to the brain, and also by regular rows of larger circular holes, through which tracheae of considerable size pass into the eye. Thus the fenestrate membrane resembles in appearance the bottom of a colander pierced with holes of two sizes.

It is generally agreed that the eyes of insects possess no power of accommodation. There are no eye muscles and the lens is absolutely fixed, both as regards position and shape. In other words the lens is incapable of being flattened for the perception of distant objects and rendered more convex for near ones. It seems that the fixed focal length without accommodation is quite satisfactory, and that this is supplemented by the use of the ocelli for very near objects, which would otherwise be quite out of focus.

To an ordinary observer a Dragonfly would appear very short sighted, since it sees objects best at distances ranging from a few inches to five or six feet. Compared, however, with other insects the Dragonfly may be reckoned long sighted. It has been stated that no insect can see beyond a distance of six feet ; this may be true as regards perception of form, but in the case of the larger Dragonflies perception of movement extends to much greater distance. All the large British Dragonflies can be frightened by waving a net in the air at a distance of twenty yards or more, unless they happen to be looking in an opposite direction.

The antennæ are the next most visible sense organs, but their importance is infinitesimal compared with that of the eyes. They are of small size, both in the larva and in the adult, but appear to be slightly larger and functionally more active in the former. The reduction of their functions is clearly correlated with the increase of power of the compound eyes in the adult. The largest antennæ are found in some of the older, that is, more primitive *Zygoptera*, such as *Synlestes*, whilst the smallest occur in the *Libellulidæ* and *Aeschninæ*, where the eyes reach their maximum development.

The sense of smell, which has proved to be located in the antennæ, has in the Dragonfly become entirely subordinated to that of sight. It is doubtful whether it was ever at all well developed in the Order. The scent of carrion, which so powerfully attracts so many insects, would be a matter of no moment to the Dragonfly, which feeds exclusively on living insects. On the other hand, their well developed sense of taste is sufficient to enable them to reject any obnoxious morsel caught on the wing.

In the antennæ of the larva of *Æschna*, Zawarsin has demonstrated the existence of a minute sense organ, known as Johnston's organ. This may have an auditory function, but Mr. Tillyard thinks it is more probably connected with testing the purity of the water. It lies in the second segment, but is not visible unless appropriately stained, as it is purely a nervous formation. It consists essentially of a ring of large bipolar nerve-cells, whose fibres run back to form two bundles passing into the two main divisions of the antennary nerve. It is difficult to imagine how such an organ could respond to anything except the vibration or movement of the antennæ as a whole. As it is only found in the larva Mr. Tillyard's suggestion as to its water-testing function seems the most tenable of any. Each segment of the antennæ carries a few sensillæ or sensory hairs. These are organs of touch.

Zawarsin also found tympanulæ on the first and second segments of the antennæ. These are tiny circular depressions, with a raised wall covered over with a chitinous membrane, which acts like the drum of the human ear. Each of these minute organs is supplied with a nerve, and is responsive to waves of sound. It is the most elementary form of auditory organ imaginable.

All these minute sensory structures are present in the antennæ of the larva. In the imago tactile hairs and tympanulæ only are present. The former are far less numerous than they are in the larval form, but the latter are apparently more highly developed, as the French entomologist, Lespes, who did a good deal of work on this subject, states that they contain statoliths, that is, small solid particles suspended in a fluid. These are present in the internal ear of many of the lower animals and serve the purpose of equilibration and orientation ; as the organism moves they are brought into contact with various sensory cells lining the cavity in which they are contained, and these convey information of the direction of movement to the higher nerve centres.

It has often been asserted that Dragonflies deprived of one or both of their antennæ are quite unable to direct their flight. This would be expected, if the tympanulæ were of any importance in orientation as is suggested by Lespes. In order to test this assertion Mr. Tillyard carefully cut off, sometimes one and sometimes both, of the antennæ of various Dragonflies he captured and then liberated them. He treated many species in this way and in no single instance did the operation affect the insect in the least ; they continued their normal occupations of hawking for insects and so forth, just as if nothing had happened. I have myself verified this statement. This suggests that it is not loss of the antennæ, but shock caused by damage to the nerve, if the operation is clumsily done, that causes them any temporary inconvenience.

The organs of taste are fairly well developed and abundant. They are situated chiefly on the epipharynx, in the form of two curved rows of yellow specks, each one being supplied with a sensory nerve ; some of these are also found on the labrum. In addition to these organs of taste, there are on the epipharynx two stiff brushes of hair pointing inwards ; these, in common with the hairs on other parts of the epipharynx, labium and hypopharynx, are generally regarded solely as organs of touch.

On all the legs of Dragonfly larvae, and probably also in the imago, there are some peculiar chordotonal organs, supposed to be organs of hearing. The larva of *Æschna* has three sets of these organs on each leg, two on the trochanter and one on the tibia, close to the knee joint. Each set consists of a number of minute organs called otaria. Each otarium is a small slit covered by smooth chitin, under which is found a tiny rod or style. This rod is hollow and carries a bundle of excessively fine nerve fibrils. The total length of such an organ is only 1/100 mm.

Chordotonal organs differ from tympanulæ in that the auditory vibration is received on a rod instead of on a stretched membrane or tympanum. Possibly such an organ only registers vibrations of a much lower frequency than those which produce sounds. Their presence on the legs of the larva suggests that they may respond to currents set in motion by other animals in the water, and thus warn the Dragonfly of the approach of either an enemy or a victim. They would be particularly useful at night time, when the eyes are probably of little use. In addition to these definite localised organs there are sensory hairs, with a tactile function, on many parts of the body.

To sum up, the Dragonfly shares with the Bird the distinction of possessing the keenest vision of any animal in its phylum. In both cases the exceptional development of the sense of sight is correlated with an aerial existence. The senses of taste and touch are normally developed, but those of smell and hearing are very poor, the former being almost, if not quite, absent, while the latter is confined to organs of excessively minute size. To these five senses, as ordinarily understood, we must add that of direction or orientation, which is probably located in the tympanulæ, with the eyes as very efficient supplements.

The intelligence of Dragonflies, or what in insects passes under that name, is solely a function of the sense organs. There are, as far as we know at present, no higher nervous centres comparable with the associative part of the cortex of the brain of higher animals, in any insects. All the movements and actions of whatever kind are simply produced as the results of various stimuli or provocations originating without or within the body.

Much has been written about the intelligence so-called of various insects, such as the wasp ; and many people seem to imagine that some kind of higher sense, a diminutive form of their own, must be possessed by creatures which exhibit such orderly and deliberate actions. As far as I can see this is quite unnecessary, even on hypothetical grounds ; and actual known details of the mechanism of the sense organs and general nervous system of insects give not the slightest indication of anything more complex than ordinary unconscious reflex action, which itself is marvellously complicated.

Reflex action reduced to its lowest terms may be explained as follows :—Some source of irritation is applied to the skin of an animal, a Dragonfly let us say, and the sensory nerve supplying this region conveys a sensation to one of the higher nerve centres. The stimulus is now transmitted to another nerve, within the substance of the ganglion, and this causes a set of muscles to contract and move one or more of the legs in such a way as to remove the offending pin or other cause of irritation ; this requires no intelligence at all.

Exactly the same process is involved when an insect goes out to hunt for food, only in this case many sets of nerves and muscles are brought into action. The physical feeling of hunger has a reflex effect upon the higher nerve centres, which bring about increased activity of the creature, especially applied towards movement in search of prey. It is useless to give more examples of these phenomena.

Such views as these, which of course are violently contested by many, do not surely in any way belittle the marvellous way in which insects perform the manifold duties of their daily life ; to my mind it makes them appear even more wonderful, since it involves such a complicated mechanical arrangement of cells, all of which have their appointed work to do in conjunction with their neighbours.

Notes on the Fauna of the Bristol Channel.

By L. H. Matthews.

THE marine fauna of the upper waters of the Bristol Channel seems to have been almost entirely neglected by Naturalists, and the following notes may serve to draw attention to a subject which would repay a closer study.

The Bristol Channel, with its muddy waters and strong tides, supports a much richer fauna than one would expect, and probably it is through the unattractive nature of the shore that it has missed the attention which it deserves. The high tides and variations in salinity (decreasing from east to west) found along the North Somerset Coast result in a fauna adapted to withstand these usually adverse conditions, and much interesting work remains to be done in the investigation of the faunistic distribution, both along the coast and vertically on the shore.

These observations, by no means the result of detailed investigation, chiefly record the commoner invertebrate animals that occur. Practically all these can be found on the shore at low tide, and in limiting these notes to those animals that occur above low tide line, a considerable list of Fishes has been excluded. Most of my collecting has been done at Portishead in the extreme north corner of the county, but some of my notes refer to other parts of the Somerset coast. Many species doubtless occur in additional places to those recorded here, but all localities are given from my personal observations.

COELENTERATA.

Hydrozoa.

Tubularia indivisa Linn. Abundant at low spring tides on Battery Point, Portishead, and at the extremity of Brean Down.

Obelia geniculata Linn. Common at low tide on Battery Point, Portishead.

Scyphozoa.

Aurelia aurita Lamarck. Large specimens are of frequent occurrence in the dock at Portishead during the summer months. I think it is probable that this jelly-fish breeds in the dock and that the fixed *Scyphistoma* stage is to be found there.

Actinozoa.

Urticina felina Linn. Very common on rocky ground at low spring tides from Portishead Pier to Clevedon and at Brean Down. Undoubtedly also occurs on suitable ground between Clevedon and Brean Down.

Actinia equina Linn. Fairly common from half-tide to low water on rocky and stoney ground at Portishead.

ANNULATA.

POLYCHÆTA.

Polynoe imbricata Linn. Fairly common under stones at low tide at Portishead.

Nereis virens Sars. Fine specimens up to 2 feet in length are common at low spring tides at Portishead. They occur under stones partly embedded in mud and in pockets of mud in the rocks.

Nereis diversicolor Müller. Very abundant in mud and under stones at Portishead.

Amphitrite sp. Common at low spring tides at Portishead. It constructs fragile tubes of mud, usually on the under-surface of stones.

Sabella alveolata Linn. Common at low spring tides and below, at Portishead. Its tubes form quite large reefs.

CRUSTACEA.

CIRRIPEDIA.

Balanus perforatus Brugiere. Very common at low water on rocks from Portishead to Clevedon and at Brean Down ; doubtless also between these last two points.

ISOPODA.

Ligia oceanica Linn. Very common at high tide mark all along the coast.

Idotea baltica Pallas. Fairly common amongst Fucus and Ascophyllum from half to low tide at Portishead.

AMPHIPODA.

Talitrus locusta Pallas. Abundant all along the coast under weeds and stones at high water mark of spring tides.

Orchestia littorea Montagu. Abundant everywhere at high water mark, under weeds and stones.

Gammarus locusta Linn. Abundant all along the coast among weeds and under stones between tide marks.

Corophium Bonellii Milne-Edwards. Plentiful among weeds at the inner end of Portishead Dock.

SCHIZOPODA.

Macropsis Slabberi van Beneden. One female specimen in a surface tow-netting in Woodhill Bay, Portishead on Aug. 17, 1921.

MACRURA.

Crangon vulgaris Linn.

Pandalus Montagui Leach. Both common at Portishead.

Pasiphæa sivado Risso. Frequent in winter at Portishead.

ANOMURA.

Galathea squamifera Leach. Common at low tide at the end of Brean Down.

Eupagurus bernhardus Linn. Frequent at low tide mark at the end of Brean Down.

BRACHYURA.

Carcinus mænas Pennant. Very common between tide marks all along the coast.

Cancer pagurus Linn. I have met with two small specimens at low spring tide at Portishead.

Portunus puber Linn. Several specimens in Portishead Dock in the summer of 1921.

MOLLUSCA.

PELECYPODA.

Mytilus edulis Linn. Very abundant on submerged objects in Portishead Dock.

Cardium edule Linn. Fairly common in the mud at the inner end of Portishead Dock.

GASTEROPODA.

Chiton cinereus Linn. Very common on rocks and stones between tide marks all along the coast.

Patella vulgata Linn. Very common on all rocky parts of the coast.

Littornina littorea Linn.

L. obtusata Linn Both fairly common on rocky ground at low tide at Portishead.

L. rudis Maton. Very common on rocks and among stones high up the beach on all suitable parts of the coast.

Buccinum undatum Linn. Several specimens found at extreme low tide at the end of Brean Down.

Purpura lapillus Linn. Very plentiful between tide marks at the end of Brean Down.

TUNICATA.

Botryllus violaceus H. Milne-Edwards. Common on submerged objects in Portishead Dock.

Spartina Townsendi in West Gloucestershire.

By Ida M. Roper, F.L.S.

A PLANT new to our Gloucestershire district (v.c. 34) has been observed during the past year growing on the mud of the shore of the River Severn. It is *Spartina Townsendi* H. and J. Groves, one of the three species of Cord Grass found in England. We are glad to welcome its establishment at a fresh locality amongst us, and thereby make a new county record.

In the " Proceedings " of the Society for 1919 and 1921 it is related how Spartina was planted about the mud below Clevedon, Somerset, as an attempt to carpet the shore by its growth, and thereby prevent the scouring away of its surface, and eventually to protect the earth saltings and sea bank from serious damage. The plant, however, appears not to be able to withstand the strong tidal currents and gales in the Clevedon locality, and the lapse of 11 years makes this clear by the uncertain and feeble growth shown. It is to be hoped greater success will come to the Grass in the higher stretches of the Severn with the conditions less adverse.

There can be little doubt that some roots of the Clevedon plants are the source of the new start within our Channel, in the same way that the few clumps visible off Berrow, Somerset, had their origin from there.

Examining the general aspect of the shore in the Gloucestershire locality, and starting from near Berkeley Pill below Sharpness Point, moving westward, it will be seen that there is a sea bank erected of height varying from 6 to 20 feet, carefully faced with stonework and coping. On the district beginning about one-and-a-half miles below the Pill and extending for nearly the same distance further along, the force of the tides is particularly felt, and as an additional protection to the sea wall, boulders have been placed in large heaps, piled high and weighing several hundred tons, at distant intervals stretching from the shore to seawards, for the purpose of breaking the rush of water during storms. These serve as large quoins, as often seen on a smaller scale on sandy beaches and placed there for a similar purpose.

It is behind five of these masses of stones that the Spartina has found a sheltered foot-hold, where it appears to be growing and likely to spread into small meadows. Its success may do no service to the shore, but the carpet of Grass may help to lessen the tidal scour against the foot of the wall facing.

At Severn House Farm and a short way northwards, there are at present some seventeen clumps of Spartina, and their dimensions vary from 12 feet by 10 feet to 6 feet by 6 feet, with a few smaller. All of these are close to the shore bank and well sheltered.

About three-quarters-of-a-mile to the west there are a number of clumps scattered distantly in the mud on the shore, 30 to 50 yards from the bank, in three sheltered bights between the stone groins. The effective shelter within the bights measures, one about 50 yards long with twenty-five clumps, and two of 100 yards long each with fifty clumps.

It seems certain the establishment of the growths is dependent on the quieter water conditions at these spots, which meet the requirements of Spartina. It will be recalled that the plant sends roots downwards into the mud to serve as an anchor, and another set of rootlets from the base of the stalk just below the surface, to throw up at intervals young shoots to form new plants around the first, and thus to produce circular clumps.

Lower down the Severn the swirl of the tides at their unchecked speed carries off the mud close to the clumps and so leaves the young rootlets exposed to heat or cold, and consequent loss of power to produce new shoots. On this site no such effects are apparent, and the growth can go forward with the vigour that distinguishes this species. Seeds, however, may be swept away, but time will show, and this year the clumps are all flowering freely. The plants stand 4 feet high in places, with smaller ones close to the drier shore line.

BRISTOL BOTANY IN 1923.

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

AMONG the more puzzling problems that confront the field-botanist from time to time are those relating to mysterious appearances, disappearances and reappearances of our native plants. For these in many instances no satisfactory explanation is forthcoming, nor can one be obtained by experimental research on account of the difficulty or even impossibility of reproducing in a laboratory the conditions that govern natural processes. For a striking example one can cite the sudden arrival of a quantity of *Filago minima* in a frequented sandstone pasture where it had never been seen before and where, after that one season, it could not be found again. Or the equally surprising reappearance of *Euphorbia Peplis* on southern seasands that had been searched for it unavailingly during a long period. These remarks have been suggested by a few similar, though doubtless less remarkable, occurrences which are mentioned in the following notes. Events such as these make us so loth to accept the extinction of any species when no considerable alteration of the ground has taken place.[1]

The pleasurable announcement can now be made that by the efforts of Messrs. A. G. Tansley, of Cambridge, H. S. Thompson, and some local sympathisers, a small enclosure on the peat of Sharpham Moor has been purchased for experimental and ecological study, with a view also to the preservation of many peat-loving species of interest. This enclosure is the home of a hybrid sedge unknown elsewhere in Britain, and of *Callitriche truncata*, lately identified by Mr. Thompson and new to the Bristol district. In order that the plot may be permanently available for the desired purposes it has been vested in the Society for the promotion of Nature Reserves.

Ranunculus radians Revel. The typical plant is most abundant in quarry pools at Wickwar. Revel's original description with his subsequent emendations are quoted at length in *Notes on British Batrachia* by W. H. Pearsall in Druce's *Report B.E. Club*, 1921, p. 445.

R. Flammula L. A specimen from Nailsea provided a curious example of an adventitious flower. One of the carpels of the undeveloped ovary bore at its base a small but perfect stalked floret.—*Miss Roper.*

Helleborus viridis L. On the Roman Encampment, Leigh Woods, a plant had produced irregular flowers in which the normal staminodes or tubular petals were replaced by ten foliaceous ones, similar to, but much narrower than the sepals.—*H. J. Gibbons.*

(1) Since writing the above an able paper by J. C. Shenstone, F.L.S., dealing with the subject has appeared in the *Journal of Botany* for Dec., 1923

H. foetidus L. Since our woodlands were opened up by felling the trees for war purposes the Stinking Hellebore has become more abundant, and this is especially noticeable on the borders of Westridge Wood, Wotton-under-Edge.—*C. Wall.*

Berberis vulgaris L. Between Bitton and Wyck, G.—*R. C. Trapnell.*

Barbarea vulgaris R. Br. var. *transiens* Druce. A large patch is permanent in the corner of a playing field at Tyndall's Park, Bristol. A marked feature of this variety lies in the linear basal pinnæ of the upper leaves that exceed the terminal lobe in width. It is a stout, branched plant with darkish yellow flowers, the pods being those of *vulgaris.*

B. arcuata Rchb. Well marked on a ditchbank between Pucklechurch and Mangotsfield, G.—*Miss Roper.*

Draba muralis L. Is said in *Fl. Brist.* p. 155, to be now unknown in Gloucestershire. I learnt lately that it grows at Kingscote, East Gloucester ; and therefore my statement should apply merely to the Western vice-county.

Viola odorata L. var. *sulfurea* Lamotte. A good patch on Combe Down, Westbury, G., April, 1922.—*R. C. Trapnell.* Var. *subcarnea.* Strongly marked in Blaise Castle Woods, G.—*Id.*

V. hirta × *odorata.* On Stinchcombe Hill and Combe Down, Westbury, G. Upper end of Brockley Combe and on Brent Knoll in plenty, S.—*Id.*

V. Riviniana Rchb. var. *diversa* Greg. Very good examples in Highwood, Patchway, G.—*Miss Roper.* Star Common, Tyning's Farm and above Cheddar Gorge on Mendip, S.—*C. G. Trapnell.* All were confirmed by Mrs. Gregory.

Dianthus deltoides L. Has been almost destroyed by fire in our only locality. Merely the leaves of two plants could be found on a search by C. G. Trapnell and N. Sandwith.

Lychnis alba × *dioica.* Several very well-marked hybrids near Clapton-in-Gordano, S.—*R. C. Trapnell.*

Cerastium vulgatum L. var. *holosteoides* Wahl. A small, slender state of this variety, differing from the common form of the species by its glabrescent foliage and the paucity of hairs on the stem, has been reported from damp rocks in shade, Leigh Woods, by H. S. Thompson and C. G. Trapnell ; and by N. Sandwith from Brockley and Goblin Combes.

Moenchia erecta Gaertn. On pennant near Hanham, G.—*N. Sandwith.*

Althæa officinalis L. Two large clumps on the Severn bank near Hill, G.—*Ernest Nelmes.*

Tilia cordata Mill. Leaves of various plants are sometimes, though rarely, fashioned into ascidia or pitchers. These have been found on *Tilia cordata* in Leigh Woods by Miss Roper, and are known to occur on *Paulownia imperialis* and *Pelargonium zonale*. In *Journ. Bot.*, 1923, p. 288, it is mentioned that J. F. von Jacquin wrote to his father at Vienna, *circ.* 1788, that Bauer, the well-known plant artist at Prague, was drawing for him some pitcher leaves from a Lime. The peculiar formation by splitting of the leaf is explained by Worsdell in his *Teratology*.

Impatiens parviflora DC. An alien species that was noted by Miss Agnes Fry on the Mulberry Farm, Failand, in July, 1919; and has this year been again gathered in the same spot.

Ilex Aquifolium L. A yellow-berried Holly may be seen on Durdham Down growing in the midst of a Hawthorn.

Ononis spinosa L. var. *mitis* C. Gmel. Several procumbent, spineless and extremely viscid plants near the Severn Tunnel pumping station. Examination of stamens showed them to be mainly abortive, and no fruit could be found.—*N. Sandwith* and *C. G. Trapnell.*

Medicago maculata Sibth. Is apparently sown nowadays as a fodder plant, and grows luxuriantly in grass fields near Cromhall and elsewhere.—*C. Alden.*

Anthyllis Vulneraria L. var. *tricolor* Rouy & Foucaud. On a limestone slope near Shipham-on-Mendip, S. Calyx nearly white, teeth purple with long silky hairs. Flowers from yellow to deep orange-red. First record for the British Isles.—*H. S. Thompson.* Mr. Thompson adds, however, that he is inclined to doubt the stability of this variety distinguished by the French authors, at least in this country. He thinks that the colour characters may change from year to year. There is certainly a no more variable species in Leguminosæ than the Kidney Vetch.

Vicia angustifolia L. var. *Bobartii* Koch. The typical plant, in good quantity, grows on Wotton Hill, G.—*C. Wall.*

Cratægus oxyacanthoides Thuill. A second bush is reported from Yate Lower Common, G.—*C. and N. Sandwith.*

Mespilus germanica L. Hedge near Almondsbury, G., and in Goblin Combe, S.; doubtfully native.—*C. G. Trapnell.*

Oenanthe Lachenalii C. Gmel. Does not appear to be on record from Max meadows, S., whence Mr. Thompson reports it to be plentiful in a boggy ditch.

Doronicum Pardalianches L. On a hedgebank near Bradley Court, Wotton-under-Edge.—*C. Wall.*

Tragopogon porrifolius L. Adventive on the border of an allotment at Horfield, G.—*Miss Roper.*

Hypochœris glabra L. Old Down, Tockington, G., and Purn Hill, Bleadon, S.—*C. G. Trapnell.*

Centaurea nigra L. This aggregate has latterly been split by the specialists into a number of varieties and forms. Of these Miss Roper has had determined the two following, viz., *C. nemoralis* Jord. var. *subintegra* Britton f. *radiata* in Hallen Bog, G.; and *C. obscura* f. *radiata* by the Yeo Reservoir, Blagdon, S.

Atropa Belladonna L. Like some other wild flowers this handsome but most poisonous plant has profited greatly by the thinning of woodlands on the Cotswolds, becoming abundant over many acres and forming masses of bushes often four feet high.

Veronica agrestis L. Since writing a note on this Speedwell last year I have come across a striking confirmation of my point—the real difficulty in separating *agrestis* from *Buxbaumii* when the corollas have fallen. On some dried specimens forwarded to the *Bot. Ex. Club B. Isles* in 1915, one expert reported in favour of *V. Buxbaumii*, while another wrote "*V. agrestis.*"

Mentha hircina Hull. (*M. aquatica* × *longifolia*). Still plentiful in an ancient shady lane above Weston-in-Gordano, S., where it was discovered by Miss Roper in 1918. The leaves are like those of *M. longifolia*, but are petiolate. In size and the relative length of its teeth the calyx is intermediate between those of the parent species. Of the two forms placed under *M. pubescens* Willd. by British authors this is nearer to *hircina* than to Sole's *palustris*, and it is stated to be much the rarer of the two. Another locality for the hybrid has recently been detected in the Chew Valley near Compton Dando by N. Sandwith.

M. piperita L. var. *vulgaris* Sole. Along a grassy roadside near Earthcott Green, G.—*Ernest Nelmes.* An addition to the county flora. From a note in the *Gardeners' Chronicle*, Oct. 22, 1922, it appears that Nelmes sent a specimen to a Kew botanist, who stated that it agreed perfectly with the description by Sole and others. The writer of the note was under the impression that this plant had never been collected since W. Sole did so, and certainly it is remarkable that although he recorded it from at least half-a-dozen localities no one else seems to have seen it in any one of them. Still, the variety cannot be so rare as has been supposed, for Dr. Druce mentions it as represented in his herbarium from five stations, all far removed from the Bristol district. It differs from *M. piperita officinalis* in having broader, more ovate leaves, rounded or subcordate at the base instead of being wedge-shaped, and in bearing much shorter, oblong spikes of flowers. In 1883 the late Mr. David Fry found *vulgaris* in a swampy spring-head at Walton-in-Gordano, S., and cultivated it in his garden at Corston. Nothing more was heard of it until 1915, when Mr.

Bucknall reported its reappearance, and at the present time it seems to have a good hold.

Statice binervosa G. E. Sm. Observed on Brean Down for the first time by T. Bruges Flower about seventy years ago, and very few persons have seen it since. C. G. Trapnell tells me that it is still there in an almost inaccessible cranny of the crumbling cliff.

Chenopodium urbicum L. In 1893 one large plant appeared near the Avon under Sneyd Park and did not recur. Now that a new road to Avonmouth is being constructed along the riverside a quantity of this fine Goose-foot has come up during the present autumn, some of it within a few yards of the original spot and more along the recently-formed embankment towards Shirehampton. As only local stone and rubble is being used on the work it is possible that the new arrivals sprung from seeds long buried on the alluvial flat.

Polygonum Bistorta L. On the edge of an old quarry at Wickwar, G.

Rumex maritimus L. A dozen or so plants in a ditch at Hill, about two miles from the Severn, 1921. The next year one plant only in that ditch, but many in another part of the village. This summer fewer were noticed in the old spots, but there were several in still another place.—*William Nelmes.* A new record for our Gloucestershire division.

Viscum album L. On a Whitebeam growing on a rocky slope, Leigh Woods.—*H. J. Gibbons.*

Quercus Robur L. The ancient Oak near Gaunt's Earthcott mentioned in *Fl. Brist.* p. 547, decayed and ruinous in 1910, has at length perished in entirety and its remains have disappeared.

Scirpus setaceus L. Occurs in dense turfy patches—an unusual growth for this species—on Cromhall Common, G.—*C. Alden.* A large form or variety, with bracts 1″—1¼″ long, on peaty ground in Walton Moor near Clevedon,—*C. G. Trapnell.*

Carex arenaria L. var. *remota* Marss. On the foreshore at Burnham.—*H. J. Gibbons.*

C. extensa Good. One tuft below the seabank between Severn Beach and Avonmouth. A first record for Gloucestershire.—*C. G. Trapnell.*

Spartina Townsendi H. & J. Groves. Another county record is afforded by this intrusive grass having established itself on a sheltered bit of the Severn shore near Berkeley, G. Brought up Channel by tides from the original plantation on the Somerset coast.

Agrostis tenuis Sibth. var. *pumila* L. On Backwell Hill, S.—*H. J. Gibbons.*

Arrhenatherum elatius M. & K. var. *biaristata* Peterm. Although only lately recognized in the Bristol district, this variety appears to be quite frequent. Mr. Gibbons has found it in Cranbrook Road ; in St. Philip's ; about Patchway and Filton, G. ; and near Wraxall and Clevedon, S.

Polypodium vulgare L. var. *serratum* Willd. In Markham Bottom, S. An extreme and beautiful state of the variety with some of the lower pinnæ bifid or trifid.—*H. J. Gibbons.*

ALIENS.—*Apium leptophyllum* Mill. A native of S. America that has become widely distributed in temperate countries. *Madia sativa* Molina. Also American. *Anthemis mixta* L. From Southern Europe. All at Portishead Dock.—*C. and N. Sandwith. Helianthus petiolaris* Nutt. North American. At Avonmouth Dock.—*Miss Roper. Rumex salicifolius* Weinm. a N. American Dock, has been known in St. Philip's, Bristol, since 1918, and still flourishes. *Hordeum trifurcatum* Jacq. The Nepaul Barley. A specimen found on rubbish at Brislington by Mr. Gibbons and dissected by Miss Roper proved to be a known abnormal form. The outer paleæ, instead of ending in long awns, have at their tips hooded appendages standing out at right angles, and often containing a pair of adventitious florets. These hoods, therefore, are considered by some botanists to be bracts and not paleæ.

The Avonian of the Tytherington-Tortworth-Wickwar Ridge, Gloucestershire.[1]

By F. S. WALLIS, Ph. D.

1. Introduction and Previous Work.
2. Topography and General Stratigraphy.
3. Description of the Zones.
4. Description of the Chief Exposures.
5. Zonal Classification of all Exposures.
6. Physiographical Conditions of Deposition.
7. Comparison with neighbouring areas.
8. Summary of Conclusions.
9. Bibliography.

1.—INTRODUCTION AND PREVIOUS WORK.

The object of the present work, undertaken at the instigation of Prof. S. H. Reynolds, was to map, in terms of Vaughan's zonal system, the northern portion of the horseshoe-shaped ridge of Avonian rocks which partly surrounds the synclinal basin of the Bristol Coalfield. Prof. S. H. Reynolds and Mr. D. E. Innes (XII.)[2] have already traced the zones between Over and the Tytherington-Grovesend railway section, whilst the Misses E. Bolton and M. C. Tuck (1) have completed a similar work in the Wickwar-Chipping Sodbury district.

The area dealt with, in the present paper, links together these two former researches and completes the Avonian Zonal map of this portion of the Bristol District.

The surface extent of the Avonian was taken from the 1-inch Geological Survey Map, though new exposures have made it necessary to differ from the Survey mapping in a few cases.

Maps :—6-in. O.S. Sheets LVI. S.W., LXIII. S.E. and N.E. and LXIV. N.W. (Glos.)

In 1824, two papers (II. and XIV.) were published containing fragmentary allusions to the Avonian of this area.

In 1839, Murchison (VIII., p. 452) mentions that although the area between Tytherington and Tortworth appears to be of simple geological structure, in reality the limestone " is broken into a number of distinct masses by transverse dislocations." He also refers to the faulted nature of the ground south of Tortworth Park and describes the " firestone " as a " reddish sandstone."

Handel Cossham (III.) briefly notices the area and Sanders includes it in his classical map of the Bristol Coalfields (1864).

Etheridge (IV.) gives a detailed map of the district (1 in. to 1 mile), but deals chiefly with the distribution of iron-ores in the Pennant Series. He maintains that Tortworth gorge is due to faulting.

(1) See *Abstract of Proc. of Geol. Soc.* No. i,iii., p. 25.
(2) Roman numerals in parentheses refer to the bibliography.

The area is also included in the revised 1-in. Geological Survey Map (Sheet XXXV.) published in 1872.

Mr. H. B. Woodward (XVII., pp. 17-27) uses the old lithological classification in describing the area, and again draws attention to the highly faulted nature of the area south of Tortworth.

Prof. C. Lloyd Morgan (V.) describes, with a horizontal section, the fine railway section between Tytherington and Grovesend, and postulates a reversed fault between the Avonian and Dolomitic Conglomerate at the eastern end of the section. This interpretation, is not tenable when zonal methods of research are employed.

The same section is also described with horizontal sections by the Rev. H. H. Winwood (XV. and XVI.). The last two authors differ in only one respect, for whilst Prof. Morgan believed that the Tytherington tunnel follows the strike and hence only cuts through some 20 to 30 feet of vertical thickness of strata, the Rev. H. H. Winwood allowed 178 feet for the beds concealed in the tunnel. The present research agrees with the former interpretation.

Prof. C. Lloyd Morgan (VI., p. 29) explains the apparently anomalous course of the stream, which flows northward through Tortworth, as due to superimposed drainage, and believes that the Tortworth Gorge is not due to faulting. In VII., p. 5, he states that he has been able to trace the "Firestone" from Wickwar round the "horseshoe" to Tytherington.

The late Dr. A. Vaughan (XIII., pp. 219-225) gives a detailed palæontological account of the Tytherington-Grovesend railway section and compares the sequence with that at Avon, Sodbury, and Failand. A few isolated exposures in the area are also described (pp. 239-240).

Prof. S. H. Reynolds (X., pp. 189-191) gives a full description of the Tytherington-Grovesend railway section, whilst in IX., p. 194, he states that the old quarries near Pump House, on the west of the Charfield-Wickwar road, are in the *Syringothyris* zone.

2.—TOPOGRAPHY AND GENERAL STRATIGRAPHY.

With the underlying Old Red Sandstone the Avonian of this area forms a well-defined wooded ridge round the northern portion of the triangular-shaped basin of the Bristol Coalfield.

Apart from the isolated Wick's Hill (300 feet), the highest portion of the area (300-350 feet) lies immediately to the north-east of the Tytherington-Grovesend railway and comprises Tytherington Hill, Baden Hill and a part of Milbury Heath. The remaining portions of the ridge lie very near the 200-feet contour.

Few surface streams drain the area. Three small streams, rising near Bibstone, Charfield and West End (west of Wickwar) respectively, flow mainly in a westerly direction and finally run together east of Cromhall Common. The westerly direction is then continued to Tapwell Bridge, whence, as Dyer's Brake, a northerly course is pursued through Tortworth Lake to the Little Avon at Middlemill. A small stream, draining the valley in which Tytherington village stands, flows in a south-easterly direction to the Frome.

The portion of the stream from Tapwell Bridge northwards has been justly claimed as an instance of superimposed drainage (VI., p. 29), and, in addition, the present writer believes that Ladden Brook originally flowed northwards and formed the upper reaches of this stream. Subsequently, the River Frome captured the head-waters of Ladden Brook and thus part of the original drainage of the Little Avon was diverted southwards.

The three small streams rising near Bibstone, Charfield and West End respectively, and also the one draining the Tytherington valley are consequent streams of a date later than the capturing of Ladden Brook by the Frome. (These stream courses are best seen on Bartholomew's ½-in. map of Bristol and Bath; Sheet No. 28).[1]

It is tempting to suppose that the Tortworth gorge is due to pre-Triassic faulting (IV., p. 42), but the fault lies to the west, and the gorge, as stated by Prof. C. Lloyd Morgan (VI., p. 29), has been eroded by stream action in a similar manner to the Avon and Blaize Castle Gorges. Tortworth Lake is artificial.

The dependence of topography on the nature of the strata is well seen and forms an aid to mapping in an area of few natural or artificial exposures. For example, the softer $C_2 + S_1$ dolomites and shales always form an area of relatively low ground between the *Caninia*-Oolite and $S_1 + S_2$ massive limestones.

About two-thirds of a mile north-east of Tytherington, the Avonian outcrop suddenly diminishes to a little less than one-half its original width. This I suggest is due to the interaction of two axes of folding. Although the synclinal fold (axis north and south) of the Bristol Coalfield is the dominant feature in this area, there is a smaller anticlinal fold (axis N.N.E., and S.S.W.) lying about 1 mile to the west of Cromhall. It appears that the southern end of this N.N.E.-S.S.W. axis "nosed" its way into the side of the main synclinal fold and was responsible for the sudden diminution in width of the Avonian outcrop.

The small width of outcrop of the remaining portion of the western limb of the ridge is probably also due to the proximity of this minor anticlinal fold on the west.

The area is affected by five faults. Two of these occur to the north-east of Tytherington and are comparable to those postulated by Prof. S. H. Reynolds and Mr. D. E. Innes (XII.) to the south-

1. Prof. Reynolds has kindly drawn my attention to some MS. maps of Prof. C. Lloyd Morgan (dated 1908), in which similar views to those outlined above, are given.

west of Tytherington. A large fault occurs to the west of the Tortworth Gorge, whilst still further to the east there are two minor shifts. The present interpretation of the faults in this area differs from that shown on the Survey Map.

3.—DESCRIPTION OF THE ZONES.

Cleistopora Zone.

EXPOSURES.

There are no good sections of this zone, though its outcrop can be easily traced by numerous insignificant exposures and also by the well-marked depression it occupies. The continuity of outcrop is broken on the north-west by Dolomitic Conglomerate.

The zone is best exposed in an old quarry, west of Tortworth Lodge.

LITHOLOGICAL CHARACTERS.

Shales, grits and thinly-bedded muddy limestones. The limestones, many of which are crinoidal, are often much decomposed into a soft ochreous rock.

In Km grits and shales predominate, in K_1 the limestones are subsidiary to the shales, whilst in K_2 limestones form the major part of the sequence.

Hæmatitic limestones of *a* type (" Bryozoa Bed ") have been recognised in two localities, viz., Tytherington-Grovesend railway section, and in an old quarry on Milbury Heath.

FAUNA.

Cleistopora aff. *geometrica* (E. & H.) ..	common at top.
Leptæna analoga (Phill.)	common
Syringothyris principalis, North	do.
Chonetes cf. *hardrensis* (Phill.)	do.
Cleiothyridina royssii (L'Ev.)	do.
Camarotoechia mitcheldeanensis, Vau. ..	do.
Orthotetes crenistria (Phill.), mut. K, Vau.	very common
Productus cf. *martini*, Sow.	common at top
Spirifer aff. *clathratus*, M'Coy emend. Vau.	do.
Rhabdomeson, sp.	common
Fenestellids	do.
Crinoids	very common

Zaphrentis Zone.

EXPOSURES.

The zone is well exposed in the Tytherington-Grovesend railway section, Slickstones Quarry (N.E. of Bibstone), and in a quarry in Tortworth Park near Leyhill Lodge.

LITHOLOGICAL CHARACTERS.

At the base of the zone are massive limestones with intervening shales. The shales gradually diminish, and in upper Z_1 and lower Z_2 dark dolomitised crinoidal limestones (Petit Granit type) form the whole of the sequence. In upper Z_2 compact dolomite (cf. *laminosa* Dolomite type) alternates with recurrent bands of Petit Granit.

At the base of Z_1 in the Tytherington-Grovesend railway section is a band of oolite.

No chert has been found.

FAUNA.

clathratus subzone (Z_1).

Zaphrentis delanouei, E. & H.	common
Spirifer aff. *clathratus*, M'Coy. emend, Vau.	very common
Orthotetes crenistria (Phill.) mut. Z Vau.	common
Leptæna analoga (Phill.)	do.
Syringothyris cuspidata (Mart.) mut. *cyrtorhyncha*, North	do.
Chonetes cf. *hardrensis* (Phill.)	common
Camarotoechia mitcheldeanensis, Vau. ..	do.
Cleiothyridina glabristria (Phill.)	common at top
Schizophoria resupinata (Mart.)	do.
Rhipidomella aff. *michelini* (L'Ev.) ..	do.
Cleiothyridina royssii (L'Ev.), mut. β Vau.	rare
Productus cora, d'Orb. mut. C. Vau. ..	do.

konincki subzone (Z_2).

Zaphrentis konincki E. & H.	very common
Zaphrentis omaliusi E. & H.	common
Syringopora θ, Vau.	do.
Cleiothyridina glabristria (Phill.)	do.
Schizophoria resupinata (Mart.)	do.
Orthotetes crenistria (Phill.), mut. Z_1 Vau.	do.
Tylothyris laminosa (M'Coy emend. North), mut. γ (North)	rare
Chonetes papilionacea (Phill.)	do.
Murchisonia, sp.	do.
Phillipsia, sp. (pygidia)	do.
Psammodus rugosus, Ag.	do.

In the collection of the Bristol Museum is a tooth of *Psammodus rugosus*, Ag. (Reg. No. C. 4936 : Donor, Earl of Ducie). Although Tortworth is the only locality given on the label the matrix incicates Slickstones Quarry (N.E. of Bibstone). Careful search in that quarry resulted in the finding of two fragments of fish teeth, and hence the presence of a " Fish Bed " on the same horizon as the " Fish Beds " in the Avon Gorge, is established.

Syringothyris zone.

EXPOSURES.

The beds of this zone are well seen in the Tytherington-Grovesend railway section and Ley Hill Quarries.

LITHOLOGICAL CHARACTERS.

In ascending order :—

(1) Thickly-bedded, nearly unfossiliferous, blue-grey, finely divided dolomites (*laminosa*-Dolomite). Small patches of crystalline calcite are common and appear by their shape to represent the re-crystallised infillings of the cavities of fossils. The beds appear to have been formed by the dolomitisation of crinoidal limestones. In some instances the crinoid ossicles have resisted the metasomatic change.

(2) A series of fossiliferous crinoidal limestones (the Sub-Oolite). This band is non-oolitic in the lower part but becomes oolitic as the *Caninia*-Oolite is approached.

(3) A thick band of white oolite (*Caninia*-Oolite).

In slice, the ooliths are seen to be congregated together in well-defined bands separated by areas of crystalline calcite. It would seem that strong, very local currents heaped up the ooliths and packed them tightly together. On a weathered surface the bands of ooliths are very resistent, and hence current-bedding is clearly depicted by the differential rates of weathering of the ooliths and matrix.

Evidence of pene-contemporaneous brecciation is afforded by the presence, near the current-bedded portions, of pieces of rounded and angular oolite embedded in the main mass. The uppermost surface of the *Caninia*–Oolite is irregular, showing that there was a short period of sub-aerial denudation before the deposition of the *Caninia*–Dolomite.

(4) Unfossiliferous thinly-bedded structureless dolomites with subsidiary shales (*Caninia*-Dolomite). The freshly-fractured surface of a dolomite from this level is often marked with curious red dendritic stains.

FAUNA. (Sub-Oolite band only.)

Zaphrentis konincki, E. & H.	rare
Zaphrentis omaliusi, E. & H.	do.
Caninia cylindrica (Scouler).	do.
Michelinia megastoma (Phill.)	do.
Chonetes papilionacea (Phill.)	very common
Orthotetes crenistria (Phill.) mut. C. Vau.	do.
Tylothyris laminosa (M'Coy emend. North) mut γ North...	common

Seminula Zone.

EXPOSURES.

The zone covers a large area and is best seen in the Church and Camp quarries at Tytherington, a series of quarries on the south-eastern flank of Tytherington Hill, and the Churchwood Farm quarries.

semireticulatus Subzone (S_1).

LITHOLOGICAL CHARACTERS.

Unfossiliferous dolomites with subsidiary shales followed by massive limestones with shaly partings. At the base of the massive limestones is a band of oolite, whilst towards the top is a thin bed of *Seminula*-Pisolite. Owing to the absence of fossils and the presence of similar lithological types in upper C_2 and lower S_1 it is impossible to draw an exact line of demarcation between these two subzones.

FAUNA.

Lithostrotion martini, E. & H.	very common
Syringopora cf. *distans* (Fischer) ..	common
Seminula ficoidea, Vau.	very common
Productus θ, Vau.	do.
Productus cora, d'Orb. mut. C. Vau. ..	common
Chonetes papilionacea (Phill.)	do.
Productus semireticulatus (Mart.)	rare
Cyrtina carbonaria, M'Coy.	do.

cora subzone (S_2).

LITHOLOGICAL CHARACTERS.

Massive limestones, sandstones, and conglomerates. The limestones include a thick bed of fossiliferous oolite (*Seminula*-Oolite). About 11 feet from the base is a band of calcareous sandstone (Firestone). The latter deposit is lenticular in all directions, with a maximum thickness (9 feet) at the Church Quarry, Tytherington. Vaughan placed this sandstone at the top of S_1 (XIII., p. 222), but as *Cyrtina carbonaria* has now been found 11 feet below it in the Church Quarry, Tytherington, it would seem more correct to place it at the base of S_2.

Sandstones and coarse conglomerate occur at the top of the subzone, and by the gradual disappearance of the intervening limestones the deposits pass into the so-called " Millstone Grit."

FAUNA.

Lithostrotion martini, E. & H.	very common, occurs in large masses.
Lithostrotion basaltiforme (Phill.) ..	common
Syringopora geniculata, Phill.	do.
Seminula ficoidea, Vau.	very common
Productus cora, d'Orb. mut. S_2, Vau. ..	common
Chonetes papilionacea (Phill.)	do.
Productus aff. *hemisphericus* (Sow.) ..	do.

Dibunophyllum Zone.
$\theta\ \varphi$ Subzone (D_1).

In the area under consideration a calcareous development of this subzone is either absent or non-exposed.

The following details were seen in a small cutting at the southern end of the Wickwar tunnel (this lies about three-quarters mile to the south of the eastern limb of our area. Ref. 6 in. O.S. Map, Glos., Sh. LXIV. S.W.).

LITHOLOGICAL CHARACTERS.

Massive highly fossiliferous limestones with few shaly partings. Some bands are strongly oolitic, others crinoidal and others are composed of a compact reddish limestone with *Productus hemisphericus*. These latter features are strictly comparable to certain beds in the Avon Section. Bands of *Chonetes* and *Productus* are very conspicuous.

There is a perfectly conformable and gradual passage into the "Millstone Grit" phase of deposition and for a short period the calcareous and grit phases alternated with each other.

FAUNA.

Syringopora distans, Fischer.
Syringopora geniculata, Phill.
Dibunophyllum θ, Vau.
Cyathophyllum murchisoni, E. & H.
Chonetes aff. *comoides* (Sow.)
Productus hemisphericus, Sow.
Productus giganteus, (Mart.)
Crinoids.

From the above evidence it would appear that a D_1 calcareous horizon is present in the southern portions of our area. Careful search for the subzone has, however, produced negative results, and for want of evidence we must assume, for the present, that grit conditions established themselves at the end of S_1 times.

It should be noted that, though at Sodbury Prof. S. H. Reynolds has recorded a thickness of 84 feet (Geol. Mag. 1923, p. 114), at Wickwar this subzone is only represented by about 55 feet of strata.

4.—DESCRIPTION OF THE CHIEF EXPOSURES.

(a) Tytherington-Grovesend Railway Section.

Although this fine section has been described by various authors, notably Prof. C. Lloyd Morgan (V.) and Dr. A. Vaughan (XIII., pp. 219-225), it is desirable to re-describe it, as an attempt has now been made to delimitate the zones.

At the southern end of the Grovesend Tunnel the beds are clearly of Old Red Sandstone age, consisting of massive sandstones with occasional beds of marl and conglomerate. Prof. Morgan places the first undoubted bed of Carboniferous Limestone about 270 yards south of the tunnel mouth, but at the present time no Avonian rocks can be traced until a point 320 yards south of the tunnel is reached. The Survey mapping of the junction line between the O.R.S. and Carboniferous was certainly too far north. Prof. Morgan shifted the line southwards, and though it is impossible to dogmatise in the present state of the exposures, it would appear that even his line is a little too far north.

Although the exposures are very bad between the first Avonian beds and the bridge crossing the railway, the general succession of the *Cleistopora* zone up to the middle of K_2 can be recognised on the northern railway bank. In some cases even the shaly bands have survived the "grassing over." A thin slice of a limestone band at the top of K_m shows that beds of this level suffered penecontemporaneous brecciation. Bryozoal, crinoidal, and limestone fragments are all in a rolled condition, and many of these fragments have received a thin coating of calcium carbonate before being re-embedded in a calcite cement.

The Bryozoa Bed is easily traceable in winter, and is of a coarser texture than the Avon representative, more resembling the Portishead type. The iron-content is not so high as is usual in this rock, and some examples are almost devoid of the familiar red appearance. Immediately south of the bridge the weathered surfaces of the thinly-bedded limestones are crowded with fossils, especially *Orthotetes*, *Syringothryis*, and *Camarotoechia*. *Cleistopora geometrica* also occurs here in considerable quantity. These beds are in K_2, and the line between the K and Z zones has been placed about 70 yards south of the bridge.

The first noticeable band in the *Zaphrentis* Zone is an oolitic limestone, better seen on the southern railway bank. The small ooliths and rolled ostracodal fragments are closely packed with very little interstitial matter. In nearly every case a small crinoid ossicle forms the nucleus of the individual ooliths. The bed was evidently formed under shallow-water conditions.

Thinly-bedded limestones with abundant *Spirifer* and *Schizophoria* form the remainder of the low cutting leading to Grovesend Quarry (not marked on 6-in. map). The major portion of this large quarry lies within the *Zaphrentis* zone, and the lithological and faunal sequence is the same as that given in the zonal descriptions. Fossils are very abundant, expecially in Z_1.

The *laminosa*-Dolomite occurs in the south-eastern corner of Grovesend Quarry, and also forms the unquarried portion between it and the adjacent Hardwick Quarry. These beds consist of blue-grey compact dolomites, their only interesting feature being the sporadic occurrence of calcite nests.

The " Sub-Oolite Bed " is well exposed in Hardwick Quarry, the dip slope in the north-western corner forming an excellent collecting ground for the fossils of this level. *Chonetes* and *Orthotetes* are specially abundant. In the eastern wall of the quarry, the usual characteristic features of the *Caninia*-Oolite are well seen On weathered surfaces the current-bedded nature of this deposit is delineated by the differential rates of weathering Evidence of shallow-water conditions is also deduced from the numerous fragments of oolite embedded in the main mass. A thin bed of Dolomitic Conglomerate rests unconformably on the truncated ends of the Avonian beds.

Caninia-Oolite is again seen in the railway cutting between Hardwick Quarry and the northern end of the Tytherington tunnel, beds of C_2 age making their appearance about 35 yards west of the tunnel mouth. There is evidence of sub-aerial erosion at the end of C_1 times, and the undulating uppermost surface of the *Caninia*-Oolite is well seen near the tunnel mouth.

At the southern end of the Grovesend Tunnel the line of section is at right angles to the strike, but from that point southwards the railway line gradually turns into the strike, and the Tytherington Tunnel is parallel to the strike. Prof. Lloyd Morgan (V.) and Rev. H. H. Winwood (XVI.) differed in their explanation of the relation of the strike of the rocks and the line of the Tytherington Tunnel. The former adopted the above interpretation and only allowed 20-30 feet of vertical thickness for strata concealed by the tunnel, whilst the latter believed the line of the tunnel and the strike to be at right angles to each other and calculated about 178 feet. At the eastern end of the Tytherington Tunnel the line of section gradually turns away from the strike, and at the extreme eastern end of the section the railway line is once again at right angles to the strike.

In the railway cutting east of the Tytherington Tunnel, the *Caninia*-Dolomite (C_2) is exposed. It consists of thinly-bedded compact dolomites with subsidiary shales. The freshly-broken surface of a dolomite from this level generally exhibits a curious dendritic red staining. China-stones are present, and at one level is an algal rock (kindly pointed out to the writer by Prof. Reynolds), composed of patches of *Spongiostroma* rounded by solution and embedded in a much weathered dolomitic matrix.

Another curious rock is a compact pink dolomite with a number of small, cylindrical, lighter patches. In thin sections these patches appear to be worm-tubes, subsequently filled with sediment. At another level in C_2 a few foraminifera have been distinguished in an otherwise structureless dolomite.

The *Caninia*-Dolomite of this section has been thrown into a series of gentle undulations.

At a point about 250 yards south of the tunnel, these rocks disappear under the overlying Dolomitic Conglomerate, re-appearing again on the line of strike of the basement beds of the Church and Camp Quarries. These basement beds consist of a white oolite with abundant *Lithostrotion martini*, and are in the *Seminula* zone.

Both Prof. Morgan (V.) and Rev. H. H. Winwood (XVI.) maintained that these Avonian rocks were separated from the Trias by a reversed fault. Dr. A. Vaughan (XIII., p. 222) affirms that the beds are in their correct stratigraphical position. He attributes the anomalous relations of the Avonian and Dolomitic Conglomerate to the erosive action of the Triassic waters at the base of the limestone cliff and the subsequent filling of the recess thus formed by Dolomitic Conglomerate. The present research indicates the correctness of Dr. Vaughan's interpretation for—

(a) No fault can be traced either north or south of the railway line.

(b) There are no signs of disturbance near the position of the supposed fault.

(c) The stratigraphical position of the beds is correct.

(d) A similar feature can be seen (in section) at the western end of the Camp Quarry (1922). Here the relations of the rocks are obvious.

The remaining portion of the sequence may be studied in either the Church or Camp Quarries, Tytherington. The section, as shown in Church Quarry, may be tabulated as follows in ascending order :—

	Ft.	Ins.
White Oolitic Limestone with large ooliths and fairly abundant *Lithostrotion martini*	8	0
Oolitic Limestone, with small ooliths	2	6
Massive compact Limestone with *Lithostrotion martini*	5	0
Shale band		5–6
White Oolitic Limestone with *Seminulæ* and *Producti*	4	0
Massive compact Limestone	2	0
Shale band, with abundant Productus θ (owing to pressure has a *P. hemisphericus* appearance)		8–9
Seminula-Pisolite	1	0
Shale band		5–6
Massive compact Limestone, with large masses of *Lithostrotion martini* and *Syringopora distans*	12	0

	Ft.	Ins.
Shale band		5–6
Massive compact Limestone, including a band of *Seminula* Pisolite	50	0
Shale band		5–6
"Firestone," 2 bands with intercalated band (3ft. to 4ft.) packed with *Lithostrotion martini*	9	0
Shale band		5–6
Massive fossiliferous limestone, partly oolitic	9	0
Seminula-Oolite	10	0
Massive very fossiliferous Limestone, partly oolitic	15	0
Massive Limestone with band (12ft. to 15ft.), entirely composed of *Lithostrotion martini*	13	0
Approx.	143	6

The "Firestone" is not entirely unfossiliferous. Recognisable fragments of *Tylothyris laminosa* and *Seminula ficoidea* can generally be found after careful search. In thin section the "firestone" is composed of a mosaic of angular and subangular quartz grains with a little interstitial calcite. Ilmenite (generally in form of leucoxene) is present in small quantities, and a few foraminifera can be recognised. It is a calcareous sandstone.

A prominent feature of this quarry is the large masses of *Lithostrotion martini* at several horizons. *Cyrtina carbonaria* (two specimens) was found in this quarry about 11 ft. below the "Firestone."

The sequence in the Camp Quarry is almost identical with that found in the Church Quarry. The shale bands are, however, more carbonaceous and the "Firestone" is only 7 ft. thick. *Lithostrotion bassaltiforme* occurs in fairly large masses in this quarry.

The vertical exposed zonal thicknesses in the Tytherington-Grovesend Railway Section may be summarised as follows :—

Seminula Zone	..	145 feet (bottom and top beds not exposed).
Syringothyris Zone	..	400 ,,
Zaphrentis Zone	..	360 ,,
Cleistopora Zone	..	380 ,,
		1,285 ,,

Both in lithological and faunal characters the Church and Camp Quarries at Tytherington are almost identical with Qu. 5 at Wickwar. (XIII., p. 238 and VII., p. 3, sketch map).

(b) Tytherington Hill.

A series of quarries occur along the south-eastern flank of Tytherington Hill. All these quarries are in the *Seminula* zone, and many of them contain the "Firestone." In the northernmost of these quarries (not marked on the 6-in. map) the "Firestone" occurs in a weathered condition, the resultant reddish-brown sugary rock being very friable.

(c) Old Quarry, Milbury Heath.

The only interest of this exposure, which lies 230 yards S.E. of Cardiff Villa, Milbury Heath, is that it includes the best exposure of the "Bryozoa Bed" in our area. The rock is of the same type as that which is poorly exposed in the Tytherington-Grovesend railway Section.

5.—ZONAL CLASSIFICATION OF ALL EXPOSURES.

Many of the exposures are of a poor character (under hedges, etc.), and though of great importance in mapping, they have not been included in this list. All references are given to the 6-in. O.S. maps of Gloucestershire.

Cleistopora Zone.			
Tytherington-Grovesend Railway Section, both north and south of Bridge over Railway ..	K_m-K_2	63	S.E.
Old Quarry, 230 yards S.E. of Cardiff Villa, Milbury Heath	K_m & K_1	63	N.E.
Old Quarry, W. of Boathouse, Tortworth Lake	K_1	56	S.W.
Old Quarry, W. of Tortworth Lodge	K_1	56	S.W.
Zaphrentis Zone.			
Tytherington-Grovesend Railway Section—Grovesend Quarry (not marked on 6-in. map) and part of railway cutting to N.W. of quarry	Z_1 & Z_2	63	S.E.
Small copse 400 yards N.W. of Barmer's Lands Farm	Z_1	63	N.E.
Old Quarry on N.W. side of Badenhill Common	Z_1	63	N.E.
Small exposures around Tortworth Lake (extreme northern portion is K zone)	Z	64	N.W.
Quarry S.W. of Leyhill Lodge, Tortworth Park	Z_1	64	N.W.
Slickstones Quarry, N.E. of Bibstone ..	Z_2	64	N.W.
Old Quarry, S. of Hammerley Down ..	Z	64	N.W.
Ley Hill Quarries	Z_2 ..	64	N.W.
Old Quarries, E. of Charfield-Wickwar Road, and 300 yards S.E. of Churchwood Farm	Z_2	64	N.W.
Syringothyris Zone.			
Tytherington-Grovesend Railway Section—Hardwick Quarry and railway cuttings both E. and W. of the Tytherington Tunnel ..	C_1 & C_2	63	S.E.

Exposure at point where footpath crosses the road (not marked on 6-in. map) N.E. of Hill Covert, near Tytherington	C_2	63	S.E.
Quarry 500 yards N.W. of Tytherington Church	C_1	63	S.E.
Old Quarry 500 yards N. of Tytherington Church	C_1	63	S.E.
Old Quarry 300 yards N. of Tytherington Church (not marked on 6-in. map)	C_1	63	S.E.
Old Quarry on E. side of Badenhill Common ..	C_1	63	N.E.
Old Quarry W. of Jones's Wood	C_1	63	N.E.
Old Quarry on S.E. margin of Stanley Wood	C_1	63	N.E.
Ley Hill Quarries	C_1 ..	64	N.W.
Old Quarries, Poor End	C_1	64	N.W.
Old Quarries, on W. side Wickwar-Charfield Road and 260 yards S.E. of Churchwood Farm	C_1	64	N.W.

Seminula Zone.

Tytherington-Grovesend Railway Section.—			
Small exposure at S.E. end of section and Church and Camp Quarries, Tytherington ..	S_1 & S_2	63	S.E.
Series of Quarries on S.E. flank of Tytherington Hill	S_1 & S_2	63 S.E. & 63 N.E.	
Old Quarry N.E. corner of Priest Wood (not marked on 6-in. map)	S_1 & S_2	63	N.E.
Old Quarries at Churchwood Farm	S_1 & S_2	64	N.W.

6.—PHYSIOGRAPHICAL CONDITIONS OF DEPOSITION.

For convenience the scene may be opened at the end of Old Red Sandstone times. Sandstones, shales and conglomerates were being deposited, and our area was either the actual scene of fluviatile conditions, or was situated near the mouth of a river. Land lay to the north whilst the open sea stretched southwards.

The waters of the southern ocean now gradually spread northwards, and with these waters came a large influx of animal life into our area. This marks the commencement of Avonian times. As in the other parts of the Bristol District, the change was perfectly gradual and for some time the sandy sediments of the Old Red Sandstone alternated with the calcareous deposits of the Avonian. It is probable that during Km times the area formed part of a large, shallow lagoon, although the only direct evidence of this is the " Bryozoa Bed." During the remainder of the *Cleistopora* period our area was occupied by shallow muddy seas.

At the beginning of the *Zaphrentis* period we find the muddy waters of *Cleistopora* times being replaced by clear, deeper waters with an abundant coral and brachiopod fauna. In our area, however, there was a recurrence to the shallow-water conditions, for near the base of the *clathratus* subzone is an oolitic band evidently deposited in shallow water. After this temporary shallowing, standard marine conditions were finally established and the *Zaphrentis* limestones with their abundant invertebrate life were laid down.

The entrance of the *Syringothyris* fauna appears to have been coincident with a general shallowing of the Avonian sea throughout the Bristol District. This period is now represented by the *laminosa*-Dolomites, which, though originally deposited, as crinoidal limestones, suffered almost contemporaneous alteration into dolomites. During the remainder of C_1 times a thick series of oolites were deposited, and from the evidence of current-bedding and also from pieces of angular or rounded oolite being found embedded in the main mass of oolite, it appears that shallow waters with strong and eddying currents prevailed.

At the end of *Caninia*-Oolite times the sea retired to the south for a short time and the area suffered sub-aerial denudation. The effects of this short denudational period are well seen in the Grovesend-Tytherington railway section. In the Avon Gorge is a similar junction line between C_1 and C_2, though here Prof. Reynolds believes that subsequent solution is the correct explanation (XI., p. 224). This difference is only to be expected from the geographical position of the two places, for throughout Avonian times our area was nearer the northern coast-line than the remainder of the Bristol District.

The thinly-bedded shales and dolomites of C_2 and S_1, appear to have been laid down in a second calcareous lagoon area.

In upper S_1 and lower S_2 times standard marine conditions once more asserted themselves and limestones, sometimes oolitic, were deposited.

Up to this point there has been no feature of outstanding interest differentiating the physical history of this area from that of the remainder of the Bristol district. At the beginning of S_2 times, however, the coast-line advanced towards the south, and in-shore conditions prevailed in our area. The "Firestone" was formed during this period. Though the total length of time of this in-shore period was short, it includes a standard-marine phase. The deposit may indicate the first appearance of the large southward-flowing river of "Millstone Grit" times, and represent a large sand-bank.

Normal marine conditions re-asserted themselves at the close of this episode, though they only lasted for a comparatively short time, and towards the close of the *Seminula* period, permanent in-shore conditions were established. This latter phase is the so-called " Millstone Grit," and probably represents a time when our area was near the mouth of a southward-flowing river.

At the Manchester Meeting of the British Association (1915 Trans. of Sects., pp. 429-431), Dr. A. Vaughan roughly sketched out the extent of the " S.W. Channel " during the Avonian Period.

From the evidence of previous writers and the present paper it appears that during Avonian times there was a progressive movement of the northern shore-line of this " S.W. Channel " in a southerly direction. This movement can be registered by noting the level in the Avonian sequence at which " Millstone Grit " conditions were established.

In the Clee Hill District the " Millstone Grit " appears at the end of Z_2 times (Dixon, G. M., 1910, p. 458), whilst further south in the Forest of Dean, it did not appear until towards the end of the *Syringothyris* zone. (Sibly, G. M., 1912, p. 420). In our area and also at Chepstow (XIII., p. 251) nearly the whole of the *Seminula* zone was deposited before the advent of the " Millstone Grit," whilst in the southerly prolongations of the sides of the " horse-shoe " the *Dibunophyllum* fauna had time to make its appearance (I., p. 31, and XII., p. 100). South of these areas, however, the whole of the *Dibunophyllum* zone was deposited before the " Millstone Grit " conditions asserted themselves. Thus in-shore conditions began at approximately the same time in both our area and the Chepstow area, and from a consideration of the geographical position of these areas it appears that the Avonian coastline at this period had an east and west trend and was not very far north of our area.

There is a marked thinning of the Avonian deposits in a northerly direction in the Bristol District. At Burrington the estimated thickness is 2,610 feet (Q.J.G.S., 1911, pp. 344-352), and in the Avon Gorge 2,540 feet (XI., p. 242), whilst at Tytherington the beds are reduced to 1,280 feet. This attenuation is due to paucity of calcareous sediments as the northern shore-line is approached, and not to any intra-formational unconformity or non-sequence.

7.—COMPARISON WITH NEIGHBOURING AREAS.

The area shows a very close resemblance to the type section of the Avon Gorge, the most striking difference being :—

(1) Non-differentiation of horizon γ owing to the absence of *Caninia* immediately above the *konincki*-subzone.

(2) Greater thickness of the Sub-Oolite band (C_1) and the *Caninia*-Dolomite (C_2).

(3) Absence (or non-exposure) of chert in any part of the sequence.

(4) Apparent in-coming of "Millstone Grit" conditions at top of S_2 and the absence of S_2 (top) Modiola Phase and the whole of the *Dibunophyllum* Zone.

Prof. S. H. Reynolds has recently (Geol. Mag. 1923, pp. 111-119) written a paper on the "Lithology of the Sodbury Section." The general faunal and lithological succession is remarkably similar in both areas, the chief difference being the non-calcareous development of the S_2 (top) and D_1 (base) subzones, in the Tytheringron area. The existence of marked current bedding in the *Caninia*-Oolite and the apparent absence of chert in both areas is noteworthy.

Both the faunal and lithological sequence in our area is similar to the Over-Tytherington area (XII.) and the Wickwar-Chipping Sodbury Ridge (1).

By placing the "Firestone" at base of S_2, it occurs on the same level in both the Tytherington and Wickwar areas (XIII., p. 238 and VII., p. 3, sketch map).

8.—SUMMARY OF CONCLUSIONS.

The chief results of this paper may be summarised as follows :—

(1) All zones, with the exception of the *Dibunophyllum* zone, have been recognised in the area.

(2) The great expansion and fossiliferous character of the "Sub-Oolite Bed," as compared with the type section of the Avon Gorge is noteworthy.

(3) The early advent of "Millstone Grit" conditions is important, and especially so when considered in relation to the time of that event in the neighbouring districts.

I am greatly indebted to Prof. S. H. Reynolds, M.A., ScD., who kindly went over the Tytherington-Grovesend railway section with me, photographed it, and also examined my thin sections from that area.

I also wish to thank the Earl of Ducie, who courteously gave me permission to examine the exposures on the Tortworth Estate.

PLATE I.—Zonal Map of the Tytherington-Tortworth-Wickwar Ridge.
,, II.—Fig. 1.—Grovesend Quarry.
,, 2.— do.
,, 3.—Hardwick Quarry.
,, 4.—Railway Cutting between Tytherington Tunnel and Station.
,, 5.—Church Quarry, Tytherington.

Owing to high cost of printing, Pl. II. has not been reproduced. The photographs have been placed on record in the Geological Note Book of the Geological Section of the Bristol Naturalists' Society.

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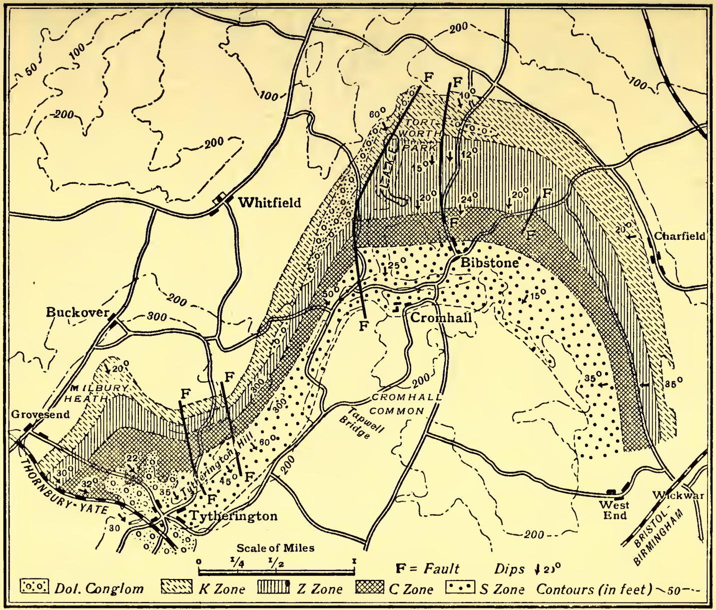
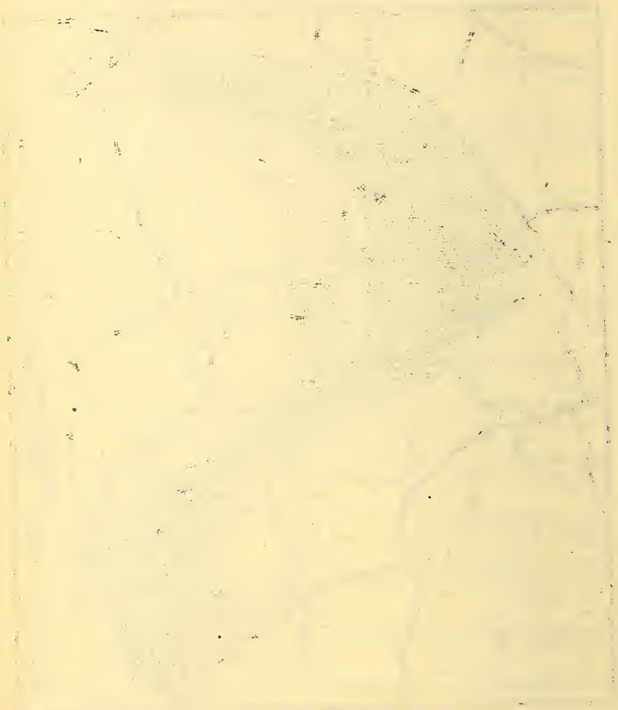

Whitfield
Buckover
Grovesend
Tytherington
Tytherington Hill
Bibstone
Cromhall
Charfield
West End
Wickwar
TORTWORTH PARK
MILBURY HEATH
CROMHALL COMMON
Tapwell Bridge
THORNBURY-YATE
BRISTOL-BIRMINGHAM
Scale of Miles
0 1/4 1/2 1
F = Fault
Dips
Dol. Conglom
K Zone
Z Zone
C Zone
S Zone
Contours (in feet)



The Avonian of the Western Mendips from the Cheddar Valley to the Sea.

By Agnes E. Bamber, M.Sc., F.G.S.

CONTENTS :

1.—INTRODUCTION.

(a) Previous Work.

The Western portion of the Mendip Area is covered by the 1″ Geological Survey Map published in 1863.

Principal T. F. Sibly in his paper " On the Carboniferous Limestone of the Mendip Area " (Q.J.G.S. vol. lxii., 1906) includes this area and has determined the zones exposed in many of the quarries.

The exposures at Uphill, Brean Down, Little Down Quarries, Bleadon and Banwell have been described by Prof. S. H. Reynolds in his Geological Excursion Handbook for the Bristol District.

The present work embodies the results obtained from detailed mapping of the faunal zones of the Carboniferous Limestone.

(b) Geographical Extent.

The area is 9 miles long in an E. to W. direction, and has a maximum width of 2½ miles in a N. and S. direction. It forms the western portion of the Mendip uplift. It includes five isolated Carboniferous inliers, which passing from west to east are as follows :—

(1) Brean Down.
(2) Uphill.
(3) Bleadon Hill.
(4) Banwell Hill.
(5) Wavering Down.

Along the northern side of our region are the villages of Banwell, Hutton and Uphill, and on the southern side those of Bleadon, Loxton, Compton Bishop and Cross. On the E., in the Triassic valley between Winscombe Hill and Banwell Hill, lie Winscombe and Christon. The area is served by two lines of railway, the main Great Western Railway and its Cheddar Valley Branch, and can be reached from Bristol (distance 15–20 miles) by the main Bridgewater road or by the Weston and Uphill road.

2.—GEOLOGICAL STRUCTURE AND PHYSICAL FEATURES.

The area forms the western half of the most westerly of the four Mendip periclinal uplifts. Its axis is elongated in an E. and W. direction. The hills rise abruptly from an almost perfectly level plain, composed in the E. of Triassic deposits, mainly Red Marl, and in the W. of alluvium and blown sand. Brean Down is nearly surrounded by the sea. The gently rising ground in the gap between Uphill and Bleadon Hill is formed of Liassic deposits, which with the Keuper have been faulted into their present position. Dolomitic Conglomerate wraps round the bases of the eastern hills.

The dip and consequently the dip slopes are everywhere steeper on the northern than on the corresponding southern side of the pericline, the folding force being directed from the S.

The filling, wholly or partially, of most of the gaps, valleys and even gullies with Triassic deposits proves conclusively that they are pre-Triassic in origin. The presence of small patches of Keuper on the tops of the hills, and of Triassic deposits in hundreds of pipes and cavities in the limestone, shows that the area was once submerged under the Triassic sea. Subsequent erosion has done little more than remove the covering of Secondary rock, and is revealing at the present time a landscape fundamentally pre-Triassic.

To the E. of Purn Hill, as the pericline approaches its minor axis, the curve of its N.—S. anticlinal arch becomes less sharp. On Bleadon Hill denudation has exposed the lower portion of the *Zaphrentis* zone, and has reduced this part of the uplift to a low plateau with steeply sloping sides. Between Banwell Hill and Wavering Down, where a long broad valley bounded on all sides by steep scarp faces has been formed, the whole Avonian series has been worn away from the central portion of the uplift, exposing the Old Red Sandstone.

To the W. of Purn Hill the whole of the southern limb of the anticline has been reduced below the present level of the alluvium and Brean Down and Uphill stand as detached portions of the northern limb.

The area in the neighbourhood of Hutton Combe and Elborough has a somewhat complicated structure. The eastern and main part of Elborough Hill is a small denuded anticline, the axis of which runs almost E.—W. S_1 beds appear at the surface on both limbs of the fold and beds rather low in γ are exposed in the centre. A fault brings y-beds against this anticline on the S.W.

On the west of this fault the rocks which have been following the general W. to E. strike of Bleadon Hill curve sharply round to the N.W., and are thrown against the above-mentioned anticline by a N.—S. fault which shifts their outcrop northwards. To the south of the anticline γ-beds have been faulted in between it and the Z_2-beds of Bleadon Hill.

Fossil evidence obtained from exposures at Walborough, Uphill shows that the same horizon is exposed there as in the cutting immediately to the north, the repetition being probably due to a strike fault. A fault in the quarry north of Bleadon and Uphill station is in line with this, and it is possible that the two faults were originally continuous. The post-Triassic faulting in the district, however, makes this uncertain. An overthrust fault parallel with this is seen where the rocks are considerably crumpled at the northern end of the cutting. Brean Down supplies evidence of faulting of a similar kind. On the south side there are numerous small faults characteristic of a shatter belt, and a strike fault can be seen in the Raven's Cave. The dolomites of the south-eastern shore are repeated on the north-eastern side of the Down by a fault perhaps the continuation of one seen to the south of Uphill Quarry, which repeats a similar series of beds.

Post-Triassic faulting has brought the Lias and Keuper against the limestone between Uphill and Bleadon Hill.

There are no surface streams or springs on the limestone anywhere in the area, the K-shale, when exposed, being well above the saturation level. The River Axe flows south of the uplift in a westerly direction until it turns rather sharply north and utilizes the gap between Brean Down and Uphill.

3.—DESCRIPTION OF THE ZONES.

The zonal notation of the late Dr. A. Vaughan has been adopted throughout this paper. The dividing line between the Tournaisian and the Visean has been placed at the top of C_2 (as in the Belgium paper)*. The persistence of the Z_2 fauna throughout hor. γ makes it reasonable to include hor. γ in the *Zaphrentis* zone.

TOURNAISIAN.

Cleistopora Zone, K.

K_2—*Perplicata subzone.*

SURFACE EXTENT.

The upper part (K_2) only is exposed. It is seen in the railway cutting and portion of the tunnel on the Cheddar Valley Railway south of Shute Shelve. Its outcrop is everywhere grass covered, but there is no reason to suppose that it does not pass downwards conformably to the Old Red Sandstone which is occasionally seen in very small exposures on the north side of Wavering Down.

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* **Correlation of Dinantian and Avonian Q.J.G.S., vol. 71, 1915.**

No exposures of the K-zone have been previously recorded from this area.

LITHOLOGICAL CHARACTERS.

In descending order the sequence is as follows :—

(1) Thickly bedded limestones, crinoidal often fossiliferous, with a considerable amount of chert. The limestones are partially stained red and have red shaly partings.

(2) Thinly bedded black limestones and shales.

In the former series there is considerable silicification and dolomitization of the rock, and fossils are often silicified. The red stain is due to hæmatite, which in the dolomitised band replaces the fossils in the cavities left by their solution. Microscopic examination shows that the metasomatic and other changes occurred in the following order :—(1) dolomitization, (2) introduction of hæmatite, (3) silicification. In the lower series the limestones are as a rule hard and very crinoidal, some bands are, however, very shaly, the limestone passing gradually into a hard calcareous shale which does not split well, and has a tendency to conchoidal fracture. In the lower parts the limestone bands are less marked and the shales softer.

Zaphrentis Zone Z.

Including
- *horizon* γ
- Z_2—*konincki subzone*
- Z_1—*clathratus subzone*
- *horizon* β

SURFACE EXTENT.

The main part of the zone is exposed only on Bleadon Hill, where it forms the top of the down, and on Wavering Down, where it forms the highest portions (excepting Crook Peak). β and Z_1 are both poorly exposed and have not previously been recorded in this area. The outcrop of the former is found only along the northern side of Wavering Down, and that of the latter on Wavering Down and a small area on the east of Bleadon Hill. Horizon γ forms the southern portion of Brean Down, all but the northern portion of Uphill, and the southern portion of Banwell Hill. It is further seen both to the N. and S. of the Z_2 outcrop on Bleadon Hill and to the S. of that on Wavering Down. It forms the upper end of Hutton Combe.

LITHOLOGICAL CHARACTERS.

Horizon β is exposed in two small quarries (see list of exposures, p. 87), and in both cases a few feet only are seen. A complete account is therefore impossible. In the lower part (Shute Shelve quarry) there are thickly bedded red and grey crinoidal limestones with bands of shale. Lithologically these form a continuation of K_2. In the upper Hill Farm Quarry, there are thinly bedded, black or grey crinoidal limestones, which show a marked tendency to split parallel to the bedding. Between the limestones are thick bands of light coloured shale with limestone nodules. Microscopic examination of these reveals finely broken material with organisms, including *Archæocidaris* spines.

The upper portion only of Z_1 is exposed and there is no continuous section of Z_2. The best exposures of both occur at Wringstone Rocks and Webbington Quarry, where the rocks consist in the main of thinly bedded black dolomitized limestone, much of which is of the 'petit granit' type, but there are marked bands of brachiopod limestone at certain levels.

Purn Hill provides an exposure of γ which is practically complete. Parts of this horizon are also excellently exposed at Uphill, Brean Down (south side) and at various points on the south-east of Elborough Hill. The horizon consists of thickly bedded fine grained, black or grey limestones of the 'petit granit' type, often slightly dolomitized.

Throughout the zone silicification is common. At certain levels in the upper part of β and in Z_1 the fossils are silicified, while nodular and lenticular chert-masses are found in Z_1 and in abundance in γ, where masses are frequently arranged parallel with the bedding. Certain scars, notably Wringstone Rocks and Purn Hill, owe their prominence to the presence of chert. For the same reason steep strike slopes are found wherever the outcrop of the upper part of γ occurs.

Syringothyris Zone. C.

Surface Extent.

The zone is exposed in every mass in the area. It forms the northern portion of Brean Down, of Uphill, and of Banwell Hill, the greater part of the northern and southern flanks of Bleadon Hill, and most of the southern slopes of Wavering Down. The topmost beds form scars, e.g., White Cliff on Bourton Farm and Crook Peak. The best exposures are to be seen at Crook Peak, Little Down Quarries, Bleadon Quarry and Uphill Quarry.

Lithological Characters.

Although this zone consists mainly of oolite, the rocks show considerable variety of lithological character. The sequence given in descending order is as follows :—

(1) Massive thickly bedded very fossiliferous oolites, partly crinoidal and foraminiferal.

(2) Massive white oolite in which the bedding planes are often obliterated and which contains few fossils.

(3) Oolites partly crinoidal and foraminiferal, with dolomite bands.

(4) Massive white oolites with few or no fossils.

(5) Dolomites over and underlain by slightly dolomitised crinoidal and foraminiferal limestone

At a level immediately above (4) the limestone is very hard, largely crinoidal, and is much stained with hæmatite. It contains *Chonetes* cf. *comoides*, *Bellerophon* and *Euomphalus*. This band is found wherever the horizon is exposed and forms a useful determining level. It is on the same level as the '*Bellerophon*-beds' found elsewhere in the Mendip and Bristol district. It is well seen at the Fort Quarry, Brean Down, the most westerly of the north-eastern quarries of Brean Down, at the Little Down Quarries, Bleadon, and in the quarry at Hutton Combe. These beds rest upon a fine white oolite, which passes down into crinoidal and foraminiferal limestone.

The thickness of the lower white oolite is not great and it varies in different parts of the area, thus at Brean Down Point it is thinner than at Hutton Coombe, where it is about 20 feet thick. The dolomite is ill-exposed, but is more fossiliferous at the base, where dolomitization is incomplete, than in the upper portion.

Since there is no continuous section of the dolomites, and very few fossils have been found in them the dividing line between C_1 and C_2 has been placed as in other areas immediately above them.

VISÉAN.

Seminula Zone. S.

S_1 or *semireticulatus zone.*

The outcrop of the *Seminula* zone is limited in extent. The lower beds only are exposed, and these come to the surface on the extreme N.E. and S.E. corners of Bleadon Hill, on the N.E. of Banwell Hill, and on the S.W. and S.E. of Wavering Down.

Lithological Characters.

The rocks exposed consist in the main of massive, thinly bedded limestones, many of which are more or less completely dolomitized.

The limestones are mainly fossiliferous and oolitic, but vary considerably in the character of the ooliths. Many of them show pene-contemporaneous brecciation. The oolite which fills the interior of the brachiopods is as might be expected, of a finer character than that of the rest of the rock. This helps to give a characteristic patchy appearance to some of the bands. Where dolomitisation has attacked the rocks it often affects the matrix, but not the ooliths. Again within the patches of finer oolite the matrix is almost undolomitised, though the dolomitisation may be complete in the calcite or aragonite originally enclosing these patches. It is possible that some of these patches may have been of the nature of pebbles (probably soft) formed during the brecciation of the original bed. Whatever their origin they seem to point to the relatively great resistance of the finer oolites to dolomitization, a conclusion which seems to be confirmed by the result of acid tests on the coarse and fine oolites. There are also bands of fine oolite with a calcite matrix, the grains having sometimes been formed round fragments of foraminifera.

Associated with the coarse oolites are china-stones, sometimes banded. The development of these is very local, and in some places they are very narrow and soon die out.

(b) FAUNAL LISTS AND NOTES.

KEY.

A =	abundant.	r =	rather rare.
a =	very common.	R =	rare.
C =	common.	1 =	one specimen only.
c =	fairly common.	x =	at certain levels.

FOSSILS.	ZONES. K	Z				C		S
	K_2	β	Z_1	Z_2	γ	C_1	C_2	S_1
Zaphrentis delanouei, E. & H.		R	c					
Zaphrentis omaliusi, E. & H.		R	c	A	a			
Zaphrentis omaliusi var. *densa*, Carruthers ...					C			
Zaphrentis konincki, E. & H.				A	a	c	r	
Amplexus coralloides, Sow.				?C	r			
Amplexus sp. (small with short septa) ...		?C						
Amplexus sp. (vermiform)					r			
Caninia cornucopiæ, Mich.				A	A			
Caninia cornucopiæ var.					c at base			
Caninia patula, Mich.					C			
Caninia cylindrica Scouler *mut.* γ Vaughan ...					A	a		
Caninia cylindrica Scouler *mut.* S_1 Vaughan							r	
Cyathophyllum θ Vaughan					R	R		
Cyathophyllum φ Vaughan							C	
Cyathophyllum φ small form					r	c		
Carcinophyllum mendipense, Sibly							at top R	
Lithostrotion irregulare (Phill.)							at top R	
Lithostrotion martini, E. & H.								a
Lithostrotion basaltiforme, Phill. var. *bristolense* Vaughan								C
Michelinia favosa (Goldf.)		?R						
Michelinia megastoma (Phill.)				c	a	C		
Syringopora θ Vaughan				C	C			
Syringopora cf. *reticulata*, Goldf.					C	C	C	
Syringopora cf. *distans* (Fischer)							C	C
Camarotaechia mitcheldeanensis, Vaughan ...	A	c						
Camarotaechia pleurodon (Phill.) Vaughan ...							top only R	
Actinoconchus lamellosa (L'Eveillé)	?C							
Actinoconchus planosulcatus (Phill.)							R	
Cliothyris royssii (L'Eveillé)		C	c	c	R			
Cliothyris glabristria (Phill.)					C	C	C	

Fossils.	Zones. K	Z				C		S
	K_2	β	Z_1	Z_2	γ	C_1	C_2	S_1
Cliothyris cf. *glabristria* (Phill.)								c
Cliothyris cf. *expansa* (Dav.)							top only r	C
Seminula ambigua (Sow.)							top only R	
Seminula ficoidea, Vaughan								c
Small Athyrids seminuloid in form							top only C	
" *Spirifer* aff. *clathratus*, M'Coy," Vaughan ...	C	a	A	A	c			
Spirifer aff. *clathratus* var. cf. *attenuata*, Sow...		c						
Spirifer ? cf. *striatus*, Martin	C							
Spiriferina perplicata, North	C							
Spiriferina probably *insculpta*, North ...					1			
Syringothyris principalis, North	C							
Syringothyris cuspidata mut. *cyrtorhyncha*, North		C	a	a	a			
Syringothyris cuspidata mut. *exoleta*, North ...						C	C	
Tylothyris laminosa, M'Coy, mut. North ...					r			
Tylothyris laminosa, M'Coy, emended North ...							c	
Leptaena analoga (Phill.)	c	C	A	A	R			
Orthotetes crenistria (Phill.) mut. *K* Vaughan	C							
do. mut. *Z* Vaughan		A	A x	A x	a			
do. mut. *C* Vaughan						ax	ax	
Reticularia cf. *reticulata* (M'Coy)	?R			a		c	C	
Rhipidomella aff. *michelini* (L'Eveillé) ...	?C		C	C	C	C	c	
Schizophoria resupinata (Mart.)					C	a		
Productus bassus, Vaughan	C	c						
" *Productus* cf. *martini*, Sow," Vaughan ...		r	c	C				
Productus sp. near *martini*, Sow.					?c			
Productus (*Pustula*) *subpustulosus*, Thomas ...					A			
Productus cf. *semireticulatus*, Mart.					r			
Productus cf. *concinnus*, Sow.							a	
Productus aff. *cora* d'Orb. mut. C_1 Vaughan ...							c	
Productus aff. *cora* d'Orb.								C x
Productus θ Vaughan							top A	C
Productus corrugatus, M'Coy							top r	
Productus aff. *hemisphericus*, Sow.								C
" *Chonetes* cf. *crassistria*, M'Coy," Vaughan ...			A					
Chonetes cf. *laguessiana*, de Kon.	C	c						
Chonetes cf. *hardrensis*, Phill.		C		a			C x	
Chonetes aff. *papilionacea* (Phill.)				C			A	a
Chonetes aff. *comoides* (Sow.)						ax	ax	
Fenestella spp.		a	c	c	a			
Rhabdomeson spp.					a			
Modiola sp.	1							
Conocardium sp.					cx			
Euomphalus sp.				r	cx	ax	ax	C
Pleurotomaria					ax	ax	Cx	C
Bellerophon sp.							C at 1 lev'l	
Phillipsia tail		1	1		1			
Psephodus tooth	1							

FURTHER NOTES ON THE FOSSILS.

(1) For the following reasons it is considered in this paper that the entry of large Caninids though presumably somewhat earlier than in the Avon section, marks the base of hor. γ :—

(a) With the exception of the presence of *C. patula* and *C. cylindrica* hor. γ is faunally continuous with Z_2.

(b) *C. patula* and *C. cylindrica* have not been found at levels far below *Syringopora* cf. *reticulata*, a characteristic γ and C_1 form.

(c) The only continuous section of the top of Z_2 and γ is at the N.W. end of Purn Hill, where the exposures are too poor to provide much useful faunal evidence.

Horizon γ is characterised by the extreme abundance and co-occurrence of *Zaphrentis konincki*, *Zaphrentis omaliusi*, *Caninia cornucopiae* and *Caninia cylindrica*, and by the abundance of *Productus* (*Pustula*) *subpustulosus*. The variety of *Caninia cornucopiae* has steeply sloping tabulæ and a well-marked fossula.

The occurrence of *Conocarduim* sp. and *Spiriferina* cf. *insculpta* is interesting, since they were mentioned by Vaughan as occurring in γ in Belgium.

(2) The lowest beds of C_1 are characterised by the very common occurrence of *Chonetes* cf. *comoides*, *Pleuratomaria* sp. and *Euomphalus* sp. and the maximum of *Schizophoria resupinata*. *Zaphrentis konincki* persists into C_2, but is not common. The large *Caninias* so abundant at the base die out rapidly as the series is ascended, in a manner which suggests that the cause is the shallowing of the sea and the resulting change in conditions.

(3) The most interesting points in the fauna of the C_2 beds are the presence of *Bellerophon* and other large gastropods in the middle portion and the incoming of Viséan forms at the top.

Cyathophyllum φ is represented by small forms in the lower beds. *Productus* cf. *concinnus* and *Productus* aff. *cora* occur in the middle beds and soon become common. *Productus* θ enters near the top, where also *Productus corrugatus* occurs very sparingly. *Seminula ambigua*, *Cliothyris* cf. *expansa*, *Camarotaechia pleurodon*, *Carcinophyllum mendipense*, and *Lithostrotion* cf. *irregulare* all enter at the top, rendering the C-S division somewhat artificial.

DESCRIPTION OF THE BEST EXPOSURES.

In order to avoid unnecessary repetition only special points of interest will be described.

1. Purn Hill.
2. Uphill Quarry to Walborough.
3. Brean Down.
4. Little Down Quarries, Bleadon.
5. Cross.
6. Bleadon and Uphill Station Quarry.
7. Hutton Coombe.

1. Purn Hill.

Purn Hill shows a series of exposures in which it is possible to examine almost every bed from the top of Z_2 to the lowest beds of C_1.

On the western face of the hill the limestones, particularly when cherty, form prominent scars, probably remnants of old sea cliffs. The rocks are mainly highly crinoidal limestones and provide an excellent collecting ground, although the fossils do not show up well either on the weathered or on freshly broken rock surfaces. In the quarries by the road there is a considerable amount of faulting, but the throw of these faults is very small. Good specimens of *Chonetes* cf. *comoides* and *Schizophoria resupinata* can be obtained from the road quarries.

2. Uphill Cutting to Walborough.

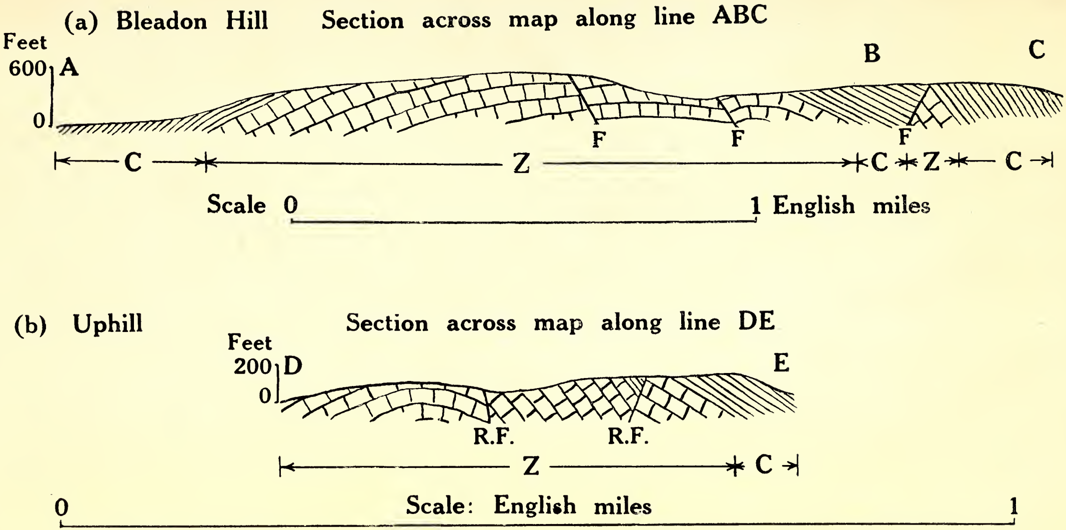
Uphill Quarry is the best exposure of lower C and the top of hor. y in the area, and shows the following section :—

C_1	Dolomitised limestone with shattered bands	47 ft.
	Light grey limestone, crinoidal and fossiliferous	44 ft.
y	Crinoidal limestone (Petit granit)	76 ft.
		167 ft.

Part of the quarry south of the engine shed shows hor. γ in which *Caninia cylindrica* mut. γ, *Caninia cornucopiae* and *Michelinia megastoma* are abundant and stand out with diagrammatic distinctness.

The shattering referred to by Prof. Reynolds of the rocks in the northern part of the quarry is confined to certain beds in the dolomites. These bands are almost unfossiliferous, and they show a marked regularity in their occurrence, which gives this end of the quarry a striped appearance. The shattering is probably due to earth movement subsequent to the deposition of the rocks, but may be contemporaneous with their deposition. Immediately south of the quarry is a very small gully, produced by a strike fault which repeats about 100 feet of the rocks exposed in the quarry. On the S. side of this gully the rocks, which have been dipping in the quarry at an angle of about 25°, are turned almost on end. A high dip is maintained for some distance S., but it becomes less on approaching Walborough. The exposures are not very good owing to the weathered state of the rocks, but sufficient fossil evidence has been obtained to show that these beds belong to γ and not to Z_1, as has formerly been stated. Horizon y with abundant *Caninia cylindrica* is exposed at Walborough.

Fig. II Horizontal Sections.



3. Brean Down.

The quarries on Brean Down and the southern shore have already been described very completely by Prof. Reynolds and there is little to add here. The exposures east of the fort in rocks below those of Fort Quarry show the same development of dolomites, crinoidal limestones and oolites as is met elsewhere at the same horizon. On the southern side of the Down shattered dolomites, similar to those at Uphill, are seen where the blown sand against the face ends. Patches of breccia on the face of the cliff are presumably fault breccia. The cliffs on the south of the Down are horizon γ, but the greater portion of the Down lies in C_1 and C_2. *Syringopora* cf. *distans* (Fischer) is found in the Fort Quarry (C_2), i.e., at a lower level than elsewhere in the area.

4. Little Down Quarries, Bleadon.

In the Little Down Quarries 210 feet of the upper part of C_2 is finely exposed. The small quarry, now occupied by a cottage, to the S. of the main quarry, is in S_1, and has in its upper part bands crowded with *Productus* aff. *cora*. The following table gives the lithological succession :—

C_2	White oolite	96 ft.
	Limestone, oolitic crinoidal, foraminiferal and partly dolomitised	49 ft.
	Oolite	50 ft.
	Dolomite	15 ft.
		210 ft.

The white oolite is similar to that on the same horizon at Burrington[1]. The quarry is riddled with pipes containing Triassic material and often lined with calcite crystals.

5. Cross Quarry.

This quarry lies just north of the Bridgewater road, about a mile due east of Axbridge. It shows about 58 feet of S_1 on which rest, in the eastern part of the quarry, about 15 feet of Dolomitic Conglomerate. The following table shows the succession :—

S_1	Oolite showing penecontemporaneous brecciation	25 ft.
	Oolite showing penecontemporaneous brecciation with china stones ..	$3\frac{1}{2}$ ft.
	Dolomite containing gasteropods	10 ft.
	Fine oolite	8 ft.
	Dolomite	1 ft.
	Oolite showing penecontemporaneous brecciation	6 ft.
	Dolomitised limestone	$2\frac{1}{2}$ ft.
		56 ft.

1. See Burrington paper, pp. 348 and 369.

China stones are thin and non-persistent. The oolite with which they are associated shows penecontemporaneous brecciation. At certain levels there are *Chonetes* and *Productus* bands, and in the middle of the series is a bed containing abundant *Euomphalus* and *Pleurotomaria.* All the fossils with the exception of *Lithostrotion basaltiforme* mentioned in this paper as characteristic of S_1 have been found in this quarry.

In the mass of Dolomitic Conglomerate on the east side the lower beds are of the usual type, but the upper ones are coarse and contain large blocks of oolitic limestone surrounded by red marl.

6. Bleadon and Uphill Station Quarry.

This quarry is in many ways the most interesting in the area, showing as it does post-Triassic faulting and an exposure of volcanic rocks.

The Great Western Railway main line has been cut through the quarry leaving a small portion containing the volcanic exposures on the western side. The eastern part of the quarry shows no volcanic rock. The limestones form a syncline, dipping northward on the southern side of the quarry, and sloping upward to the post-Triassic fault which brings the Lias and Keuper down on the northern side. The cutting to the north shows a series of Red and Tea Green Marls and succeeded non-sequentially by the Lower Lias[1].

7. Hutton Coombe.

The quarry in Hutton Coombe shows a level in C_2, including the Gastropod beds and the C_2 beds below it. The C_2 dolomites are for the most part overgrown, but the topmost beds are fairly well exposed.

The white oolite immediately underneath the Gastropod beds is almost entirely unfossiliferous and fossils are scarce in the more foraminiferal limestones below.

The beds are dipping at a high angle of 50°—60° S.S.W. and striking N.N.E.

(V.) LIST OF THE EXPOSURES.

(Small holes dug for stone walls, and all very small exposures are omitted).

K zone.	Horizon.	6in. Ordnance Survey sheet
Old well in field S. of Barton Drove and N. of Broad Knoll	K_2	XVII. S.E.
Hillside exposure, Shute Shelve (west of railway)	,,	,, ,,

1. L. Richardson, Q.J.G.S., vol. xlvii. (1911) p. 55.

	Horizon.	6in. Ordnance Survey sheet
Railway cutting, Shute Shelve	,,	,, ,,
Cutting in road (east of railway)	,,	,, ,,

Z ZONE (including hor. β and hor. γ).

North Side.

Hillside exposure on Elborough Hill immediately N. of Christon Plantation	γ	XVII. N.W.
Quarry in Hutton Coombe S.E. of Yew Tree Cottage and E. of the road ..	,,	,, ,,
Ditto (west of the road)	,,	,, ,,
Quarry in Hutton Coombe W. of Canada Farm	,,	,, ,,
Hillside exposure S. of Roman road and S. of Christon Plantation	,,	,, ,,
Roadside exposure S.E. of Christon Plantation	,,	,, ,,
Small cave in woods S. of Banwell Monument	,,	,, ,,
Quarries on Bleadon Hill, S. of Roman road	,,	,, ,,
Quarries on G.W.R. main line N. of Bleadon and Uphill station	,,	XVI. N.E.
Uphill quarry and Walborough	,,	,, ,,
Shore exposure S. of Brean Down ..	,,	,, N.W.

South side.

Small quarry by road S. of Bleadon and Uphill station		XVI. S.E.
Purn Hill	Z_2 & hor. γ	,, ,,
Ravine in Hellenge Acre, Bleadon ..	,,	,, ,,
Pathside exposure on Bleadon Hill, near Christon	Z_1	,, ,,
Quarry N. of Crook Peak on Webbington road	Z_1 & Z_2	XVII. S.W.
Wringstone Rocks	,,	,, S.E
Old well in field S. of Barton Drove and N. of Broad Knoll	β	,, ,,
Old quarry on Hill Farm, S. of Winscombe	β	,, ,,

C ZONE.

North side.

Quarries on Banwell Hill, N.-W. of Banwell Castle	C_2	XVII. N.E.
Old quarry W. of Plantation House, Banwell	,,	,, N.W.
Cutting on Banwell road S. of Caves Farm	,,	,, ,,

	Horizon.	6in. Ordnance Survey sheet	
Small quarry W. of Higher Leaze ..	,,	,,	,,
Quarry in Hutton Coombe and sides of coombe	C_2 & C_1	,,	,,
Quarries N. of Lower Canada	C_2	,,	,,
Hillside exposures S. of Hutton quarry ..	,,	,,	,,
Old quarry near Uphill Farm	C_1	XVI.	N.E.
Exposures on Uphill road N. of St. Nicholas' Church	,,	,,	,,
Uphill quarry	,,	,,	,,
Quarries on E. & N.E. of Brean Down ..	,,	,,	,,
Old quarry near Fort, Brean Down ..	C_2	,,	,,
Cliffs around Brean Down	C_1 & C_2	,,	,,
South side.			
Quarries S. of Purn Hill	C_1	XVI.	S.E.
Ravine in Hellenge Acre, Bleadon ..	,,	,,	,,
Cutting and quarry, Wonderstone ..	,,	,,	,,
Old quarry on Manor Farm, Shiplate ..	C_2	XVII.	S.W.
Old quarry behind School, Loxton ..	,, (top)	,,	,,
Old quarry N. of Manor Farm, Loxton ..	,, ,,	,,	,,
Old quarry by side of path, N.-W. of Loxton quarries	C_1	,,	,,
Top of Crook Peak, and S. sides of the hill	C_2	,,	,,
Hillside exposures on S. flanks of Wavering Down	C_1 & C_2	,,	S.E.
White Cliff on Bourton Farm	C_2	,,	,,
Fore Cliff and Yew Tree Cliff (N. of Cross)	,,	,	,,

S ZONE.

North side.			
Old quarry E. of Banwell Wood	S_1	XVII.	N.E.
Old quarry on path from Elborough Farm	,,	XVI.	N.W.
Cutting on road N.W. of Elborough Wood	,,	,,	,,
Old quarry S.W. of St. Mary's, Hutton ..	,,	,,	,,
South side.			
Old quarry E. of Shiplate House	,,	XVII.	S.W.
Quarries and hillside exposures on road S. of Crook Peak	,,	,,	,,
Denny's Hole	,,	,,	S.E.
Quarry N. of reservoir at Cross	,,	,,	,,
Roadside exposures, Post Office, Cross ..	,,	,,	,,

VI. COMPARISON OF THE AVONIAN OF THE WESTERN MENDIPS with

(a) The Avon Section,

(b) The Burrington Section.

(a) The Avon Section.

Dr. T. F. Sibly has compared the Avonian of the Mendips with that of the Avon, having regard more especially to the palæontological sequence. The work carried out in the Western Mendips confirms his observations and conclusions, though detailed mapping shows the levels of the Hutton Coombe district to be somewhat higher than he supposed. Only special points therefore need be mentioned here.

Cleistopora Zone—K_2 *subzone.*

The lithological characters are similar to those of the Avon Section, but dolomitization is more general and silicification is more frequent.

Zaphrentis Zone.

Lithologically and palæontologically similar to the Avon Section and others in the South-west Province. Silicification is again more prevalent than in the Avon Section, being common in Z_1, occurring occasionally in Z_2 and abundantly in γ in the West Mendips, while in the Avon Section cherts are found only in Z_1. Other evidence that the conditions of deposition were not absolutely identical is found in the greatly increased thickness of this zone (due to the tremendous increase in thickness in γ). Points of interest regarding the fossils found in the Z beds of the Western Mendips are the following :—(1) the occurrence of a small *Amplexus* in β; (2) the abundance of *Productus* (*Pustula*) *subpustulosus*, of *Caninia cornucopiæ* and its variety with steeply sloping tabulæ in γ ; (3) the common occurrence of *Zaphrentis densa* in γ.

Syringothyris Zone.

In common with the rest of the Mendip area this zone shows less dolomitization in the lower part than is seen in the Avon Section, while the *Caninia* dolomites of the Avon are represented by a series of oolitic and foraminiferal limestones with subsidiary bands of dolomite or slightly dolomitised limestones. Oolites occur on the same horizon as the *Caninia* oolites of the Avon. Though china-stones have been found at Broadfield Down, 10 miles to the N.-E., and calcite mud-stones in the Avon Section at the top of C_2, neither has been found in C_2 of the W. Mendips, typical lagoon phase conditions being absent.

Seminula Zone—S_1 *subzone.*

In the W. Mendips, oolites sometimes showing penecontemporaneous brecciation, with subsidiary bands of dolomite and a small and local development of china-stones occur on the same horizon as the calcite mud-stones, china-stones and dolomitized limestones of the Avon. It is evident that lagoon phase conditions extended to the area, but were established later and less completely than in the Avon Section. Oolite bands sometimes pass laterally into china-stones.

Dr. Sibly in discussing the relative acceleration of the Mendip coral fauna, as compared with the brachiopods, gives a list of corals which appear at lower levels in the Mendips than in the Avon Section[1]. To this list may be added *Syringopora* cf. *distans* low in C_2, *Lithostrotion basaltiforme* at the base of S_1, and *L. irregulare* at the top of C_2.

(b) THE BURRINGTON SECTION.

As might be expected the lithological and palæontological characters in the Western Mendips are very similar to those of Burrington, in fact to a large extent identical, so points of difference only will be noted here.

Cleistopora—K_2 *zone.*

Siliceous rocks and dolomitised limestones, while present in the Western Mendips area, have not been recorded at Burrington. This can probably be accounted for by the incompleteness of the exposures there.

Zaphrentis Zone.

Some chert occurs in Z_2 in the Western Mendips, but it is by no means characteristic of the subzone. The development of chert elsewhere in the zone is similar to that of Burrington. *Spirifer* aff. *clathratus* is common in Z_2 in the Western Mendips, but not at Burrington. *Productus* (*Pustula*) *subpustulosus* is abundant throughout γ in the Western Mendips, but common only at one level at Burrington. *Productus* cf. *semireticulatus*, on the other hand, is common at Burrington, but not in the Western Mendips.

Syringothyris Zone.

The most important differences lie in the greater amount of dolomitisation in the zone, and the more varied fauna at the top in the Western Mendips; thus *Caninia cylindrica* mut. S_1, *Camaratœchia pleurodon*, *Syringothyris cuspidata* mut. *exoleta* occur in addition to the white oolite fauna of Burrington.

Seminula Zone—S_1 *subzone.*

The portion exposed is similar in type to the Burrington Section, except that china-stones present in the Western Mendips are not recorded at Burrington.

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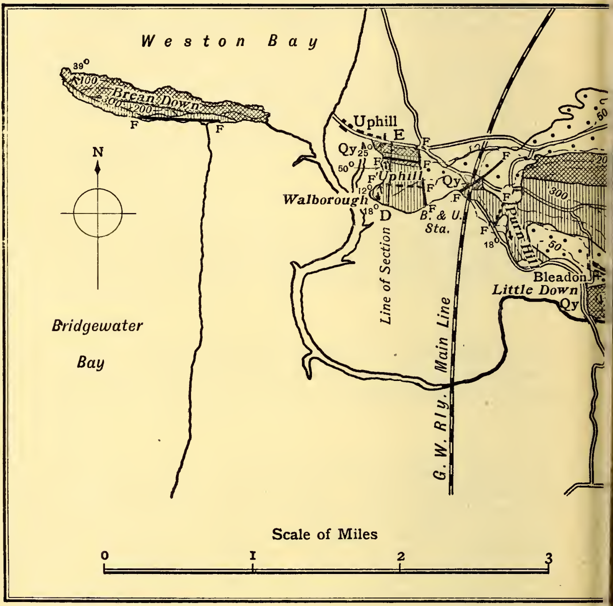
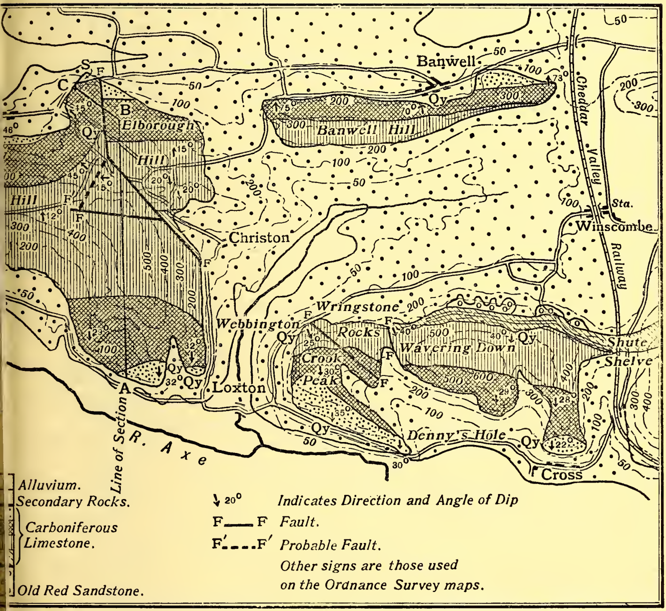
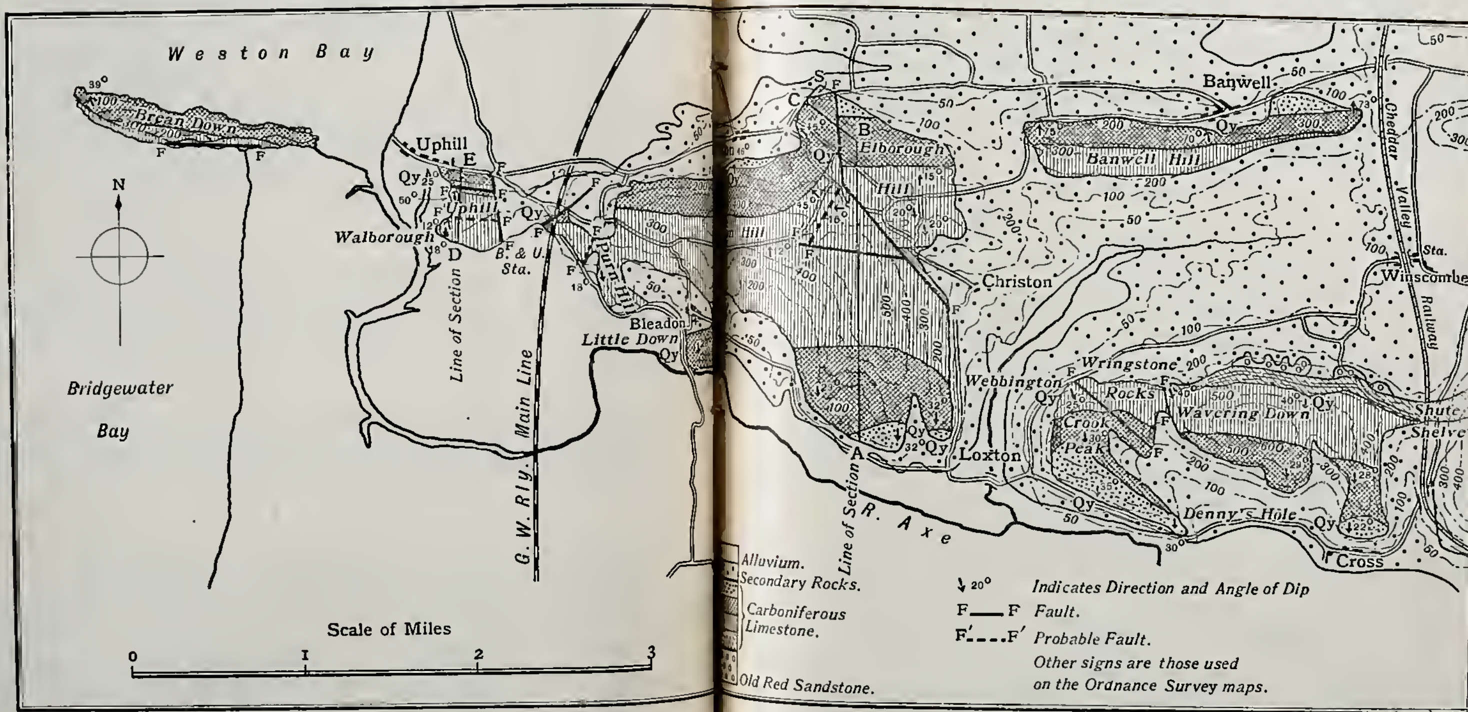
1. Q.J.G.S., vol. 62 (1906) p. 355.


Weston Bay
Brean Down
Uphill
Walborough
Line of Section
Bridgewater
Bay
B. & U. Sta.
Purn Hill
Bleadon
Little Down
G. W. Rly. Main Line
Scale of Miles
0
1
2
3



Banwell
Banwell Hill
Elborough Hill
Hill
Christon
Winscombe
Sta.
Cheddar Valley Railway
Wringstone Rocks
Webbington
Crook Peak
Wavering Down
Shute Shelve
Denny's Hole
Loxton
Cross
R. Axe
Line of Section
Alluvium.
Secondary Rocks.
Carboniferous Limestone.
Old Red Sandstone.
Indicates Direction and Angle of Dip
F —— F Fault.
F′ - - - F′ Probable Fault.
Other signs are those used on the Ordnance Survey maps.



Weston Bay
Brean Down
Uphill
Walborough
Bridgewater Bay
Line of Section
G. W. Rly. Main Line
B. & U. Sta.
Purn Hill
Bleadon
Little Down
Elborough Hill
Banwell
Banwell Hill
Cheddar Valley Railway
Sta.
Winscombe
Christon
Webbington
Wringstone Rocks
Wavering Down
Crook Peak
Loxton
Denny's Hole
Shute Shelve
Cross
R. Axe
Alluvium.
Secondary Rocks.
Carboniferous Limestone.
Old Red Sandstone.
Indicates Direction and Angle of Dip
F—F Fault.
F'---F' Probable Fault.
Other signs are those used on the Ordnance Survey maps.
Scale of Miles
0 1 2 3

CONCLUSIONS.

(1) The detailed study of this small area of the Mendip country affords a further proof of the applicability of Vaughan's zonal classification of the Carboniferous Limestone.

(2) The conclusions arrived at by Dr. T. F. Sibly and stated in the summary of his Mendip paper have been confirmed.

(3) Comparison with the Avon and Burrington Sections show the following similarities and contrasts :—

(a) With the exception of the C_2 S_1 beds an essentially similar lithological sequence occurs.

(b) The lagoon phase conditions of S_1 in the Avon Section are met with in the Western Mendips, but were not completely established there.

(4) K_2, β and Z_1, hitherto unrecorded from the area, have been proved to be exposed.

(5) *Conocardium*[1] *and Spiriferina,* probably an early form of S. *insculpta,* have been recorded from a level low in y, and *Cyathophyllum* θ[2] from the lowest beds of C_1.

[1] *Conocardium* has been recorded from y of Belgium, but not previously from the Bristol area.

[2] *Cyathophyllum* θ has been previously recorded only from y in the Mendips.

In making the above comparisons and arriving at the conclusions stated, the following papers have been used :—

A. Vaughan.—"The Palæontological Sequence in the Carboniferous Limestone of the Bristol Area." Q.J.G.S., vol. lxi. (1905).

T. F. Silby.—"The Carboniferous Limestone (Avonian) of the Mendip Area," ibid. vol. lxii. (1906).

A Vaughan.—"The Avonian of the Avon Gorge," Proc. Bristol Nat. Soc., 1906.

S. H. Reynolds and A. Vaughan.—"The Avonian of Burrington Combe," Q.J.G.S., vol. lxvii. (1911).

S. H. Reynolds.—"The Lithological Succession of the Carboniferous Limestone (Avonian) of the Avon Section at Clifton," ibid. vol. lxxvii. (1921).

In conclusion I should like to thank Professor S. H. Reynolds and Dr. Stanley Smith, the former for his help and advice at times which could not always have been convenient, in all matters relating to the work, the latter for his help in the field and with the palæontological details, and both for their kindly criticisms and suggestions in the preparation of the manuscript and for the encouragement they have given me. I must also thank Dr. F. S. Wallis for help of a similar kind. For naming some of my specimens my thanks are due to Miss H. M. Wood, M.Sc., Dr. F. J. North and Dr. Stanley Smith. I am also indebted to Mrs. Whitby, T. Bisdee, Esq., and others, who have very kindly allowed me to examine exposures in private grounds.

The Old Red Sandstone and Carboniferous Limestone of the Portishead-Clevedon Area.

BY S. H. REYNOLDS, M.A., Sc.D., F.G.S., and E. GREENLY, D.Sc., F.G.S.

IN a communication read before the Geological Society of London an account is given of the geological structure of the Portishead—Clevedon area, but details as to the exposures are in the main omitted. They are given in the present paper.

I. THE PORTISHEAD AREA AND THE RIDGE FROM PORTISHEAD TO LADYE BAY, CLEVEDON (S.H.R.).

OLD RED SANDSTONE.

These rocks are exposed at intervals all along the coast from Ladye Bay, Clevedon, to Woodhill Bay, Portishead. Of the inland exposures on Weston and Portishead Downs attention may be drawn to one in a small quarry west of Farley, and to others about midway between Charlcomb Wood and Weston Lodge, also to one by the Down road ¼ mile east of Hollywood Lodge. Old Red Sandstone is seen near the top of both the Fore Hill Lanes, and in the old quarry at Portishead station, and is well exposed in the grounds at Fircliff, Woodhill. The best section is that behind the factory at Portishead Pier station, the details of which are given in the next paragraph.

CARBONIFEROUS LIMESTONE SERIES.

K m. By far the best section of these beds is in the old quarry at Portishead Pier station. The succession is :—

		Ft.	Ins.
	Bryozoa-bed red crinoidal limestone to top of section	18	0
K m 50ft. 3in.	Red calcareous sandstone, sandy limestone and shale	25	0
	Massive, red, highly ferruginous limestone with crinoids, ostracods and ill-preserved lamellibranchs	2	9
	Red calcareous sandstone and sandy shale ..	10	0
	Red sandy limestone	1	0
	Red calcareous sandstone and sandy shale, mostly in thin bands	11	6
Old Red Sand-stone 154 ft.	Massive red sandstone	4	0
	Shale with thin sandstone bands, ill-exposed ..	16	0
	Massive red sandstone	8	0
	Highly fissile, thin-bedded micaceous sandstone	11	0
	Massive thick-bedded red sandstone	35	0
	Gap, no exposures, about	60	0
	Red and yellow sandstones and shale, somewhat disturbed	20	0

BRYOZOA BED.—This is seen at the following points :—

(1). In the old quarry at Portishead Pier Station

(2). Forming the small cliff at the southern end of the shore section to the south of Battery Point.

(3). In the section at the northern end of the road round the Marine Lake. Here the rocks are intensely disturbed. Part of this section is repeated at the northern end of the Esplanade.

(4). In the small quarry at the Knoll, where there are signs of disturbance and slickensiding.

(5). Of the three little old quarries on the eastern slopes of Woodhill, south of Royal Terrace the two northerly ones are in the Bryozoa bed, which in the most northerly is folded into a sharp anticline. The rocks are now very ill exposed.

(6). There is a small exposure of red limestone, probably Bryozoa bed, at the bend of the road near the top of St. Mary's Lane.

(7). The small quarry standing back from the road, near the top of Nightingale Valley, shows 8 feet of Bryozoa bed—red highly crinoidal current bedded limestone.

(8). At the west end of Lawn Ripple, Bank Hill.

K_1. The most southerly of the Woodhill quarries is in K_1, fairly massive limestone partly dolomitized, from which a normal series of K_1 fossils has been obtained. The base of K_1, including the "palate bed" with *Psephodus laevissimus*, was formerly exposed above the Bryozoa bed in the most northerly quarry. Another exposure of the K_1 beds is in the small roadside quarry near the top of Nightingale Valley, where 5 feet of very fossiliferous, rather thin-bedded, grey limestone with shaly partings overlie the Bryozoa bed. Several specimens of *Cleistopora* were found here.

There are small exposures of K_1 near the western end of Lawn Ripple.

K_2 The well-known section to the south of Battery Point is in K_2. It is briefly described by Vaughan (Q.J.G.S., vol. 61 (1905), pp. 228–230). He records a considerable list of fossils.

Abundant K_2 fossils were collected from a hillside exposure and debris about $\frac{1}{4}$ of a mile W.-S.-W. of Capenore Court.

The upper part of K_2 is exposed in the Walton Castle section.

β and Z_1. The exposures at Eastwood, Portishead, are on this horizon. The best are :—

(1). In an old quarry by the road above Portishead Pier station, where the rocks dip 40 N.-W.

(2). In an old quarry west of Royal Terrace, where the rocks are practically vertical.

(3). I have a record of a visit with Vaughan in June, 1905, to a section of β and Z_1, which was then visible at the bend of the road east of Battery Point.

(4). There is a fine section of β and Z_1 at Battery Point and along the shore to the east. The fossils show much beekitization.

Fore Hill Quarry affords a fine section of β and Z_1, the lower beds being noticeable for the very large amount of chert present. The same type of limestone with silicified crinoids is ill-exposed on the hillside to the north-west of St. Mary's Well. β and Z_1 containing the usual fossils are ill-seen in exposures by the side of the road leading up to Nightingale Valley, and Z_1 is exposed on the hillside below Manor Farm.

Plumley's quarry, Walton-in-Gordano, affords a good section of β and Z_1. The lower beds are very fossiliferous, the fossils being much beekitized. The upper beds, which are partly dolomitized, contain much chert. The beds are a good deal disturbed and show folding and probably overthrusting.

The scarp of Castle Hill overlooking the golf course is formed of Z_1, and there is a good section of β and Z_1 between the Farm and the Castle.

Z_2 and γ. The best sections of these rocks are those in the Weston Big Wood Quarries. Vaughan (op. cit., p. 230) gives a list of fossils from this locality. In the eastern quarry now in work a thickness of over 200 feet is seen, in the western quarry only about 110 feet. The rocks are throughout massive crinoidal limestone, largely dolomitized and highly fossiliferous. The rocks are vertical or overfolded to the north-west, in part of the western quarry to as much as 20°.

The same rocks are seen in small excavations recently re-opened and enlarged just north of the large quarry at the lower end of Nightingale Valley. They are again well exposed in the small quarry at Walton-in-Gordano and in the crags above the road north of the quarry. In all these exposures the rocks consist of the usual highly fossiliferous dark dolomitized crinoidal limestone.

C_1 *Laminosa* dolomite. The best section of this horizon is at the large quarry near the southern end of Nightingale Valley. The big bedding plane forming the northern wall of the quarry may be taken as the top of the *Laminosa* dolomite, and a section chiefly consisting of rather massive red dolomite is poorly exposed in the approach to the quarry. There are poor exposures of *Laminosa* dolomite in Holly Lane.

C_1 *Caninia*-Oolite. This is well seen in the quarry at the bottom of Nightingale Valley, where a thickness of about 95 feet is seen. The upper beds, which show well-marked current bedding, are traversed by close-set parallel joints at right angles to the bedding. At about 25 feet from the base is a band full of *Orthotetes crenistria*[1] and crinoids. Small ill-preserved brachiopods

1. Vaughan (op. cit., p. 230) records *Orthotetes* and *Chonetes* as abundant at the base of the Caninia oolite.

are common in the overlying limestone for a thickness of about 20 feet.

There are many small exposures of the *Caninia* oolite in Weston Big Wood, and in the woods which fringe the Down from Weston-in-Gordano to Walton Castle. The Holly Lane Quarries are in *Caninia* oolite much shattered.

C_2 *Caninia* dolomite. The highest beds exposed in the old quarry at the bottom of Nightingale Valley are *Caninia* dolomite.

Coal Measures (*Pennant*) red or grey micaceous sandstone or grit. These rocks are only seen along the northern shore. The largest exposure is north of the Royal Hotel, Portishead. Three small patches appear through the Trias on the shore near Eastwood and Woodside.

II. THE CLEVEDON AREA (E.G.).

OLD RED SANDSTONE.

This formation consists mainly of red micaceous sandstone often rather pale, and frequently false-bedded ; alternating with more deeply coloured red and green-mottled mud-stones, locally calcareous. A well-defined corn-stone is exposed in a shallow cave just beyond Ladye Point. In the sandstones there are pebbly bands, whose pebbles (rarely exceeding an inch in diameter), include venous quartz, quartzite, and red jasper, all of which might have been derived from the Mona Complex. The formation is seen for a few yards at the north end of Clevedon Beach close to the Pier, but the best section, which is about 100 feet in height, is at Ladye Bay. There is also an inland section behind Severncliffe. The zone of passage to the Carboniferous rocks does not appear to be exposed. Even at Clevedon Beach, as the strike of the Old Red Sandstone diverges from that of the adjacent K-beds at an angle of some 20°, the passage must be cut out by a small fault.

THE CARBONIFEROUS LIMESTONE.

As the K-beds, owing to their crumbly character, are apt to elude observation, it will be useful to record even small and poor exposures of them.* Beginning at Walton, they are well exposed for a few yards at the corner of Hillside Road, 90 yards north of St. Mary's Church, and on the roadside bluff 100 yards west of the Church, while crumbling shale can be detected in the upper banks of the churchyard, near a spring which is evidently thrown out by them. They have been reported in the hotel garden (Walton Gardens), and along Argyle Road, as well as to the north of the Rectory. Green shales can also be detected just at the base of the Triassic rocks near B.M. 147·7 in Park Lodge Lane, as well as at the adjacent pond. Where the foundations of the Franciscan Friary have been

* For the coast-sections see *Proc. B.N.S.*, 4th Ser., vol. v., pp. 138-9. It may be added, however, that Prof. Reynolds has found that the landing stage on Clevedon Beach is built upon the outcrop of the Bryozoa bed.

cut back through the Triassic beds into the hill they may be seen tolerably well at the back of the buildings. Finally they reappear from below the Trias in the floor of Stancliff old quarry, and at a small but interesting exposure on the path at the south end of that quarry, where they can be seen dipping south-eastward at high angles, with their upturned edges roofed by the Triassic dolomite. The existence of Clevedon Bay, and of the closely-built-over hollow behind it, are due to the easy erosion of the K-beds.

The Z-beds, highly fossiliferous limestone, usually rather massive, and irregular upon the bedding planes, rise above the K-beds of the Beach in a sharp escarpment some 40 feet in height, which, running-on inland, enabled me to trace their boundary along Sea Vale Road, and (with less accuracy) under Bellevue Road as far as the Hill Road Crag disturbance. They are well seen on the Hill Road Crag itself, from Newton House to where it overlooks the Alexandra Gardens, also on the road along the Crag's brow, and on the escarpment of Dial Hill as far as Old Park House. In Channel Road there is an excellent section in the Rectory Garden, extremely rich in brachiopoda, and another (not so good) in the stable-yard opposite. At the back of Stancliff House they again rise above the K-beds in a low but sharp escarpment, which can be traced all the way to the Ladye Bay fault. On the other line of strike; they are finely seen on both sides of East Clevedon Gap, and can be traced by their debris north-west of "The Arches" House. Reappearing beyond the Trias of the Fir Wood, they are well seen in the grounds of Mount Elton (in the drive of which they are somewhat sharply folded), and of some of the houses to the west. There are good roadside sections in the steep curve of Park Road, also between Christchurch and the passage-bed crag of Highdale Avenue. A quarter of a mile further on there is a good section at the house called "The Quarry" in Jesmond Road; beyond which are the fine sections on the Old Church Headland, as described by Vaughan.

The *Laminosa* Dolomites are, normally, fine, grey, saccharoid rocks (sometimes with a very faint rosy tinge). The beds appear on the Hill Road Crag at Newton House, and are seen on the road above the crag on either side of Hallam Hall. Thence they can be traced as far as Holly Lane, and roughly separated from the adjacent outcrops of the Z-beds and the oolite, by means of weathered rubble in ploughed land. The rocks are well seen on the brow above the thickets just before descending into Holly Lane and along the southern cuttings of the lane. Along the southern line of outcrop; they can be traced down through the steep woods on the eastern side of East Clevedon Gap to near the Court Farm, and, beyond the Gap, round the steep dip-slope south-east of "The Arches" House. They reappear in the southern grounds of Mount Elton and on the dip-slopes of Highdale Hill, in the Avenue section, and on the steep road near the School. Hangstone quarry is a steep dip-slope section, and there is a similar though much smaller one in the grounds of Clevedon Hall, after which they are seen again at a small outlier on the dip-slope of the Church Hill, where the junction section is described by Vaughan.

The Caninia-Oolite is conspicuous on the Hill Road Crag behind Hampton House and is well seen on the open ground above, where its highest beds are softer and somewhat darker than usual, though the *Caninia*-Dolomites have not been observed here. A long old quarry at Hillcote, and some poor exposures towards Hillside Lodge bring us on to the wooded crag under Woodside, on which, and along the steep dip-slope of Bennet's Ripple, there is almost continuous exposure all the way to the great quarries of Holly Lane, where there are signs of thrusting, and an extraordinary development of calcite veins. In the eastern quarry there is a fossiliferous band which cannot be far from the base, and both quarries have now been cut back to beds which appear to be the top of the underlying dolomites, though only for a few yards. There is also a fine crag in Bella Vista Woods. Triassic denudation has reduced the oolite on the southern outcrop to three masses, all of which are outliers on a steep dip-slope. The first, nearly overstepped by Triassic conglomerate, is at the Court Farm and in the adjacent woods ; the next, above East Clevedon crossroads, is exposed in Coombe Hill behind the cottages, and in the grounds higher up. The third is first seen in the cellar of Mr. Turner's house in Highdale Avenue, then in the Avenue itself, and among the cottages lower down, with a final good roadside cutting in the steep street close to Clevedon Triangle. Everywhere the rock is characteristically massive, but the true bedding planes may often be detected by means of a regular interbanding of slightly differing oolitic texture. A massive limestone which occurs on the Hill Road Crag and on the Dial Hill outlier appears to be a modification of this oolite which is produced in the vicinity of disturbances.†

THE COAL MEASURES.

These are usually referred to the "Pennant" division of the group. They are highly false-bedded medium-grained sandstones of a clear grey tint where unstained, with abundant flakes of carbon and with some pebbles here and there (mainly of vein-quartz with a few of quartzite). Obscure plant-remains are not uncommon. The best exposure (just outside the mapped area) is at the large quarries of Conygar, but the rocks are well seen on the escarpment and at the north end of Court Hill crags and again in Bella Vista Woods. There is also a quarry close to Park Cottage, whence the rapidly narrowing outcrop is traceable by weathered rubble in ploughed land to its disappearance near the lower-level reservoir.

† For the overlying "china-stone" of the *Caninia* Dolomite see *Proc. B.N.S.* 4th ser., vol. v., p. 139.

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TABLE OF CONTENTS.

FOURTH SERIES. VOL. VI., PART II. (1924).

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

Prof. C. Lloyd-Morgan, LL.D., F.R.S., F.G.S., 5, Victoria Square, Clifton, Bristol.

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

W. G. Scott, 25, Duke Street, 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.

Sir W. A. Tilden, D.Sc., F.R.S., Professor of Chemistry in the Imperial College of Science, S. Kensington, S.W.7.

William Whitaker, B.A., F.R.S., F.G.S., Wellesley Court, Wellesley Road, Croydon.

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

REPORT OF COUNCIL

To December 31st, 1924.

UNDER the new President, Prof. O. V. Darbishire, the usual activities have continued, and in order to make the Society's existence known more fully to the public an advertisement has been inserted this year in the local newspapers to announce in advance the holding of each Meeting, and to invite the attendance of anyone interested to the annual open night. On this occasion we welcomed Prof. W. M. Tattersall of Cardiff University College, who gave us a Paper with illustrations on " Rhythm in Nature," which was listened to with pleasure by members, and a limited attendance of the public.

To bring forward the objects of Natural History in the possession of many members the hour before each meeting is now used for the exhibition of such, when it is felt that the social spirit of Naturalists may be increased, and encouragement given to the younger recruits. To make a success of this departure it is hoped that a greater effort will be made to send exhibits, with short descriptive labels, if the exhibitor cannot be present to describe them.

The Summer excursion to Berrow and Brean Down had to be abandoned, because the limited number of members who were prepared to attend did not justify the completion of the arrangements made. This is to be regretted, because excursions were asked for, and one of the aims of a Society, such as ours, is to go together into suitable surroundings to study and discuss the ways in which Nature carries out her handiwork.

The Geological Society of London has honoured Mr. J. W. Tutcher, one of our Vice-Presidents, by conferring on him the Lyell Fund Award, and to celebrate the occasion the Geological Section held a dinner in his honour.

The Society has suffered seriously from losses by death during the year, and with much regret we record the death of Mr. George E. Blood, for 49 years a member ; Mr. E. A. Wilson ; Mr. A. D. R. Bacchus, a worker on Conchology and Hemiptera ; Col. T. Jermyn, a keen Entomologist, and an authority on Indian Lepidoptera ; and within the last month, Mr. G. C. Griffiths, for 52 years a member, a past President, and since 1898, not only the President of, but an enthusiastic worker for, the Entomological Section.

We have only added 7 new members, and start the new year with a membership of 121, and the Society is losing the valued services of its Hon. Librarian and its Hon. Treasurer. Dr. A. B. Prowse has laboured for 21 years to make the Library the success it is, and the Council has paid him the highest honour in its power by making him an Honorary Member. Dr. W. A. Smith has managed the financial side of the Society so successfully that in spite of a limited income, the balance has always been substantial.

IDA M. ROPER,

Hon. Secretary.

THE HON. TREASURER in Account with THE BRISTOL NATURALISTS' SOCIETY.

GENERAL ACCOUNT FOR THE YEAR 1924.

Dr.

	£	s.	d.
To Members' Subscriptions :—			
Ordinary	42	5	0
Associated	3	15	0
,, Entrance Fees	0	10	0
,, Subscriptions in advance	2	10	0
,, Arrears collected	4	10	0
,, Donations	15	11	0
,, Sale of Publications, etc.	4	14	6
,, Balance forward	65	10	1
,, Balance Bookbinding	63	0	6
	£202	6	1

Cr.

	£	s.	d.
By Subscriptions to Societies :—			
Ray	1	1	0
Commons and Footpaths	0	10	6
S.W. Naturalists' Union	0	14	0
,, Cost of " Proceedings " with maps, 1923	60	14	6
,, Printing and Postages	7	1	6
,, Rent and Fire Insurance	0	8	6
,, Gratuities	1	0	0
,, Advertising and Library Expenses ...	4	14	10
,, Index Cards for Catalogue	7	0	0
,, Books Bought	7	1	6
,, Bookbinding	54	7	9
,, Cash in hand	57	12	0
	£202	6	1

December 31st, 1924.

Audited and found correct,

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

LIBRARIAN'S REPORT

For the Year 1924.

THE Library from its central position, continues to be well used, and it is noticeable that this is largely for reference to the books on the spot, rather than for borrowing them to study at home.

The general members, although they do not read the books as much as might be desired, have not overlooked the advantages of the Library, because the donations to it of modern books have shown a marked increase this year.

After holding the office of Hon. Librarian for 21 years Dr. A. B. Prowse has felt obliged to resign, but before giving up it has been a pleasure to him to see the books well arranged on the shelves at the Museum, and many valuable current publications prepared and passed through the binder's hands. This desirable improvement has been made possible by the liberality, at the end of last year, of Mr. Horace Gummer placing funds for bookbinding in the hands of the Treasurer. The money has been all spent, and there are still arrears waiting to be bound, so that a further sum of £25 from members could be spent to advantage.

The Society had the pleasure to give to the Bristol University a long series of publications issued by the U.S.A. Geological Survey numbering 317 bound and 150 unbound volumes with 5 atlases, and for this gift Council has received appreciative thanks.

To add to the usefulness of the Library, Council decided to appoint a small Committee of sectional members to prepare a Card Catalogue of the Articles contained in the numerous publications on the shelves, in order to secure ready reference to any subject therein likely to be of assistance to individual study. The work is progressing, and some advantages from it may be available shortly.

The Sections continue to present various monthly publications and several other useful books. Gifts, too, have been received from Mrs. Bacchus, in memory of her late husband, from Mr. T. Charbonnier, Dr. A. L. Flemming, the late Mr. G. C. Griffiths, Mr. William Griffiths, Dr. A. B. Prowse, Miss Roper, Royal Colonial Institute, and Mr. H. S. Thompson, as well as a collection of MSS. of scientific Papers prepared by the late Mr. W. W. Stoddart, whilst an active member of our Society. Thanks are given to donors for their welcome contributions.

By subscriptions we have received :—

The Ray Society, " The British Charophytes," Vol. II, by Groves and Bullock-Webster.

" The Zoological Record," Vol. 59, 1922.

ARTHUR B. PROWSE, Lt.-Col., *Hon. Librarian.*

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

ENTOMOLOGICAL SECTION.

1924.

THIS Section having been formed May 12th, 1864, celebrated this year its Diamond Jubilee. Our President, who died December 2nd, had written its History, which is published in the present issue, and points out that only two Presidents have held the office in the long period of sixty years.

The abnormally wet year was very unfavourable for Entomology, and no field excursion was held, but it is evident from the attendances and exhibits at the meetings that interest is being maintained, and good work done ; many rare and some new species have been exhibited, amongst the most noteworthy being :—

DIPTERA. *Tipula irrorata*, from Lawrence Weston, and *Orthocladius nivcipennis*, Charterhouse, Mendip, by Mr. H. Womersley.

HEMIPTERA. *Pachytonella parallela* and *Æpophilus bonnairei*, Mr. A. D. R. Bacchus.

LEPIDOPTERA. *Sterrha sacraria*, male. Fort Efford and *Heliothis peltigera*, Paignton ; Mr. A. H. Peach ; *Colias edusa* var. *helice*, Tickenham ; Mrs. Sandwith ; *Chrysophanus phlœas* var. *Schmidtii*, Lyndhurst ; Mr. R. E. Chamberlain ; *Limenitis sibylla* var. *nigrina*, New Forest ; Mr. G. C. Griffiths.

ODONATA. *Æschna grandis*, Devizes ; Mr. C. Bartlett.

PROTURA. *Acerentomon doderoi* ; Mr. H. Womersley.

PSOCOPTERA. *Cæcilius corticis*, Winterbourne and Leigh, a new species ; also *Pseudopsocus Rostochi* Kolbe, new to the British list, and the second European record ; Mr. J. V. Pearman.

On November 14th, the President read a Paper upon a subject to which he had given research, *viz.* : " The Frenulum of the Lepidoptera," illustrated by photographs, microscopic slides and the Australian butterfly *Euschemon Rafflesiæ*.

The Section especially, and Entomology in Bristol and district, has suffered very serious losses by death during the year. A. Douglas R. Bacchus, a victim of the Great War, was a student of the Hemiptera, and his enlarged coloured drawings of the various species showed his ability in this direction ; his collection is now in the Bristol Museum. Turenne Jermyn, F.E.S., passed away on August 29th after a few days illness. In India he formed a fine collection of butterflies, and settling in 1913 at Weston-super-Mare, he continued to do splendid work amongst the Diptera and Hymenoptera especially. It will be difficult to find a successor, and as a hard working, genial and popular member of the Section he will be much missed. George Charles Griffiths, F.E.S., joined the Society in 1872, was President of it in 1917–19, and President of the Section since 1899, and Hon. Curator for Entomology to the Bristol Museum. A man of quiet and retiring disposition, with much kindness of heart, and a true naturalist, he was particularly interested in the Lepidoptera, of which he had a fine collection of foreign Rhopalocera, especially *Papilioninæ*. A Paper on his special study of the frenulum of the Lepidoptera read at the Entomological Society of London appears in their Transactions for 1898 ; this was followed by further investigations, which were recorded in Tutt's British Lepidoptera, vols. I, II and V. The Section is indebted to their late President for kind hospitality for some years, the meetings having been held at his house, where his extensive collections were always available for exhibition and study. Those who have passed away leave a high example, and to those bereaved our sincere sympathies extend.

CHARLES BARTLETT,
Hon. Secretary and Treasurer.

GEOLOGICAL SECTION.

1924.

THE Officers of last year were re-elected, with the addition of Mr. J. W. Tutcher as Vice-President. Under the new regulations whereby individuals may join a Section without of necessity becoming a member of the Society, the membership has increased to 45. It is hoped that during the coming year many of these new members will seek the fuller privileges of the Library and "Proceedings."

Our Vice-President was awarded the Lyell Fund by the Geological Society of London, and at a dinner arranged for the purpose, Mr. Tutcher received the congratulations of the Section on this well-deserved recognition.

The Section continues to place the Geological Magazine and Palæontographical Society's Monograph in the Library, and with all subscriptions paid has a credit balance of £1 3*s*. 2*d*.

At the opening meeting of the year, Dr. H. Bolton gave a thoughtful paper on "Palæontology," and showed how a new era was dawning in that science. He urged the greater use of imagination in dealing with fossils. Mr. E. K. Tratman, B.D.S., gave an interesting account of a visit to some Derbyshire Caves, and dealt with the problem of the formation of Blue John. The lecture on "Earthquakes," by Mr. T. V. T. Baxter, M.A., B.Sc., was repeated to the Parent Society, and a summary of that will be printed in the "Proceedings." Dr. S. Smith showed how geology has played a leading part in the movements of races and ventured the opinion that all wars were ultimately traceable to mineral resources. Mr. E. B. Tyrrell, B.A., traced the dependence of Geography on Geology, illustrating his remarks by well-chosen examples, while Mr. G. E. Bush detailed the recent growth of the Kilve oil-shale industry. In the subsequent discussion the need for more exacting work on the Lower Lias of this area was emphasised.

The joint excursions with the Bristol Field Club (Geological Section) included visits to Fishponds (Pennant Quarry), Yate, Portishead, Avon Gorge, Swildon's Hole and Aust, and have been unusually well attended.

F. S. WALLIS,

Hon. Secretary and Treasurer.

ORNITHOLOGICAL SECTION.

1924.

IN some respects the past year has been an unfortunate one for the Section. It is with the deepest regret that we have to record the death of Colonel Jermyn. Living at Weston he did not attend the Sectional meetings. but in many other ways helped on its work. Another of our most active members, Miss Selman, has left Bristol, and we can ill afford to lose one who took so practical an interest in Ornithology, and who was always ready to do anything for the Section that she could. After the foregoing it may seem rather an anti-climax to refer to the weather, but at the same time it has consistently contrived to step in just at the critical moment throughout the bird-season and destroy the effects of weeks of observation.

However, on the other side of the scale we can set some very definite achievements. Two of our members, following up previous years observations, established the fact that the Curlew is still to be found breeding on Mendip. The last record of which we are aware is that of Dr. D. Munro Smith in 1909, but we think there is no doubt it has bred there regularly. The confounding of certain confirmed sceptics was in itself pleasant, but what certainly added to the pleasure was the fact that a well-known " Bird-Man," spent some time on the Mendips this year with the main object of observing the Curlew, but was unsuccessful in hitting up a pair.

In the 1923 Report it was stated the Section was about to take up the Witherby Marking Scheme for Birds in order to try and help discover more about their life-histories. Three members have between them ringed 62 birds. The average returns of marked birds varies with different species from about 2 per cent. to about 5 per cent., but it may well be some years before any of the birds marked by the Section are reported.

There have been five meetings during 1924, and amongst the many exhibits shewn at each meeting were the following :—Transverse section of the eye of the Lesser Horseshoe Bat (*Rhinolophus hipposideros*) by Dr. Flemming, specimens of the Barbastelle (*Barbastella barbastellus*) and Natterer's bat (*Myotis nattereri*) by Miss Selman, a photograph of the Stormy Petrel (*Hydrobates pelagicus*) by Mr. Gait, and a specimen of the Little Auk (*Alle a. alle*) by the Honorary Secretary. The subject matter of the meetings varied as usual from points of structural interest to matters that dealt with purely field work. The Section aims to have first a short paper occupying about 15 minutes which should raise as many debateable points as possible, to be followed by discussion and exhibits illustrating the paper, and then by other discussions on any point of Ornithological interest. The success of meetings depends therefore on individual efforts, and members can bring out their own points of interest apart from the giving of papers. One way of attaining these objectives might be by making more use of the books in the Library where (amongst others) one may see last year's volume and current numbers of British Birds, subscribed for by the Section.

COLDSTREAM TUCKETT,

Hon. Secretary and Treasurer.

Account of the Annual and General Meetings.

THE 61st ANNUAL MEETING.

January 17th, 1924.

Professor O. V. Darbishire, Ph.D., F.L.S., was elected President, and Mr. J. W. Tutcher a Vice-President, with minor alterations in Council. The retiring President, Mr. H. Womersley, gave his Annual Address for his year of office, 1923, entitled, "The Modern Study of Entomology," (*See Page* 28).

THE 507th GENERAL MEETING.

February 7th, 1924.

"Modern Views on Evolution," by Prof. O. V. Darbishire, Ph.D.

The lecture was an account of de Vries' Mutation Theory. It referred to the story of how de Vries found Œnothera Lamarckiana in 1875 in a field near Hilversum in Holland, and his discovery of two species in the same field.

In 1886 de Vries transplanted 9 plants of O. Lamarkiana to his experimental garden at Amsterdam, in the hope of actually observing the origin of new species. His hopes were realised when during his breeding experiments, he came across a number of Sports or Mutations, which bred true from seed, and have continued to do so.

The Mutation theory of de Vries has been the subject of extensive research all over the world, and has resulted in a flood of literature. His original material has been criticised as being not a pure plant, but a hybrid. At the same time there is no doubt that mutations of the constancy described by de Vries do occur plentifully among animals and plants. The occurrence of a mutation we have good evidence to believe, is accompanied by a more or less profound change in the Nucleus of the plant or animal cell. It is a phenomenon totally different from hybridisation.

de Vries believes that by mutation new species may originate. There is evidence that this is the case. At the same time, we must admit, that to define the word "species" is not an easy matter.

Supposing even that de Vries theory could account for the origin of species, using this term in the conventional Linnean sense, we cannot even then be sure that mutation plays any part in the evolution of new genera.

Members congratulated Mr. J. W. Tutcher, one of the Vice-Presidents, on the honour conferred on him by the award of the Lyell Fund from the Geological Society of London.

THE 508TH GENERAL MEETING.

March 6th, 1924.

"Rhythm in Nature," by Prof. W. M. Tattersall, D.Sc., (*University College, Cardiff*).

Rhythm is one of the most widespread phenomena in nature, so general and so familiar as almost to escape notice. The earth itself is part of a rhythmic universe. The regular alternation of night and day, the phases of the moon, the rise and fall of the tides, the succession of the seasons and all that they mean to plants and animals, seedtime and harvest, are rhythmical phenomena with which we are all familiar. Our very lives are almost dependent on rhythm. The regular alternation of sleep and activity, the regular hours for our meals, our work, our pleasure, in fact the very orderliness and rhythm of our very existence, are sufficient evidence of the fundamental importance of this phenomenon. From a biological point of view two classes of rhythm may be distinguished. (1) Those due to response to an external factor. (2) Those not dependent on environment, but of a vital nature corresponding to something inherent in the organism. Examples of the latter class may be cited in the rhythmical beating of the heart and the action of the lungs. Rhythms of the first order, while not more important than those of the second, are more interesting because it is possible to discover the primary causes of rhythm and to speculate on the possible meaning and results of the whole phenomenon. Examples of this kind of rhythm are very numerous, and include the periodic nature of the luminosity of some marine organisms; the formation of wood in trees in temperate climates; the growth of fish scales; the rhythmic behaviour of Convoluta, and the migrations of birds and fishes. Examined in detail, the rhythmical behaviour of these organisms is found to be due to some external factor, such as light, tidal movements, and so on, and analysis shows that the rhythmic nature of the external stimulus results in the rhythmical response of the organism. Rhythms can therefore be regarded as tropisms, *i.e.*, obligatory responses to regularly applied stimuli. Observations on certain organisms exhibiting rhythmical behaviour have shown that an established rhythm in a physiological process often persists after the original stimulus has been removed. For instance, Convoluta will exhibit rhythmical movements for a time after removal from the shore to an aquarium where it is freed from the effects of the tides to which the rhythmical behaviour is due. In other words, the organism "remembers," and automatically responds. May we not see in these observations the beginnings of what are known as instincts, and possibly though this is much more speculative, the beginnings of conscious memory? It is at least an interesting speculation. Life is essentially a rhythmic phenomenon, and it seems almost inevitable that, with the progress of time and research, all important biological phenomena, whether concerned with the inner functioning of the organism or with its behaviour in relation to its environment, will be shown to be rhythmic in character, or at least evolving in that direction.

The lecture was illustrated by a series of admirable lantern slides.

THE 509TH GENERAL MEETING.

April 3rd, 1924.

"Some Key Features in the Structure of Birds," by Dr. A. L. Flemming, M.B., Ch.B. (Bris.).

The task of classification was difficult from the fact that something like 19,000 species of birds had been described, but owing to the scientific work of men like Pycraft, Chalmers-Mitchell, Beebe, Garrod, and Nitzsch, much of the existing confusion had been cleared up. The work was highly technical, and based on fundamental anatomical data, and not on superficial features, which might be so misleading. There were certain tits, for instance, exactly alike in anatomy and in the pattern of their plumage although totally different in colour, and, on the other hand, two varieties of woodpeckers existed, indistinguishable as regards colour and yet possessing differently formed feet. And adaptations to similar surroundings might lead birds of such different origin, as the diver and the auk, to be erroneously classed together. Classification, he said, was based on such things as anatomy of skull, arrangements of muscles, variations in intestinal coils and feather tracts. The reptilian origin of birds was suggested by many points in their structure, such as skin, articulation of skull with jaw and with spine, brain, and claws on wings of certain nestlings. The features peculiar to birds were their lungs and air sacs, their crop and digestive system, and the structure and composition of their feathers.

Exhibit by Mr. W. Griffiths of a male specimen of the moth, *Lycia hirtaria*, bred so early as 2nd April.

THE 510TH GENERAL MEETING.

May 1st, 1924.

I. "Homœomorphy" by Mr. J. W. Tutcher.

Homœomorphy might be described as the imitation of one species by another, and was the phenomenon of species nearly alike in superficial appearance, but unlike in structural details.

Phylogeny was the history of the race, ontogeny was the history of the individual. The science dealt with the tendency of different stocks to develope in similar ways. The modern procedure of tracing phylogeny by ontogenetic methods had resulted in the detection of numerous cases of homœomorphy amongst fossil organisms. Unrecognised homœomorphs, occurring at different dates, might be responsible for the misidentification of strata to such an extent that serious economic and financial loss might be caused in mining or well-sinking operations. The development of ornament on the shells—taking ammonites as an example—illustrated one of the numerous ways in which homœomorphs were produced. Different stocks tended to develope ornamentation in the following order—smooth to striate, then to costate (or ribbed), then to tuberculate (that was, with tubercules on the ribs)—in progressive series (or anagemesis) and then to reverse the order from tuberculate back to smooth in a retrogressive series (catagenesis). At some point of the development (in either direction) species of different stocks might reach a similar stage of ornamentation. In such cases, other characteristics being equal, these would have superficial resemblances, thus becoming homœomorphs.

II. "Mysteries of Seeds," by Mr. J. W. White, F.L.S.

Although the persistent application of biological research to botanical problems during the last few decades had solved many riddles, there still remained in Nature's processes plenty of incomprehensible things. Some plants produce a prodigious quantity of seeds. Such an example was the teasle-headed trifolium found near Shirehampton, and if all its seeds germinated, there would not be standing room between Bristol and the sea in a few seasons. And yet, owing to some unknown restrictive law or influence, a little-varying average number of such species perpetuated the race year after year by a germination limited to a minute proportion of the seeds available. More information was also needed on those mysterious appearances of flowering plants after deep excavations of the soil; luxuriant crops, often new to the locality, that had been attributed to spontaneous germination or to special creations, but which undoubtedly pointed to a prolonged vitality of wild seeds when buried under certain conditions. Then there was the question of the masses of vegetation that sprang upon deposited dredgings from harbours and tidal rivers, and the occupation of burnt woodland in temperate countries by particular species. Another undoubted mystery is that while the most aggressive weeds in the New World are immigrants from Europe, no American weeds in turn have invaded our cornfields. As to the nature and duration of seed vitality, some Orders of seeds deteriorate more quickly than others; seeds of wild plants remain fertile longer than cultivated ones; and seeds buried in the soil deepest retain their vitality longest.

III. "Psocids," by Mr. J. V. Pearman.

These small orthopterous insects are characterised by the presence of prominent globular eyes and of horny appendages on the first maxillæ, the mandibles also not having an equal number of teeth. There are two to three joints in the feet. There are winged and wingless species, and some in which the males are winged, and the females wingless. When present, the wings are four in number. Colouration varies very much. The psocids feed on algæ, lichens, and dead insects, and are in the main, woodland animals. The eggs, laid in batches of six to nine, hatch out into wingless insects, much resembling the adult forms. The two well-known "book lice" are minute whitish psocids, which feed on dust. There are 50 British species, the classification of which in the insecta is a matter of great difficulty. Quite recently Mr. Pearman has himself added three new species to the British list of psocids, of which one, new to science, was found at Winterbourne, and named by Mr. Pearman *Cæcilius corticis*. This species is peculiar, as the young insects continue to reside beneath the egg-covering web until mature.

THE 511TH GENERAL MEETING.

October 2nd, 1924.

"Recent Earthquakes," by Mr. T. V. T. Baxter, M.A. Camb., B.Sc. Lond.

(Abstract printed on page 161).

Exhibits by Prof. O. V. Darbishire of Lichens from N. Wales; by Miss Roper of fungi and mosses; by Mr. H. S. Thompson of a flower of the Fringed gentian to show mimicry of a species of Primula.

THE 512TH GENERAL MEETING.

November 6th, 1924.

Exhibits of Natural History by the Members.

All sections were well represented. In geology may be mentioned one to show the six systems of the crystallisation of minerals by Mr. H. W. Turner, giving a clear understanding of the specialised work of nature; local fossils attractively set out from the Rhætic and Lower Lias of Aust Cliff by Mr. J. W. Tutcher; and others by Mr. H. F. Barke from the Cotswolds near Cheltenham; and a fine fossil of the wing of an insect, obtained from the coal measures of Coalpit Heath, by Dr. H. Bolton.

In Entomology among other exhibits was a long series by Mr. H. A. Francis, of British wild bees, a more brilliant coloration by Mr. G. C. Griffiths, of day-flying moths and of swallow-tail butterflies from the Tropics, and another of butterflies from Hampshire by Mr. R. E. Chamberlain, while the injury suffered by economic culture was exemplified by Mrs. Sandwith with the living grubs of a hover fly, a pest of daffodil bulbs.

In Bird Life, Mr. R. P. Gait illustrated by excellent photographs the doings of the stormy petrel, tern, and various gulls in their natural haunts on the Scilly Isles, supplemented by photographs by Miss G. Griffiths, of other birds at the Lizard; and Mr. C. Tuckett had micrographs of numerous lice which, as parasites, worry living birds.

In Botany were exhibited some of the results of summer rambles by the members, including Mrs. Sandwith's beautifully-preserved specimens of many species of the clovers collected locally; Miss Roper's instructive lot of the poisonous plants of the countryside; Miss Bolton's various fruits to illustrate the marvels of ingenious means of fruit dispersal; and Prof. O. V. Darbishire's examples of seaweeds, living and mounted.

Among other items was an exhibit by Mr. H. S. Thompson, of a beautiful edition of Curtis's "Flora Londinensis," of 1777–1798, with the 342 hand-coloured plates of the wild flowers Curtis was able to gather for the most part round London before it became suburban; although Bristol contributed some share to the charm of the volume by several rare plants collected here, and for the first time described and figured in the book.

Coffee was served during the meeting.

THE 513TH GENERAL MEETING.

December 4th, 1924.

I. "Geological Methods of Water Finding," by Mr. H. F. Barke, F.I.C.

Underground water exists mainly in a state of rest, saturating porous rocks and filling all pores and fissures, and not in the form of underground streams, as frequently seen in caves. Rocks classify themselves into two classes—the permeable, such as loose sandstones, which hold and yield water; and the impermeable, such as clay, which do not yield any, but serve when lying below a permeable rock to prevent the water from sinking further. By means of diagrams thrown on the screen it was shown that when porous strata lie on clay springs occur on the line of junction, and that where a ridge or hill is composed entirely of porous rock the line of springs is in the bottom of the valley, and that in consequence wells sunk on such hills have to reach to a depth equal to that of the valley below, so that no villages have been built on them. A failure of geological methods to find water in certain cases was on account of hidden foldings and faulting of the impervious strata.

II. "Some Local Birds," by Mr. C. Tuckett.

The lecturer showed some remarkably intimate lantern slides of his subject, and gave his audience a very fair indication of the extreme delicacy of the ornithologist's task. To secure a view of a bird under its natural conditions, he said, required no little skill and patience. One invaluable way of locating a bird was by getting to know its call note, and once that was heard, it was then mainly a question of settling down somewhere in the neighbourhood of where the bird was. Time would then give the desired opportunity of catching a glimpse of it, but the utmost quietness was essential, as birds disliked movement intensely.

Exhibits by Mr. F. W. Evens of three species of Mycetozoa from Leigh Woods, *Arcyria incarnata, Trichia persimilis* and *T. scabra*; by Miss Roper of the Truffle root gall from the base of an oak.

The Diamond Jubilee of the Entomological Section

By the late George C. Griffiths, F.E.S.

THE formation of Sections in the Bristol Naturalists' Society took place in 1864. In May of that year the Society passed rules for the registration of objects of Natural History, the subjects suggested being Zoology, Botany, Palæontology and Mineralogy. On the 12th of that month the Entomological Section was founded, and is therefore the senior of the group. The first President of this Section was Mr. Stephen Barton, F.E.S., whose residence in Australia had enabled him to add many new species of Coleoptera to our lists. The " beetles " were always his favourite order, and of these he amassed a vast collection, but he also took great interest in the other groups of insects, and was respected and beloved as President of the Section until his death in 1898. He was succeeded in the office by the writer, who at the present still holds it. The first Secretary of the Section was Mr. Edwyn C. Reed, who, however, only held the post for a few months, as he left for South America in 1865. He became Curator of the Museum of Santiago, and afterwards of that of Concepcion, Chili, and was the author of a Monograph of Chilian Butterflies, " Mariposas Chilenas," and lists of Chilian insects. Copies of these works he presented to the Entomological Society of London, of which he was a Fellow until his death in 1910. Throughout his life he retained his interest in the Bristol Society, and when in England would read papers to the Section on various subjects.

Mr. John Barber was elected Secretary of the Section in January 1865, but resigned in July of the same year, when Mr. George Harding, F.E.S., succeeded him, and retained office until 1896. He did much good work in local *Lepidoptera*, and also collected *Exotic Coleoptera*. He was succeeded by the present Sectional Secretary, Mr. Charles Bartlett, who collects both *Coleoptera* and *Lepidoptera*, and has done much valuable work in arranging the collection of British *Coleoptera* in the Bristol Museum.

Looking through the older records of the Section, one must be struck by the magnificent enthusiasm of its members for collecting locally. Many were the prizes found round Bristol for the first time, and the care bestowed on the *larvæ* and *pupæ* enabled fine results to be shown at the meetings, and at the British Association, when at Bristol. The large collections in the possession of the two Presidents gave opportunities to gain a wide knowledge of exotic and foreign Insects, and the affinities of these were often discussed from the formation of the Section until the end of the last century. After that date short Papers on the structure, life-history and nests of various insects were added to the scope of the meetings, and all the time Entomological books and magazines were being purchased and circulated. The study of special Orders received sympathetic encouragement, and if certain seasons proved insects to be scarce locally, the probable causes were jointly discussed. Altogether the members were clearly a happy family, carrying out regularly active work and urged on by high aims.

The late Mr. A. E. Hudd, F.E.S., was the author of a "Catalogue of the *Lepidoptera* of the Bristol District," published in the Proceedings of the Society between 1877 and 1884, and in this he was assisted by other members of the Section. To the close of his life, Mr. Hudd preserved notes of additional records of *Lepidoptera* to the district, and these are now in the possession of the writer. To Mr. Hudd also we owe the excellent list of the *Lepidoptera* of Somerset, which appeared in the Victoria County History in 1903, and was followed by two supplementary lists.

One of our Hon. members, Mr. H. J. Charbonnier, is the author of a List of *Diptera* of the Bristol District (Proc. B.N.S., Ser. IV, Vol. III, Part II, 1912) and some of our present members, Messrs. Womersley, Audcent, Pearman and Bartlett, with others, have helped in adding to our knowledge of local *Diptera*. Dr. C. K. Rudge has attended the meetings over many years, and once astonished the members by showing an insect living and breeding in cayenne pepper! If the past history of the Section shows vigorous life amongst a moderate number of citizens in pursuit of recreation, the modern account can be regarded equally with admiration and encouragement. The members of the Section, now numbering 26, are not content with the well trodden paths of *Lepidoptera* and *Coleoptera*, still pursued by some, but are seeking out "fresh fields and pastures new."

Mr. A. D. R. Bacchus, F.E.S., whose recent death is much to be deplored, devoted his principal attention to the *Hemiptera*, which he illustrated with beautiful enlarged drawings, Mr. H. Womersley is working on the *Thysanura*, and Mr. J. V. Pearman on the *Corrodentia*, each of whom have added new species to our records, Mr. C. Tuckett on the obscure and difficult group of the *Mallophaga*, whilst Miss Ida M. Roper, F.L.S., has given special attention to the Gall-gnats, and Miss M. M. Selman to the Dragonflies. With these branches added to enlarge its interests the continued success of the Section is assured, and will equal in its work that of the previous sixty years.

In Memoriam

GEORGE CHARLES GRIFFITHS,

F.E.S.

Entomology in Bristol and the West of England has suffered a serious loss through the death of the writer of the above article. Our esteemed President, Mr. George Charles Griffiths, F.E.S., died at his residence, 3, Leigh Road, Clifton, on December 2nd. Mr. Griffiths spent all his business career at the Old Bank, Corn Street, Bristol, as their accountant, until his retirement, about 12 years ago. His life-long hobby was entomology, and he had amassed a large and fine collection of British *Lepidoptera* and butterflies of the world. On his special subject he had the fullest knowledge, and was ever ready to help and encourage students ; at the same time, his kindly disposition endeared him to everyone with whom he came in contact.

He was a past-President of the Society, having been a member for over 50 years ; President of the Entomological Section, succeeding the late Mr. Stephen Barton in 1898 ; a member of the Entomological Section of the Somerset Archæological and Natural History Society, and of the South-Western Naturalists' Union, being their referee for the *Lepidoptera*. Mr. Griffiths was also the honorary curator of the insect collection in the Bristol Museum, and its arrangement and care were largely the work of his hands, as the Greville Smyth Room bears witness.

The deceased leaves a widow and daughter to mourn his loss. The funeral was at Portbury Church, the Rev. Charles Sutcliffe, late vicar of Holy Trinity, Stalybridge, officiating, and the following public bodies were represented : The National Provincial and Union Bank ; Bristol Museum and Art Gallery ; Bristol Naturalists' Society, and the Entomological Sections of the Bristol and Somerset Societies.

C.B.

PRESIDENTIAL ADDRESS, 1924.

"Adaptation in Plants and Animals."

By Prof. O. V. Darbishire.

A SHORT time ago Professor Lloyd Morgan gave the field naturalist, especially the ornithologist, some idea as to how to proceed in his work. He should study in detail the habits and behaviour of some particular bird, and thus make out its biography. Observations made in this way in the field and possibly rather mechanically recorded, should then be analysed biologically, and studied in reference to those conditions, external and internal, which in any way appear to effect that particular bird. This method, biographical first, and then biological, can be applied with equal purpose and interest by the field naturalist who is not an ornithologist in particular, or even a zoologist in general, but say, only a botanist. May I explain this by reference to a simple example taken from the plant world.

Everybody is familiar with the ivy-leaved toad-flax. It occurs on walls, and has its root organs hidden in the crevices between the stones of the wall. It is a plant characteristic of this particular type of locality, and it is evidently well adapted to growing there. Careful study of this one species, or preferably one or a few more individuals of this species, throughout one whole year at least, will give us its biography. We next analyse the biographical notes biologically, and we may then be able to see in what respect certain characteristic features of this plant, as regards structure and behaviour, can be interpreted as being adaptations to the special surrounding conditions. It is about such adaptations that I wish to speak to-night.

We examine the leaves of our plant, all of which expose their upper surface to the light. The leaves are succulent and fleshy. Succulent leaves we find are of common occurrence in other plants growing in the same locality, such as the stonecrop, navelwort, and other species. This succulence is, in fact, an adaptation to tne water shortage, one of the conditions prevailing in the wall. There is little soil and vegetation, which might store rain-water. The succulent leaves are able to store water and thus prevent it being given off too rapidly by transpiration. We will further observe the plant flowering in the summer, when the flowerstalks carry the flowers well into the light into such a position that they can be seen by the insects, like the honeybee, the visits of which are necessary for pollination. Later in the autumn the flowerstalks, now bearing little capsules containing seeds will bend away from the light and push the capsules into the darkness of some recess or crack in the wall there to burst and shed their seeds. This is again an adaptation to the conditions under which this species is growing. The seeds are shed in a place where on germination the seedling will find suitable conditions for growth.

The following are some simple and striking examples of adaptation exhibited by animals; the white protective colouring of the fur of the arctic fox and hare, the spreading toes of the camel of the sandy desert, the protective mimicry of the leaf– and stick–insects, and so on.

There is no difficulty in understanding the meaning of the word adaptation in the case of the few examples here cited. In studying cases of adaptation we will come across one remarkable fact. In most localities we find many animals and plants often very unlike in appearance to one another, yet clearly all well adapted to living under identical conditions. Adaptation to the same prevailing surrounding conditions need in fact not be the same in all animals and plants. Thus the navelwort makes sure of its seedlings obtaining a foothold in some cranny of the wall by having very numerous and very light seeds, which are carried easily by the wind to which they are exposed when the capsules burst. The seeds are thus blown into the cracks of the wall when germination commences very soon. Navelwort and toad-flax grow under similar conditions but each has its own particular method or adaptation for securing a suitable locality for the seeds to germinate in. In the case of the outer limits of a saltmarsh we have only one plant completely adapted to the adverse conditions obtaining there, namely the glasswort. But generally speaking we find many plants and animals characterising one particular locality. These organisms are adapted not only to the physical, chemical and climatic conditions of the locality, but also to living in close association with other animals and plants. You will see then how complicated the study of adaptations really is. It necessitates careful observation not of the plant or animal taken each by itself, but on the contrary in close reference to its surroundings. This forms the subject of Ecology, another name really for Biology.

We can easily analyse our observations made in the field to the extent of saying what are the typical adaptations exhibited by the animals and plants of any particular locality, without necessarily being able even to suggest the advantage to the living organism of any one modification. It is, for example, easy to understand the long roots of the marram grass in the salt water—free sand of a sand dune area, in view of the shortage of water near the surface of the sand. But it is not so easy to explain the leaf succulence of plants like the searocket growing in the generally rather narrow strip occupied by succulent strand plants between the outer area where the sea wheat grows and the inner one occupied by the marram grass.

All representatives of the flowering plants show an adaptation to their dry-land-and-air habit. They possess pores or stomata by which air has free access to the interior of the plant, and water in the form of watery vapour can pass out by transpiration, though under the control of the living plant. Leaves, stem and root have their air passages, all of which are connected with the pores just mentioned, and air has thus access to every internal part of the plant. In seaweeds, as typical water plants, pores and air passages are entirely absent, and air is obtainable only when dissolved in the surrounding water. The bladders found in some seaweeds are not comparable with the air passages of the land plants. Pores and airpassages are thus an adaptation to the dry-land-and-air habit of the land plant, their absence to the water habit of the true water plant.

When a land plant descends completely into the water and makes the water its home, what happens to its pores and air passages ? Does it discard all these structures and assume the structure of the typical water plant ? No. It does not. Tradition and historical prejudice of the race, *i.e.*, phylogenetic traditions inherited by every plant from its ancestors prevent this. We may get a modification of the characteristic adaptation to the land habit. The pores generally go, it is true, but the air passages remain, because the plant has not quite learned to breathe air dissolved in water. So the land plant in descending into the water to become submerged suffers from a shortage of air, mainly oxygen for breathing purposes, and has adapted itself by increasing the extent of the air passages in order to store the oxygen, which is liberated during the chemical processes that go on in the green plant. We can see this very well in the case of the mare's tail, a plant which now of aquatic habit has descended from land plants. We may say that the mare's tail has adapted itself to living in the water, but what it has really done is to modify an old land plant adaptation. Portions of our plant which are not submerged but stand out of the water have pores just like an ordinary land plant. Aquatic flowering plants which have all descended originally from land plants are still unable to carry out their sexual reproductive processes when submerged, and therefore come to the surface to flower. Land plants descending into the water cease to form cork and root hairs. They reduce the amount of vascular tissue developed. But these structures make their appearance when the plants return to the land.

Experiments carried out in this Laboratory by Mr. Norris, and reported on in the " Proceedings " of this Society, show how a plant can be made to change its structure according to the nature of its surroundings. Maize seedlings grown in well aërated soil, like sand, will exhibit a certain but limited number of small air spaces, as shown in a section of the root. If we grow such a seedling standing in water where there is much less free air available than in sand, air spaces will increase considerably. According to the kind of soil we take we can get varying degrees of adjustment of the volume of air space to the needs of the plant. All this is adaptation or rather modification of an already present adaptation. The maize plant exhibits in the first place an adaptation to the land-and-air habit, but it possesses an extraordinary adaptability, and it is thus able to live in soils of a varying state of aëration. This adaptability itself is then really a most valuable adaptation. Instead of being adapted to one particular and narrowly limited condition of aëration only the maize plant can grow in soil of almost any degree of aëration. Only a thorough biographical study of the plant will show us this.

May I take another example, namely that of the beech leaf. An ordinary green leaf shows below the epidermis of the upper side one or more layers of narrow palissade cells containing numerous small green starchbuilders or plastids. The green colouring matter which they contain is very sensitive to light. The small starchbuilders therefore move to the long side walls of these palissade cells in strong light so as to be as little exposed as possible to this light. They move to the ends of the cells in diffused light in order to catch every ray of this light. In the case of the beech the leaves on the sunny side of the tree have two layers of palissade cells, and thus they have considerable power to protect the plastids against the strong light. The leaves of the shady side of the tree have one layer only, as there is not the same need to protect the plastids against the light. So here again we have a wonderful modification of an adaptation. The quality of the adaptation does not change, but only its quantity. The seedling leaves of the beech have an adaptation suited to diffused or weak light, as the young plants will generally at first be growing in the darker portions of the forest. The shade condition occurs in seedlings even when the parent plants have been growing fully exposed to strong light. The first leaves of a twig too are shade leaves, but during the summer the later leaves, if necessary, modify the general adaptation in accordance with the degree of strength of the sunlight.

The value of this adaptability or power to modify an already existing adaptation is of course very great. It enables the beech leaf to deal with strong light. It enables the maize root to grow in almost any type of soil. It has enabled certain flowering plants of the dry land successfully to invade the water, and not only freshwater, but to a more limited extent, brackish water, like the horned pondweed, and, even pure seawater, like the grass-wrack. Seaweeds, true water plants as you will remember, cannot modify their narrowly limited adaptation to their water habit, and have therefore not really succeeded in invading the land. There are a few plants which might be called exceptions however. A small species of Fucus is found on saltmarshes near the sea, and *Pelvetia canaliculata* grows above ordinary highwater mark where it is but rarely submerged. But neither of these plants have adopted any of the adaptations characteristic of dry-land-and-air plants, nor have they really modified any of their typical water habits. Nothing new comes in when the land plant first made itself at home in the water. It merely modified an adaptation already there. This great power of secondary adaptation, this adaptability places the flowering plants on a higher plane than the seaweeds in this respect. However the latter may be as perfectly adapted to their life in the sea as the former are to theirs on the dry land. Conditions on the latter are more variable and increased adaptability is a great asset.

Let us now take an example from the animal world. The whole shape and structure of the fish represent adaptations to a completely submerged form of life. The lung-fishes are, of course, excluded from this generalization. The fish is a water animal proper, just as the seaweed is a water plant proper. But just as dry-land-and-air plants have invaded the sea so have land-and-air animals. The whale is a land animal the ancestors of which invaded the sea. The whale has not freed itself of its land-and-air traditions, and has not learned to breathe when submerged. But it has so far modified its limbs suitable for progress on land as to be externally as like a fish as possible. The tail of the fish stands vertically up, it is true, and that of the whale horizontally. But that is a minor detail. The whale has not adopted any new organ, but only modified its old organs adapted to life on the land. Tradition is so powerful that it has not been able to get rid of the necessity of coming to the surface of the water to breathe. This shows again the paramount power of tradition in evolution. It is this phylogenetic tradition which has such a fatal effect on a race when it has become so all-powerful in the life of any species that the latter has lost entirely, or almost entirely, the power of adaptability, that is of modifying old functional adaptative structures.

A change of climate, or of other surrounding conditions, a slow and gradual change of course, may effect deeply the well established fauna and flora of any district. We know that great changes have occurred. In the carboniferous period there was no alternation in the seasons as we have to-day. This we can see from the absence of annual rings in the stems of fossil plants. The climate was uniformly warm and damp in this epoch. Again the slow shrinkage of the earth causes its crust to give rise to higher hills, deeper valleys, and more rapid streams, thus producing altered, and often quite new conditions. Those organisms which were incapable of modifying their structural adaptations in accordance with any climatic or other change will gradually have died out. This may account for the disappearance of most, if not all, animals and plant types, known now as fossils only. Many of the fossil and extinct animals and plants appear to have been as perfectly adapted to their environments as those of to-day are to theirs, but with their perfect adaptation may have been associated a loss of adaptability. Almost every area of the world is inhabited to a greater or lesser extent by animals and plants, and these must have spread from certain common points. This transmigration to new localities, often probably with new surrounding conditions, could only have been successful if the plants and animals thus migrating to fresh fields and pastures new had to some extent at least the power of adaptability.

The evolution and ancestry of the horse is fairly well-known in outline, and it would, I think, be instructive to refer to it at this point.

The Eohippus of the Eocene period, was a small animal about the size of a whippet, that is about 12 inches high. It lived in the forest, and in the grass, and had four perfect toes on each fore-foot, and one rudimentary one, the five digits indicating the five-toed fore-foot of an ancestor. The hind-feet had three proper toes, and one rudimentary bone each.

The Mesohippus of the Oligocene still lived in the forest, and had three functional toes on fore and hind-feet, though an additional rudimentary one on each fore-foot. The animal was 18 inches to 24 inches high. The smaller number of toes reaching the ground indicate increasing fleetness of foot.

The Hipparion of the Miocene, still had three proper toes on each foot, and still a rudimentary one on each fore-foot, but of the three properly developed toes only one in each case actually reached the ground. The presence of a solitary digit touching the ground we know to be an adaptation to fleetness of foot, a necessary and important adaptation in the open and exposed prairie which this animal, now more of the shape of the horse of to-day, inhabited. Its milk-teeth still preserved the ancestral form with little or no cement, the permanent teeth, however, already showed the heavily cemented condition of the horse of to-day, an adaptation to the special food obtainable on the prairie. The Hipparion migrated all over the world from its cradle in America, leaving no successors however, there. The race died out in America. It continued to develope, or its successors continued to develope, in the Old World. The horses in America now are recent introductions from the old Old World.

The Pliohippus of the Pliocene was the first really one-toed horse, though each foot still had two more rudimentary, but quite functionless toes. In shape and size of body and skeleton, this horse was almost like the horse of to-day. Its height was about 40 inches.

Then in the Pleistocene came the Equus, the species of which were the immediate ancestors of the recent horse of to-day, with its long head and big cemented teeth, and height up to 60 inches. The whole structure of body and shape are most perfectly adapted to fleetness of movement.

This sketch of the pedigree of the horse of to-day, all the ancestors of which have died out, except those developed since the Pleistocene, shows clearly how the five toes of the hypothetical earliest slowly moving ancestor of the horse living in the forest, and probably actually on the trees have gradually by a modification of the foot well adapted to the forest habit given rise to the one-toed foot of the fleet horse of the open prairie. In this area none but the fleetest could survive, and only in those forms in which a modification of the many-toed foot occurred was survival possible. Nothing really new came with the horse of to-day, and we can only trace modifications of already present adaptations. Not the best adapted, but the most readily adaptable, the best able to modify old adaptations, survived. The example of the horse illustrates the development of a morphological feature in close correlation with a special functional adaptation to new surroundings in the case of a single animal.

Living together in communities ants, both in their bodies and in their activities, represent a very high state of social evolution. There are between 3,000 and 4,000 species of ants, many of which appear to be very highly adapted structurally and functionally to living together in very special ways. Not only are their limbs highly specialized and adapted, but the ants have learned to carry out certain communal activities which have become the inheritable property of the various species and races. Thus the driver ants of Brazil march in the form of well organized armies, led by big-headed officers and scouts, and raid the nests of other ants to secure their larvæ and pupæ as food. Certain slave-making ants have got so used to having everything done by their slaves that they have quite forgotten how to do anything themselves. The herding ants live in close symbiotic association with other insects, as aphides, the latter serving as domestic cattle serve man. We have agricultural ants which in the case of the harvester ants are known to sow the seeds of their favourite grass, the ant rice, and so on. These communal activities are really very special functional adaptations of the ants and serve the purpose of obtaining food for themselves and their offspring. These adaptations are closely connected with structural adaptations, and have become traditional, and are now instinctive or automatic in nature. A certain amount of adaptability is noticeable, but only within very narrow limits. This communal organization of the ants appears to be most complete, and this has made them the most widely spread of animals. But it is an inherited property, and not an organization that is undergoing development and steady improvement at the hands of an intelligent and thinking race.

Now let us take a sudden jump—to man, by way of contrast to the small ant. Is man very highly specialized, and very well adapted? He certainly is, but in a quite different way from the ant. Let us for example look at his hands. Are they specialized, like the hands or fore-feet of the horse, or the wings of the bird, or the fins of the fish, or the fore-feet of the mole? These organs are all functionally adapted and specialized to do some one very special thing. But we can do almost anything with our quite unspecialized hand. We can swim on the sea in ships, and below the water in submarines, we can fly in aeroplanes, we can move quickly on bicycles, or in motorcars, we can dig furrows in the soil by mechanical ploughs. Yet we have only an unspecialized hand to do all these things, a hand which still has the original five digits of our ancestors, all in working order. How are we able to do all these wonderful things? When man first took into his hands a rough stone to use as a weapon, instead of catching his prey with his hands, and when subsequently he fashioned this stone in various ways, and thus made his first stone implements, he had started on his career as man the inventor. The evolution of the hand had reached its end. The evolution of the tool had begun. The aeroplane is only a very highly developed tool which enables us to fly. The bird had to develope wings in order to fly, but by this very specialization of its limbs its other activities became limited.

Our most prized possessions are the organs of our body fixed by long tradition, which are, however, able to control the tools which are indefinitely adaptable. Our tradition does not take the form of highly specialized organs adapted to one purpose only, but it has handed us simple organs that can do almost anything, and then not only what we as individuals have learned in the course of our short lives, but the gigantic store of learning of the whole race handed down from generation to generation is at our disposal. Education, knowledge, inventions, art, literature, all these we are adapted to learn from our parents, and pass on to our children, because we can speak and learn and teach, and store up and pass on experience. No other animal can pass on cultural achievements as man does. Our mind is sufficiently independent of traditional instinct, and we can control and develope outside our bodies tools by our intelligence and imagination in direct response to external influences and problems. Side by side with the want of specialization of our limbs has gone the development of the brain of man, a modification only of an adaptation already present in our ape-like ancestors. We are adapted to learn and to be trained. Education plays an important part in our lives. We are adapted to profit by it. We can pass on what we have learnt by books or by word of mouth. Education is teaching and training the boy of to-day. Education is not necessarily improving the race. It may succeed in doing so however, by educating the parent under the influence of whom the next generation is going to grow up.

I hope now that I have made it clear what I mean by an adaptation and by adaptability. Increased specialization means loss of adaptability. Man's greatest adaptation lies in the loss of specialization in his limbs accompanied by unlimited adaptability.

But what is the origin of an adaptation ? The appearance of a quite new adaptation would mean an advance in the history of a species, in its evolution. When therefore we solve the question of the origin of a new adaptation we will have learnt of the method along which evolution proceeds. Let us return for a moment to the beech leaf. The first leaves on the seedling you will remember are shade leaves. Expose the plant to strong sunlight, and we get sun-leaves. The influence, the direct influence of the strong light, has given us the two palissade layers. This is a case of direct adaptation, but it is only a quantitive adaptation of a kind or quality of adaptation which is already there, the palissade layer. In fact we will find that every so-called direct adaptation we can observe in animal or plant is in reality only a quantitative, and often, a very slight modification of an old quality or less specialized adaptation. The quality of the adaptation is very largely a matter of tradition inalienably connected with, and inherited by every member of a particular race. Races tend to diverge from one another, and can be distinguished by certain traditional " family " characters. The quantity or degree of adaptability of an adaptation is often more or less dependent on the direct influence of external conditions, and is not necessarily inheritable. Under this heading plants and animals under similar conditions tend to exhibit the phenomenon of convergence.

The Cactaceæ are characteristic of the deserts of Central America, the Euphorbiaceæ of the deserts of Central Africa. Certain species of Ceres and Euphorbia are in their adaptation to the adverse conditions of their surroundings, almost indistinguishable in their general external development. Intense adaptation to severe local conditions has led to a morphological evolution along convergent lines. Historically all organs are, however, controlled by traditions which have led these two Natural Orders along divergent lines. This is clearly shown in the general structure of their vegetative organs, and the detailed structure of their reproductive organs. Examples of this divergence and convergence respectively can be found to a still more striking extent in the animal world. The Mollusca and the Vertebrates show a morphological development along divergent lines. In the functional adaptation to light, in the development of the eye, they exhibit evolution along convergent lines.

There is no evidence that direct influence of the surrounding conditions can produce in a race a new adaptation qualitatively. If this were so, and the new adaptation were inheritable we would have to believe in the inheritance of acquired characters. This means that characters acquired quite newly during the life time of the individual under the influence of external conditions are transmitted to succeeding generations. There is no evidence that this occurs at all. Some recent work by Kammerer of Vienna has proved to his satisfaction that characteristics acquired during the life of an individual can be transmitted to the offspring. But his evidence is not convincing. What he calls a new character is really only a modification of a character, or adaptation already present. He appears to be talking of adaptability really, and not new adaptations. But we should observe an open mind in this matter as we know so little about it.

Lamarck (1809) the first great evolutionist believed in the direct adaptation of the living organism to external conditions. Every variation occurring in a plant or animal to him was purposeful and of advantage to the particular organism. Such an adaptation if inheritable might become so well established as to give rise to a new species. The purposeful elongation of the neck of one of its ancestors gave us the giraffe, according to Lamarck. Every change would therefore already represent an adaptation.

Darwin (1859) imagined a large number of slight variations arising by chance in an organism. The most useful variation out of many useless ones would be picked out by natural selection in successive generations till it had become an important adaptation. This too might lead to the formation of a new species.

Samuel Butler named one of his books : " Luck or Cunning." Is it luck and chance variation that gives us a new adaptation, that may develope into a new species, as Darwin thinks, or is it purposeful cunning in the species, as Lamarck believes ? Butler supports Lamarck's view. Both processes would be so slow, however, as to be undetectable by us. There is not much evidence in favour of either. Most evidence is in favour of a more sudden change in plant or animal, whereby a new but big chance variation makes its appearance suddenly, a mutation, as de Vries (1900) calls it. A sudden mutation, if yielding a useful adaptation, and if inheritable would pass on to the next generation. Selection would weed out any unsuitable mutation. Whatever the method may be it results in plants and animals becoming gradually better adapted to their surroundings.

There still remains an unanswered question. What originally started the mutation or variation ? No answer can be given to this question yet. The appearance of a mutation appears however to be connected with a more or less profound change in the nucleus. That is really all we know.

The power of the green plant to pick out the red rays of the sun-light, and to absorb them, and in the twinkling of the eye to build up from the water supplied from the root and carbon obtained from the air, sugar and starch, is a most wonderful adaptation to the conditions obtaining on this earth. Plants are in this way storing up energy from the sun. This we in turn get from the plant directly by taking plant products as food, or indirectly when eating meat. Thus we are able to work and walk. The green plant is adapted to obtaining its energy directly from the sun, we indirectly by feeding directly or indirectly on plant material. What I have called an adaptation here is really a most complicated system of adaptations deeply correlated, and it is impossible for us at present to picture their beginning or their mode of origin, though we may recognise and appreciate their value.

We can collect animals and plants and we can determine the conditions under which they live. We can determine by careful observation and study what the chief adaptative characters of certain animals and plants are. We may even be able to show what advantage any particular adaptation confers on its owner. I would like to sound a warning note here. We should be careful not to endeavour to give a meaning to every structure we find in animals and plants. There are many striking structures in both the advantage of which to the owner are quite unclear. We must also beware of interpreting plant and animal structures in terms of human activities. Not every spine we find in plants is a protection against the grazing habits of animals. Thorns in the hawthorn are closely connected with exposure to cold winds and to shortage of water. We do not know how adaptations arose in the first place. It is the keen, observant, and studious field naturalist who in the end may show the experimentalist of the laboratory along what lines to proceed in order to settle this question. Even if he does not succeed in doing this he can still provide the experimentalist with a great deal of most valuable observational material. I hope that my disconnected remarks will give at any rate, to some of you who are mostly field naturalists, some food for thought.

The Aculeate Hymenoptera of Gloucestershire and Somersetshire.

By R. C. L. Perkins, M.A., D.Sc., F.R.S., F.Z.S.

THE following list of species of Aculeate Hymenoptera is made up of those which have been, or now are recorded from the two counties of Gloucester and Somerset. These counties have been taken together for the reason that a number of the old records give as a locality "Bristol," and it is well-known that this included species captured on each side of the Avon, while in a number of cases it is not known whether the actual locality of a species was in Somersetshire or Gloucestershire. Some of the species obtained by the old Bristol collectors are so extremely local or rare in England, that it was considered inadvisable to leave these out of the list, as must have been done had the counties been dealt with separately.

Between 1830 and 1860 Bristol and Clifton produced two of the most successful collectors of this group of insects of that or of any other period. Apparently both were specially attracted by the group. Dr. Thwaites appears to have begun his collecting somewhat earlier than Walcott. At any rate he is several times mentioned as having been the first to obtain some particular insect. What became of his collection I do not know. Walcott's collection is incorporated in the general collection of the Museum of Zoology at Cambridge. The writer examined this collection with considerable care about 25 years ago. It was remarkable for the fine series of many species then considered extremely local or rare and contained specimens of almost all the species known as British in Walcott's time. The specimens were nearly always in beautiful, fresh condition and clean, and their general condition, I should say, superior to those in the collection of F. Smith, who often collected indifferent examples, and was less clean in his manipulation.

Walcott had fine series of some species poorly represented in Smith's collection, and so far as I remember the naming was not more incorrect than in the latter. Unfortunately hardly any individuals of this model collection had any label of locality or date, but a few supposed British, but really foreign species, which were received in exchange from the British Museum, and were probably derived from Leach's collection were marked "in exchange British Mus."

The late Prof. Alfred Newton put himself to some trouble to find out whether some further details might not be obtained concerning Walcott's specimens, but except that the collection was presented to the Museum by Walcott's widow, and, if I remember rightly, that he himself died abroad, nothing was discovered. If one assumes that the greater part of the collection was made at "Bristol" then this must be an extremely rich neighbourhood in Aculeata, but it is certain that either Walcott himself, or others for him, must have collected in very different localities, for he had fine series of species then only known from Scotland and the North of England.

It is remarkable that Smith, who received many specimens from Walcott, should not have taken the trouble to obtain from him a list of all the rare and local species that he possessed, and to record them in his books. As a matter of fact he is almost never mentioned, except in connection with some "Bristol" insect, though once he is said to have collected a certain stylopised bee near Brighton, and in other cases to have received specimens of rare species from Brighton. Considering the number of rare and local species that we know to have been obtained by him at Bristol, it is fair to assume that numbers of others well represented in his collection, yet not included in this county list, may still be obtained in that district.

Before leaving the subject it may be mentioned that several species unknown in Britain in Smith's day could have been found in Walcott's collection, either unindentified or wrongly named. The most important of these was, I think, the wasp *Odynerus tomentosus*. Specimens of this were found mixed with *O. pictus* in the collection itself and others in a drawer of duplicates and unidentified material. *O. pictus* so common in the West of England, was not so in Smith's localities, and Walcott sent him specimens, having superabundant material himself. That these *tomentosus* were British can hardly be doubted, for though they have no locality label, some of them had a small label with the actual date of capture in Walcott's writing, and some of the *pictus* had similar labels with the very same date. The mere fact that he had taken the trouble to use such a label at all, as, he very rarely used any, might perhaps be a slight reason for supposing that he obtained these in some place other than Bristol, but on the other hand some Bristol insects, which he sent Smith, had quite similar labels with date of capture only.

Probably no collector in the two counties since the days of Walcott and Thwaites has paid such particular attention to the Aculeata as they did.

V. R. Perkins, though interested in all Orders of Insects, collected the Aculeata, for which he had a special fondness, for more than 40 years in the neighbourhood of Wotton-under-Edge.

This locality, as he justly observes, is not one which the special student of these Hymenoptera would select as a collecting ground, nor is it likely that it would compare favourably with the Bristol district, and moreover he did not go far afield. His observations, and the list itself have a real value from the fact that the former were practically continuous for so long a period. During two recent summers I have had the opportunity of collecting on some 6 or 7 days of August in the same locality, and in the very same spots, in which V. R. Perkins did most of his collecting, and where in 1885–90 we frequently collected together. One fact impressed me considerably, *viz.*: that the Aculeata fauna must have considerably changed in the last 20 years, though the condition of the locality was on the whole little altered. There is no reason to suppose that many, if any, of the formerly existing species had been lost, for many of these were obviously present, and for the fact that some were not seen the unfavourable weather may have been responsible. But the incursion of new species was quite remarkable.

In the 1902 list there is no record from Wotton-under-Edge of the following: *Halictus decipiens*, common in 1922, with *H. lævigatus*, *Andrena ovatula* (2nd brood), *Bombus soroensis* (abundant everywhere), *Ceratophorus morio*, *Blepharhipus nigritus* (in numbers), *Cuphopterus signatus*, *Metacrabro lituratus*, *Vespa norvegica* (abundantly), all in the same year, while *Megachile ligniseca* was found in a neighbouring village, and V. R. Perkins had himself in his later collecting found *Sapyga clavicornis* in some numbers, and a few years ago *Nyson dimidiatus* appeared for the first time.

Collectors, who happen to be restricted to some home locality for most of their collecting may therefore feel some assurance that at any time new and desirable species are likely to turn up, even in very well worked places. I imagine that similar changes or addition to the Wotton fauna have taken place in the Lepidoptera, for *Polia chi*, unknown there in earlier days, had become a common and widely distributed species, and other similar cases were noticed.

Above I have spoken in depreciation of Wotton as a collecting ground for Aculeata in general. It is therefore pleasing to be able to refer to its richness in *Crabronidæ*.

Those species peculiar to light sandy soils and sandhills are naturally not found there, but within an area of a few acres on a stiff clay have been found the following: *tibiale*, *clavipes*, *capitosus*, *styrius*, *leucostoma*, *cetratus*, *podagricus*, *gonager*, *palmipes*, *varius*, *anxius*, *elongatulus*, *dimidiatus*, *signatus*, *cribrarius*, *vagus*, *microstictus*, 4-*cinctus*, *lituratus*, *chrysostomus*, *sexcinctus*, and *cavifrons*. There cannot be many localities, which have yielded so many species in so small an area. Contrast this with the Bee genus *Andrena*, where of the species which emerge from mid-

June onwards, whether as first or second broods, only three very common species have ever occurred in the district, *viz.* : *minutula, gwynana* and (once only) *ovatula* !

It is to be regretted that the Wotton collection should not have been secured by some local Museum, since it takes a prominent place in the Gloucestershire list. I should have been glad to have examined the specimens of some of the species that I suspect of being wrongly determined, but I have been unable to learn the name of the purchaser. The collection of the Bees which filled about a dozen cabinet drawers was within the means of most Museums, as the whole was bought for five shillings. The other Hymenoptera, seeing that the boxes were included in the price, were practically given away with these !

Nearly all the labour of compiling the Somersetshire list was undertaken by my friend the late Col. T. Jermyn, who was for some years the chief collector of these insects in that county, at any rate since the time of Walcott and Thwaites. All the species in his collection, and I think all the specimens, have been submitted to me for naming, or for confirmation of the names, and his collection included many specimens which he received from friends, Capt. R. D. Troup (abbrev. in list R. D. T.), and Messrs. H. Audcent (H. A.) and H. Slater (H. S.). He also furnished me with an extensive list of species of the Bristol district, drawn up by Mr. H. J. Charbonnier (H. J. C.), with Col. Linley Blathwayt's county list (L. B.), and with one enumerating the species collected near Weston-super-Mare by Mr. H. M. Hallett (H. M. H.). Col. Jermyn's death is a severe loss to Entomology in Somersetshire, and especially so to his friends. A box of insects received from him shortly before his death, which I have only now been able to examine, contains at least three species which I had not seen before from Somersetshire, *Bombus muscorum,* and *latreillellus,* and *Psithyrus distinctus.* By far his most important capture was the Bee *Sphecodes scabricollis* in 1919, of which only a single example (without special locality) in the Kirby collection of the British Museum, caught some 120 years ago, was known as British. This specimen he most generously added to my collection.

The first of the initials (T. J.). is sometimes varied in the list, when the specimens were collected by some other member of his family. Other initials used are (E. S.) for Edward Saunders, and (A. T.) Rev. A. Thornley. I have also received a short list from Mr. A. H. Martineau of Crewkerne, including both Gloucestershire and Somersetshire species. The Wotton-under-Edge species were collected entirely by my uncle and by myself, usually by both of us. For a complete list of Ants of both counties I am greatly indebted to Mr. H. Womersley.

In the recently published list of Devonshire Aculeata I have remarked that large areas are still quite unexplored by collectors of these insects, but this list is probably far more nearly complete than that of Gloucestershire and Somersetshire, which have been still less collected over. Of the two counties the latter may be expected to considerably exceed the former in the number of species represented. It is safe to say that in each large additions are sure to be made.

In this list of the two counties the *Apoidea* number 125, the *Sphecoidea* 62, the *Vespoidea* (including *Chrysididæ*) 53, and the Ants 16 species, a total of 256. In the recent Devon list I enumerated 324 species, and as the common *Ceropales maculatus* was accidently omitted, and I became aware of the occurrence of 3 or 4 other species too late for inclusion, the total should be somewhat increased. It is quite certain that the apparent richness of Devonshire is due to the fact that more extensive and intensive collecting has been done there, than in the other two counties.

APOIDEA.

Hylacidæ.

Hylæus (Prosopis).

1. *H. spilotus* Forst. (*masoni*). G. Recorded from Stapleton (H. J. C.).
2. *H. communis* Nyl. A common species in both counties, often resting on gate-posts and visiting flowers of Rubus, Sedum, Reseda and onions.
3. *H. pratensis* Geoffr. (*signatus*). The largest species of the genus often found on Reseda in gardens, but apparently local or rare in either county. G. Wotton-under-Edge, formerly abundant, but not recently. S. Freshford (H. J. C.).
4. *H. hyalinatus* Sm. A very common species in many localities.
5. *H. confusus* Nyl. G. Wotton; Olveston (H. J. C.). S. Isle Brewers (R. C. L. P.). Kewstoke Woods (H. M. H.).
6. *H. minutus* F. (*brevicornis*). G. Wotton and Kilcot. S. Minehead (L. B.). Usually found on Rubus and white Umbelliferæ, and will occur in many other localities.
7. *H. pictipes* Nyl. First recorded as British from "Bristol" by F. Smith, who described it as a new species (*varipes* Sm.). Smith's type of the male was the present species, but the female was a variety of *hyalinatus*. The bramble stems from which he bred the species were sent to him by Dr. Thwaites.

Colletidæ.

Colletes.

1. *C. glutinans* Cuv. (*succincta*). I have only one record for Gloucestershire, but the species is common in Somersetshire in places where heather or ling are abundant, frequenting these flowers. It is an abundant moorland insect and *Epeolus rufipes* its parasite usually occurs with it. G. Hanham (H. J. C.).
2. *C. marginata* Sm. G. Olveston in June (H. J. C.). S. Minehead (L. B.).
3. *C. fodiens* K. An abundant species in sandhills and partial to the flowers of ragwort, yarrow, etc. Very common along the coast near Burnham; Dunster (H. A.). Not recorded from Glos.
4. *C. daviesana* Sm. Probably the most widely distributed of the genus, not only burrowing in sandy soils, but sometimes forming large colonies in the soft mortar of walls. G. Wotton; Hanham and Olveston (H. J. C.). S. Freshford (H. J. C.). Crewkerne (R. C. L. P.).

Andrenidæ.

Andrena.

1. *A. albicans* Mull. Probably the commonest species of the genus, and found in all kinds of localities.
2. *A. carbonaria* L. (*pilipes*). S. Only recorded from Leigh Woods (H. J. C.).
3. *A. flavipes* Panz. (*fulvicrus*). S. "Common locally" about Weston-super-Mare (T. J.); Wembdon (R. D. T.). In Glos. recorded only from Wotton, I believe erroneously. I have seen none thence which were correctly named. (*A. tibialis* K. is recorded only from Wotton, but was probably wrongly determined. *A. florea* from the same locality was based on an abraded specimen of (I think) *A. jacobi*, determined by F. Smith. The supposed Wotton *florea* I examined was not caught in 1883 as V. R. P. records, but earlier.
4. *A. thoracica* F. S. Batheaston (L. B.); Bitton and Taunton (H. J. C.).
5. *A. nitida* Fourc. S. "Generally distributed and abundant" (T. J.). G. Similarly common.
6. *A. cineraria* L. S. Batheaston (L. B.); Wembdon, abundant (R. D. T.).
7. *A. nigroænea* K. Usually very common, and of general distribution.

8. *A. gwynana* K. A double-brooded and generally distributed species, the first brood visiting many flowers, the second often on Campanula and Malva, but not at all restricted to these.

9. *A. angustior* K. G. Common in the Cotswolds. S. Weston-super-Mare (T. J.); Buncombe (R. T.); Crewkerne (R. C. L. P.); Wembdon (T. J.).

10. *A. jacobi* Perk (*trimmerana* Auct.). A very common species from April to June.

11. *A. trimmerana* K. (*spinigera* K., 1st brood). Double-brooded, the summer brood has often been called *rosæ* in error by Saunders and others. S. Wembdon (T. J.); Ilminster and Crewkerne (R. C. L. P.).

12. *A. rosæ* Panz. Also double-brooded, the Spring brood being the *eximia* of F. Smith. S. Minehead (T. J.); also recorded from Freshford (H. J. C.), but this may perhaps refer to the preceding species, as the two were not considered distinct by Saunders.

13. *A. bucephala* St. A local species remarkable for its habits, large number of females carrying their pollen into a single burrow, often placed beneath a rock or large stone. Bristol (Walcott); G. Durdham Down (Martineau); Colesbourne and Cirencester (A. T.). S. Weston-super-Mare in April, May and June (T. J.).

14. *A. ferox* Sm. G. Taken freely by the old Bristol collectors at Sea Mills, and though the actual spot where it occurred may have been spoilt, it will probably be rediscovered in new localities. Walcott supplied the British Museum and F. Smith with specimens.

15. *A. fucata* Sm. Bristol (Walcott). G. Wotton. S. Minehead and Exford (T. J.); Burnham (R. T.). This species is often very plentiful in moorland districts on the flowers of Potentilla, and no doubt occurs in many localities.

16. *A. varians* Rossi. S. Minehead and Wembdon (T. J.); recorded from Wotton by V. R. P., but almost certainly in error, as there was much confusion between this and the allied species at the time he wrote.

17. *A. helvola* L. G. Badminton, but very rare (R. C. L. P.), and also recorded from Redland (H. J. C.); Colesbourne (A. T.).

18. *A. fulva* Schr. G. Wotton, rarely, and in my father's garden at Alderley in some numbers in 1907 and 1909; Stoke Bishop and Olveston (H. J. C.). S. Shepton Mallet (H. J. C.); Backwell (T. J.). Apparently local and uncommon in these counties.

19. *A. clarkella* K. G. Wotton, very rarely and irregularly, and recorded for Somerset in the "Victoria History," without locality. I believe it was taken numerously in Bristol district by the old collectors.
20. *A. apicata* Sm. Bristol (Walcott). G. Found plentifully in 1890 and 1891 at Kilcot near Wotton (R. C. L. P.).
21. *A. fuscipes* K. Not recorded in any of the lists I have seen, but it was observed in some numbers at Shapwick in August 1924, when I spent a few hours there on a rather unfavourable day. It is a common heath and moorland species, and must occur in many localities in Somersetshire. Since writing this note I find that Jermyn records in a footnote to the Victoria list that he has taken this species, though it is left out in his later list, and Mr. A. H. Martineau records it from Shapwick on the same day as I noticed it.
22. *A. denticulata* K. S. Not rare near Dulverton, July 1907 (R. C. L. P.).
23. *A. sericea* Chr. (*albicrus*). S. This bee, so partial to sand-hills, is very abundant at Burnham and other places on the coast, and is recorded from Batheaston (L. B.) and Freshford (H. J. C.). The record from Wotton is, I believe, an error.
24. *A. fulvago* Chr. G. Stroud (A. H. Martineau). S. Quite plentiful on Hieracium in Kewstoke Woods, June 1919 (H. M. H.).
25. *A. humilis* Imh. G. Redland (H. J. C.); Wotton, very local, only one colony known. S. Kewstoke Woods commonly, with the preceding (H. M. H.).
26. *A. labialis* K. G. Wotton and Alderley, irregular and often scarce, though abundant in 1876; Redland (H. J. C.). S. Batheaston (L. B.); Freshford and Shepton Mallet (H. J. C.); Weston, Berrow, Uphill and Nailsea (T. J.).
27. *A. coitana* K. S. Withypool (T. J.). The Wotton record was erroneous, being based on a specimen of *A. saundersella*, wrongly identified by F. Smith.
28. *A. tarsata* Nyl. (*analis*). S. Shapwick (T. J.); Dulverton (R. C. L. P.).
29. *A. chrysosceles* K. Common in both counties.
30. *A. cingulata* F. G. Wortley, near Wotton, but not generally common. S. Batheaston (L. B.); Wembdon (T. J.).
31. *A. saundersella* Perk. (*nana* E.S.). Common in both counties, often recorded as *nana*.
32. *A. minutula* K. Common and generally distributed.
33. *A. subopaca* Nyl. G. Abundant at some seasons at Wotton. S. Weston-super-Mare and Wembdon (T. J.). Probably generally distributed.
34. *A. proxima* K. "Bristol" (Walcott).

35. *A. ovatula* K. A double-brooded species. G. A single specimen in August 1922 at Wotton. Earlier records under this name should be all referred to the next species. S. Freshford (H. J. C.); and I observed several females on heather at Shapwick in August 1924.

36. *A. wilkella* K. Common and no doubt generally distributed, often in gardens, while the preceding is most partial to heaths and moors and uncultivated coast localities.

37. *A. similis* Sm. Originally described from specimens captured at Bristol by Walcott. The record of Wotton is probably incorrect.

38. *A. sp.* Since this list was prepared a male *Andrena*, captured by the Rev. A. Thornley at Cirencester, has been examined by me and appears to be *A. congruens* Schm. The species is new to this country.

Cilissa.

1. *C. hæmorrhoidalis* F. G. Taken abundantly on Durdham Downs by the old Bristol collectors; Wotton, not common, on Campanula and Malva; very abundant at Kilcot in 1886, on Malva, but could not be found there in 1922. S. Bath (E. Saunders); Shepton Mallet (H. J. C.).

2. *C. leporina* Panz. S. Dulverton 1907 (R. C. L. P.).

Halictus.

1. *H. rubicundus* Chr. Very common and generally distributed.

2. *H. xanthopus* K. G. Olveston (H. J. C.); Wotton; Alderley; the hibernated females common in my father's garden in 1907. S. Wembdon (R. T.); Isle Brewers (R. C. L. P.).

3. *H. lævigatus* K. G. Wotton 1922 (R. C. L. P.), where it was previously unknown. S. Batheaston (L. B.); Shepton Mallet (E. Saunders); Weston; Banwell; Shapwick; and Exford (T. J.); Isle Brewers, common on Inula (R. C. L. P.).

4. *H. leucozonius* K. G. Wotton, irregular, and as a rule scarce, when it occurs. S. Widely distributed and not rare.

5. *H. zonulus* Sm. Bristol (Walcott). G. Very rare near Wotton. S. Probably common; Weston; Shapwick; Ashcott; Winscombe (T. J.); Wells (R. C. L. P.).

6. *H. lativentris* Sch. (4-*notatus* Auct partim). G. Not known in the Wotton district until 1907, when it was found at Alderley, and abundant at Wotton in 1922. S. Banwell, Hutton and Weston (T. J.); Isle Brewers (R. C. L. P.).

7. *H. calceatus* Sc. (*cylindricus*). Abundant everywhere.

8. *H. albipes* K. Also very common.
9. *H. malachurus* v. *longulus* Sm. S. Recorded from Batheaston (L. B.). The record of Wotton is incorrect. The specimen so named by Smith was *fulvicornis*.
10. *H. fulvicornis* K. G. One of the commonest bees in the Cotswold district. S. Flax Bourton (T. J.). Abundant at Isle Brewers, and near Crewkerne (R. C. L. P.).
11. *H. freygessneri* Alfk. G. Forest of Dean (R. J.). S. Weston-super-Mare and Ashcott (T. J.); Wembdon (R. T.). This species, common in N. Britain and Ireland, is usually found in the South in moorland districts, or on elevated heaths.
12. *H. villosulus* K. A common and generally distributed species, frequent in both counties and generally found on yellow Compositæ.
13. *H. punctatissimus* Sch. G. Very scarce at Wotton, and not included in the list for Somerset sent by Col. Jermyn, but certain to occur on and amongst heather and on moorland. In the Spring the females are often abundant on flowers of Ulex.
14. *H. minutissimus* K. G. Rare in the Wotton district. S. Isle Brewers on Inula and at Crewkerne. No doubt common in the county, but overlooked.
15. *H. nitidiusculus* K. A very common species in all Southern counties.
16. *H. minutus* K. G. Wotton, formerly very rare, a single specimen taken by myself, about 35 years ago. V. R. P.'s record was based on a specimen of *rufitarsis*, wrongly determined by Saunders. In 1922 two colonies were found at Wotton; Cirencester (A. T.). S. Dulverton (R. C. L. P.) and no doubt occurs in many localities.
17. *H. rufitarsis* Zelt. (*atricornis*). G. Wotton, rarely, and in the Forest of Dean. Not yet recorded for Somersetshire, though it occurs also in Glamorganshire.
18. *H. tumulorum* L. Very common and generally distributed.
19. *H. morio* F. Common generally.
20. *H. smeathmanellus* K. Common in both counties, often in gardens.
21. *H. leucopus* K. G. Wotton, frequent on the hillsides. S. Ashcott (T. J.). A common species, which has been overlooked.

Sphecodes.

1. *S. scabricollis* Wesm. S. A single specimen was captured by Col. Jermyn at Shapwick. The place where it was found was burnt out in the hot, dry summer of 1921, and

he was unable to find the species again in either of the years following.

2. *S. spinulosus* v. Hag. G. Once found in some number at Wotton by V. R. P., but many years ago. It is parasitic on *H. xanthopus*, and both sexes appear in May and June.
3. *S. gibbus* L. Frequent in both counties. A common parasite of *H. rubicundus*.
4. *S. monilicornis* K. (*subquadratus*). Even commoner than the preceding, with the same host, but also attacking other species of *Halictus*.
5. *S. pellucidus* Sm. (*pilifrons*). Parasitic on *Andrena sericea* and found often in great numbers around its burrows on sandhills and light sandy soils. S. Burnham (L. B.); Berrow (T. J.); Shepton Mallet (E. S.). G. Recorded for Olveston (H. J. C.), and Wotton (V. R. P.). Specimens from the latter place were large examples of *divisus*, wrongly determined by E. S., as on several occasions; those from Olveston I have not seen.
6. *S. divisus* K. (*similis*). G. Wotton, plentiful in some seasons, and probably common in the county. S. Common.
7. *S. puncticeps* Th. G. Wotton, rarely. S. Probably common. Burnham (L. B.); Cheddar (H. J. C.); Brean Down (H. M. H.); Bridgwater (T. J.). Usually occurs with *H. lativentris* Sch. and 4-*notatus* K.
8. *S. ferruginatus* Sch. G. Common in some seasons in the Cotswolds. S. Cheddar (H. J. C.); Crewkerne 1924 (R. C. L. P.) and previously near Fivehead.
9. *S. hyalinatus* v. Hag. G. Abundant in the Cotswolds in most seasons. S. Keynsham (H. J. C.); Banwell (T. J.); Isle Brewers (R. C. L. P.). This and the preceding species are found in company with *H. fulvicornis* and *freygessneri*.
10. *S. variegatus* v. Hag. G. Wotton occasionally. S. Keynsham and Freshford (H. J. C.); Shapwick? (T. J.). Only the female found.
11. *S. affinis* v. Hag. A very common species, often found about and in colonies of *H. nitidiusculus*.
12. *S. dimidiatus* v. Hag. Recorded from Wotton erroneously, and from Shepton Mallet (H. J. C.), but I have not seen a Somersetshire specimen. Except in the case of very typical examples, county records should not be based on the females of these three last species, as they are often extremely difficult to distinguish from one another. The males cannot be confused, if the genitalia are examined.

Dasypoda.

D. hirtipes Latr. S. Berrow (T. J.); Burnham (G. C. Griffiths.).

Ceratinidæ.

Ceratina.

C. cyanea K. Taken in plenty by the old Bristol collectors in Leigh Woods.

Anthophoridæ.

Nomada.

1. *N. germanica* Panz. (*ferruginata*). S. Kewstoke Woods (H. M. H.). No doubt to be found in many localities. Parasitic on *A. humilis*.
2. *N. obtusifrons* Nyl. S. Dulverton, both in Somersetshire and Devonshire (R. C. L. P.). A parasite of *A. coitana*.
3. *N. tormentillæ* Alfk. (*roberjeotiana*). S. Shapwick (T. J.).
4. *N. sexfasciata* Panz. S. Batheaston (L. B.). Recorded from Wotton by V. R..P., but his remarks under this and its host *Eucera* sufficiently show there must have been mistakes in identification, and I have no record for Glos.
5. *N. goodeniana* K. (*succincta*). Common in both counties on *A. nigroænea*.
6. *N. marshamella* K. (*alternata*). Common generally with *A. jacobi*.
7. *N. lineola* Panz. S. Batheaston (L. B.). Parasitic on *A. tibialis*, *carbonaria* and *bimaculata*. G. Recorded from Olveston, and therefore at least one of these unrecorded hosts should occur there.
8. *N. bifida* Th. Common in both counties on *A. albicans*.
9. *N. hillana* K. (*ochrostoma*). G. Common in some seasons at Wotton ; Bitton (H. J. C.). S. No doubt common. Freshford and Shepton Mallet (H. J. C.) ; Kewstoke Woods (H. M. H.) ; Wembdon (R. T.) ; Cannington (H. S.) ; Shapwick (T. J.). Parasitic on *A. wilkella*.
10. *N. bucephalæ* Perk. Bristol district (Walcott). No doubt taken on Durdham Downs with *A. bucephala*, its host.
11. *N. flava* Panz. (*ruficornis* part). G. Wotton, common, and no doubt of general distribution. S. Generally distributed and abundant.
12. *N. ruficornis* L. G. Very scarce in the Wotton district, and not yet recorded for Somersetshire, where it is certain to be found in numbers. It is less generally distributed in the Western counties than *flava*, and the confusion of the two species makes it impossible to cite older records of *ruficornis*.
13. *N. signata* Panz. This parasite of *A. fulva* was taken by the old Bristol collectors in that district. I found it numerously in Monmouthshire, not far from the Glos. border.
14. *N. fabriciana* K. A common parasite of *A. gwynana*.

15. *N. flavoguttata* K. A common parasite on several species of the group of *A. minutula*.

16. *N. furva* Panz. G. Recorded from Wotton by V. R. P., but I have not examined the specimens. S. Keynsham (H. J. C.). It will certainly be found in numbers in this county. It is generally found at colonies of *H. nitidiusculus*, and may often be collected from daisies.

EPEOLUS.

E. cruciger Panz. S. Dunster (H. A.); Minehead, Shapwick and Burnham, but not abundant (T. J.).

MELECTA.

M. armata Panz. S. Batheaston (L. B.); Wembdon (R. T.); Brean Down and Shapwick (T. J.). G. Wotton; Bitton; Olveston and Brentry (H. J. C.). It is a very common species, parasitic on the ubiquitous *Anthophora pilipes*. (*M. luctuosa* Sc. Recorded from Wotton by V. R. P., but erroneously. Iron Acton (H. J. C.), but incorrect identification may be suspected, for the host, *A. retusa*, is usually a very abundant species where it occurs, and the parasite rare, yet the host has not been found in the county. The same remark applies to H. J. C.'s record for Freshford. The strongly marked examples of the preceding are frequently mistaken for this species.

ANTHOPHORA.

1. *A. pilipes* F. Common in both counties.
2. *A. furcata* Panz. G. Wotton; Redland and Horfield (H. J. C.). S. Kewstoke Woods (H. M. H.); Bincombe (H. S.); Weston and Minehead (T. J.).
3. *A. 4-maculata* Panz. Wotton, but very many years ago (V. R. P.).

EUCERA.

E. longicornis L. G. Wotton, infrequent; Bitton, local and scarce (H. J. C.). S. Portishead (C. Bartlett); near Wells (R. T.); Clevedon (T. J.).

MEGACHILIDÆ.

CHELOSTOMA.

1. *C. florisomne* L. G. Wotton, Alderley and Badminton. S. Sedgemoor and Weston-super-Mare (T. J.). It would appear to be not generally common in these counties.
2. *C. campanularum* K. G. The Wotton locality is not quite correct, as the specimens were captured by myself in the village of Kilcot some miles distant, where a large colony was established in the boards of an old outhouse, and the bees were abundant in the flowers of Geranium pratense. About 35 years later (in 1922) none were to be found there.

Megachile.

1. *M. maritima* K. S. Berrow, Sand Bay and Shapwick, numerous (T. J.).
2. *M. willughbiella* K. Frequent in both counties; often a common insect in gardens.
3. *M. circumcincta* K. S. Very abundant in Sand Bay (H. M. H.); Berrow (T. J.).
4. *M. ligniseca* K. G. In the village of Kilcot, a few miles from Wotton, August 1922 (R. C. L. P.).
5. *M. versicolor* Sm. S. Shapwick, Withypool, Winscombe and Nailsea (T. J.).
6. *M. centuncularis* L. A very common bee.
7. *M. argentata* F. S. Burnham (E. S.); Berrow (T. J.). (*M. ericetorum* Lep., reported from Bristol in F. Smith's Work is a dubious record. In Walcott's collection there was a specimen of this bee, not caught at Bristol, but purchased from Pelerin, who gave Southampton as the locality. This and other of Pelerin's supposed captures cannot be accepted as British.)

Coelioxys.

1. *C. conoidea* Ill. (*vectis*). S. Weston-super-Mare (T. J.).
2. *C. elongata* Lep. G. Wotton (V. R. P.); Redland (H. J. C.). S. Sand Bay, very numerous with its host *M. circumcincta* (H. M. H.).
3. *C. acuminata* Nyl. G. Wotton and Hawkesbury; Redland (H. J. C.). S. Leigh Wods (A. E. Hudd); Weston (T. J.). Common at Crewkerne (R. C. L. P.). Parasitic on *M. centuncularis* and *versicolor*.

Anthidium.

A. manicatum L. G. Wotton; Redland (H. J. C.). S. Cheddar (H. J. C.); Cannington (H. S.); Weston-super-Mare, common and sometimes very abundant (T. J.).

Stelis.

1. *S. aterrima* Pang. G. Bristol (H. A. Francis); Clifton (fide F. Smith). S. The Mendips (E. Saunders).
2. *S. phæoptera* K. Wotton district, rare. Taken also by the old Bristol collectors.
3. *S. ornatula* Kl. (8-*maculata*). Bristol. First obtained by Dr. Thwaites, who bred it from the nest of *Osmia leucomelana*; Walcott also collected it, I believe in Leigh Woods.

Osmia.

1. *O. rufa* L. An abundant and generally distributed bee.

2. *O. pilicornis* Sm. G. Wotton, formerly common, scarcer recently; Durdham Downs (Thwaites); Painswick (Martineau). S. Leigh Woods, taken abundantly on Bugle by the old collectors. Kewstoke Woods (H. M. H.); Buncombe (R. T.); Brockley Combe, Flax Bourton and Weston (T. J.).
3. *O. xanthomelana* K. G. Wotton (V. R. P. about 50 years ago, but not since). Bristol taken freely by Walcott about 1840, but not recorded since.
4. *O. cærulescens* L. Common and widely distributed.
5. *O. ventralis* Panz. (*leaiana, fulviventris*). G. Common, often in gardens. S. Jermyn's, and other lists fail to record the species for Somersetshire, but I observed it in a garden near Crewkerne in August 1924 on garden Composites, and it must occur in many localities.
6. *O. aurulenta* Panz. S. Sand Bay (H. M. H.); Uphill (T. J.). Recorded by V. R. P. for Wotton, Glos., but if this is correct, it must be very irregular or rare, as I have never seen it there.
7. *O. bicolor* F. G. Common on the Cotswolds both on the open hills and in woods. Stroud and Selsey (Martineau). S. Sand Bay (H. M. H.); Polden Hills (T. J.). It was found very numerously by the old Bristol collectors on Durdham Downs and in Leigh Woods. On the open hills at Wotton it covers the snail shell, in which it nests, with cut lengths of grass stems; in woods with the scales that fall from beech twigs.
8. *O. leucomelana* K. G. Wotton and the Forest of Dean; Painswick (H. J. C.); Stroud (Martineau). S. Taken by old collectors in abundance in the Leigh Woods and both Walcott and Thwaites obtained its parasite *Stelis ornatula* thence. Sand Bay (H. M. H.). It will be found in many localities in the county.
9. *O. spinulosa* K. Abundant on the open hillsides of the Cotswolds in some seasons, frequenting knapweed, cistus, and other plants. We have found its cells in the smaller snail shells on the hills near Wotton (R. C. L. P.); Stroud (Martineau).

Bombidæ.

Bombus.

1. *B. muscorum* L. This name is now applied to the pale Southern form of *B. Smithianus* of the Shetlands. S. A worker, belonging without doubt to this species, was taken by Col. Jermyn at Shapwick August 1919.
2. *B. helferanus* Seidl. (*venustus*). Common and widely distributed in both counties.

3. *B. agrorum* F. Common everywhere.
4. *B. ruderarius* Mull. (*derhamellus*). Common in both counties.
5. *B. sylvarum* L. G. Abundant and generally distributed. S. Shapwick and Ashcott commonly, and Nailsea, "seems to be a local species" (T. J.); Shepton Mallet (H. J. C.). Very common at Isle Brewers and Crewkerne on Bartsia (R. C. L. P.).
6. *B. pratorum* L. Very common.
7. *B. jonellus* K. G. Occasionally at Wotton. S. Banwell and Weston (T. J.). Numerous at Shapwick in August 1924 (R. C. L. P.).
8. *B. lapponicus* F. G. A stray specimen of the female twice taken at Wotton by V. R. P. No doubt the species will occur on Exmoor, being abundant on Dartmoor.
9. *B. lapidarius* L. Abundant.
10. *B. soroensis* F. Very abundant on the Cotswolds for some miles on either side of Wotton in recent years, though formerly unknown there. S. Near Crewkerne August 1924. (R. C. L. P.).
11. *B. lucorum* L. Common everywhere.
12. *B. terrestris* L. Equally common.
13. *B. hortorum* K. A very common species.
14. *B. ruderatus* F. (*subterraneus*). Common. Jermyn remarks that the all-black var. *harrisellus* is the commonest form in Somersetshire, and he has not found the brightest varieties. On the Cotswolds the palest var., resembling *hortorum*, is frequent, but all the other varieties are also common.
15. *B. subterraneus* L. (*latreillellus*). G. Rather common in the Wotton district in some seasons. S. Ashcott, a single male (T. J.).
16. *B. distinguendus* Mor. G. Much rarer than *subterraneus* L. in the Cotswold district, and not observed at all round Wotton in most seasons. I have no record at all for Somersetshire, but it is almost certain to occur in the Exmoor district at least.

   (*B. cullumanus* K. G. According to Smith this species was obtained by Walcott, as also was *soroensis*, on the Downs near Bristol. The latter species (Cat. Brit. Hym. Ed. 1) he calls *collinus* Sm., considering *cullumanus* (on the authority of Schiodte) to be the true male of *soroensis*. It is curious that Smith makes practically the same remark about the specimens of either species, *viz.* that Walcott captured both near Bristol, and also received both from the Brighton Downs. Both are represented in Walcott's collection, but one wonders whether some error may not have been made in the localities.)

Psithyrus.

1. *P. rupestris* F. G. Very abundant in the Cotswolds district in good seasons, and no doubt generally distributed. S. Freshford (H. J. C.); Nailsea, Ashcott, Banwell and Weston (T. J.); Isle Brewers (R. C. L. P.).
2. *P. vestalis* Fourc. G. Very common. S. "Abundant and generally distributed" (T. J.).
3. *P. distinctus* Perez. G. Wotton, and near Badminton, irregular, not noticed at all in most seasons (R. C. L. P.); Dean Forest (R. J.). S. Weston-super-Mare and Banwell (T. J.).
4. *P. barbutellus* K. G. Abundant and generally distributed. S. Batheaston (L. B.); Cheddar (H. J. C.); Banwell, Weston and Shapwick (T. J.); Crewkerne (R. C. L. P.).
5. *P. quadricolor* Lep. G. Abundant and generally distributed. S. Shapwick, Banwell and Weston-super-Mare (T. J.). Isle Brewers and Crewkerne (R. C. L. P.).
6. *P. campestris* Panz. G. Very abundant in some seasons on the Cotswolds. S. Shepton Mallet and Freshford (H. J. C.); Isle Brewers and Crewkerne (R. C. L. P.).

SPHECOIDEA.

Sphegidæ.

Sphex (Ammophila).

1. *S. sabulosa* L. S. Burnham (L. B.); Sand Bay (H. M. H.); Berrow (H. S. and T. J.); Shapwick, commonly including a var. with 2-cubital cells (T. J.). No doubt common in many localities.
2. *S. hirsuta* Scop. S. Burnham (L. B.); Berrow (H. S.). Neither of these two widely distributed species appear to have been recorded from Glos. at present.

Mimesidæ.

Psen (Mimesa).

1. *P. unicolor* v.d. L. S. This species, which often abounds on coast sandhills, has only been recorded from Taunton (H. J. C.). The male without dissection is hardly distinguishable from *P. dahlbomi*, which is generally a woodland insect, and I have not seen the Taunton specimens.
2. *P. dahlbomi* Wesm. G. Not rare in woods at Wotton in some seasons, but none could be found in 1922 and 1923. S. Burnham (H. J. C.). One would rather expect it to be *unicolor, q.v.*

Psenulus.

P. pallipes Panz. G. and S. This small and common insect is not recorded from many localities, but it is no doubt common in both counties. It frequently abounds in gardens.

Pemphredonidæ.

Pemphredon.

Three species of this genus are common and generally distributed in the S.W. of England, and special localities need not be given. The other *P. wesmæli* is not at present known from either county, and seems less rare in N. Britain.

1. *P. lugubris* F.
2. *P. shuckardi* Mor.
3. *P. lethifer* Shuck.

Ceratophorus.

C. morio v.d. L. Bristol (Walcott). G. Wotton for the first time in 1922 (R. C. L. P.) ; Redland (H. J. C.).

Diodontus.

1. *D. tristis* v.d. Lind. G. Wotton.
2. *D. minutus* F. G. This sand-loving species has been recorded from Wotton, burrowing in banks and the mortar of walls (V. R. P.), but I have not seen the specimens, and the species burrowing in the mortar of the walls of V. R. P.'s garden was *tristis* ; Redland (H. J. C.). S. Brean Down (T. J. and H. M. H.) ; Axbridge (Rev. S. O. Ridley in H. J. C.'s M.SS. notes).
3. *D. luperus* Sh. G. Wotton (V. R. P.), probably in error ; University gardens, Bristol (H. J. C.).

   The great confusion of species in this and the following genus, even in good collections such as S. Smith's and many others, renders the records very uncertain, unless the specimens have had a very close examination.

Passalœcus.

1. *P. corniger* Sh. G. Abundant at Wotton in good season. S. Wembdon (R. D. T.) ; Crewkerne (Martineau).
2. *P. insignis* v.d. L. G. Wotton ; Olverston (H. J. C.). S. Batheaston (L. B.) ; Freshford (H. J. C.) ; Crewkerne (R. C. L. P.).
3. *P. gracilis* Curt. G. Wotton ; Redland (H. J. C.). S. Crewkerne (R. C. L. P.).
4. *P. monilicornis* Dahl. G. Wotton, not rare. S. Mendips (E. Saunders) ; Crewkerne (Martineau).

Stigmus.

S. solskyi Mor. G. Wotton, in gardens and in the woods ; Olveston (H. J. C.). S. Burnham (L. B.) ; Dulverton (R. C. L. P.).

Spilomena.

S. troglodytes v.d. L. G. Kilcot, near Wotton 1888, in old gate posts (R. C. L. P.); Filton, in pierced bramble stems (H. J. C.). S. Leigh Woods (H. J. C.); Crewkerne (Martineau).

Crabronidæ.

Clytochrysus.

1. *C. sexcinctus* F. (*saundersi*). G. Wotton in some numbers on one or two occasions (R. C. L. P.). S. Wells, burrowing in an old willow, in company with *cavifrons*, 4-*cinctus* and others, August 1907 (R. C. L. P.).
2. *C. cavifrons* Th. G. Wotton, sometimes common; Redland (H. J. C.). S. Batheaston (L. B.); Freshford (H. J. C.); Kewstoke Woods (H. M. H.); Shapwick (T. J.); Crewkerne Martineau); Wells, very commonly (R. C. L. P.).
3. *C. chrysostomus* Lep. Common in both counties, and generally distributed.

Metacabro.

1. *M. lituratus* Panz. (*kollari*). G. Wotton, first noted in 1922 (R. C. L. P.). S. Minehead (Rothney); Banwell (T. J.); Bridgwater (R. D. T.); Crewkerne (Martineau); Hazelbury near Crewkerne, common on white Umbelliferæ, August 1924 (R. C. L. P.).
2. *M.* 4-*cinctus* F. (*interruptus*). G. Common in some seasons in the Cotswolds. S. Burnham (L. B.); Minehead (Rothney); Cannington (H. S.); Kewstoke Woods (T. J.); Wells (R. C. L. P.). Taken freely in the Bristol district by the old collectors.

Solenius.

1. *S. vagus* L. G. Wotton, much more abundant in 1922 than it used to be; Redland (H. J. C.). S. Burnham (L. B.); Weston, Nailsea, Shapwick and Ashcott, common (T. J.).
2. *S. microstictus* H.S. G. Wotton, August 1922 (R. C. L. P.). In my earlier collecting between 1885 and 1890 I captured several specimens in this district, and they were the sole representatives of (supposed) *S. vagus* in my collection at that time, this common species apparently being then absent from the spots where I collected.

Crabro.

1. *C. cribrarius* F. G. Wotton. S. Batheaston (L. B.); Cheddar (H. J. C.); Brean Down (H. M. H.); Exford and Minehead (T. J.); Crewkerne (Martineau). Evidently of general distribution in suitable places.
2. *C. peltarius* Schr. S. Burnham (L. B.); Kewstoke Woods (T. J.).

Acanthocrabro.

A. vagabundus Panz. Is recorded from Wotton by V. R. P., but it does not appear a likely locality for this insect, and there is probably some error. F. Smith, who named some of his earlier captures, had specimens of other species mixed with the few *vagabundus* that were in his own collection.

Hoplocrabro.

H. 4-maculatus F. G. Forest of Dean (R. C. L. P.). S. Dulverton. A huge colony amongst the roots and adherent earth of a large elm tree that had been blown down (R. C. L. P.

Cuphopterus.

1. *C. dimidiatus* F. G. Wotton, sometimes common. Redland and Olveston (H. J. C.). S. Kewstoke Woods (T. J.).
2. *C. signatus* Panz. G. Rare at Wotton, where it has occurred, usually singly.

Blepharipus.

1. *B. leucostomus* L. Common in both counties.
2. *B. nigritus* Lep. (*pubescens*). G. Wotton and Alderley, not rare in 1922; only a single male found previously. S. Freshford (H. J. C.); Backwell 14th June 1924 (T. J.).
3. *B. cetratus* Sh. G. Wotton, rare. S. Dulverton and Isle Brewers (R. C. L. P.).
4. *B. capitosus* Sh. G. Wotton, but not common in 1922 (R. C. L. P.). S. Freshford (H. J. C.); Dulverton, abundantly (R. C. L. P.).
5. *B. gonager* Lep. G. Generally common at Wotton; Alderley and Badminton (R. C. L. P.). S. Freshford (H. J. C.).

Ablepharipus.

A. podagricus v.d. L. G. Very abundant at Wotton; Bristol (H. J. C.). S. Brean Down (H. M. H.). It must occur in many localities.

Crossocerus.

1. *C. palmipes* L. G. Wotton, abundant in some seasons; Painswick (C. J. W.). S. Only recorded from Taunton (H. J. C.), and Brean Down (H. M. H.).
2. *C. varius* Lep. G. Often common at Wotton; Bristol (H. J. C.). S. Brean Down (H. M. H.); Wembdon (R. D. T.).
3. *C. ovalis* Lep. (*anxius*). G. Occasionally at Wotton and Alderley (R. C. L. P.).

4. *C. wesmæli* v.d. L. A common sandhill species. S. Brean Down (H. M. H.); Berrow (R. D. T.). The Glos. record Wotton is almost certainly a mistake; probably the supposed *wesmæli* was *ovalis*, the old record of which was based on captures by myself.
5. *C. elongatulus* v.d. L. The commonest of the genus and generally distributed, found in most gardens on leaves of currant bushes, etc., often in company with less common species.

RHOPALUM.

P. tibiale Lep. G. Wotton, but many years ago (V. R. P.). I believe this species was obtained in numbers by the old Bristol collectors.

PHYSOSCELIS.

P. clavipes L. G. Common in the Cotswold district, and no doubt elsewhere. S. Only recorded from Batheaston (L. B.) and Shepton Mallet (H. J. C.), but it is probably to be found in all districts.

LINDENIUS.

L. albilabris F. S. Brean Down (H. M. H.); Crewkerne (Martineau). This common insect is not recorded from Glos. at present.

ENTOMOGNATHUS.

E. brevis v.d. L. G. Wotton; Redland and Olveston (H. J. C.). S. Minehead (L. B.).

OXYBELIDÆ.

OXYBELUS.

1. *O. uniglumis* L. S. Burnham (L. B.); Berrow (T. J.). This common insect does not appear to have been recorded from Glos.
2. *O. argentatus* Curt. (*mucronatus*). S. Burnham (L. B.); Berrow (T. J.).

NYSSONIDÆ.

GORYTES.

G. mystaceus L. Not rare in either county, and common in some places.

HOPLISUS.

This genus is not recorded, but its parasite *Nysson trimaculatus* was found at Minehead by Rothney.

ARPACTUS.

A. tumidus Panz. G. Wotton, but not common. S. Only recorded from Kewstoke Woods (T. J.), but its special parasite is noted from Minehead.

Didineis.

D. lunicornis Fab. Bristol (Walcott).

Nysson.

1. *N. spinosus* F. I have no record for this common parasite of *G. mystaceus* from Glos., but Jermyn reports it as common at Burnham, and from Kewstoke Woods.
2. *N. trimaculatus* Rossi. S. Minehead (Rothney).
3. *N. dimidiatus* Jur. G. Occurred for the first time in 1922 at Wotton. S. Minehead (L. B.). It is parasitic on *Arpactus*.

Mellinidæ.

Mellinus.

1. *M. arvensis* L. G. Wotton (V. R. P.). I feel some doubt about the correctness of this record, which might have been an error of observation, and *Crabro dimidiatus* or some such species observed. I feel sure the insect has not been found in Wotton in my time, or for about 40 years. S. Common in many places from Leigh Woods to Exmoor, and at Crewkerne.
2. *M. sabulosus* F. S. Burnham (L. B.).

Trypoxylonidæ.

Trypoxylon.

1. *T. figulus* L. Common in both counties.
2. *T. clavicerum* Lep. Also common.
3. *T. attenuatum* Sm. Not rare. G. Wotton; Bristol, common to the old collectors. Redland (H. J. C.). S. Clevedon (Watkins); Taunton (H. J. C.); Ashcott (T. J.).

Philanthidæ.

Cerceris.

C. ornata F. S. Portishead (H. J. C.'s list). No species is yet recorded from Glos., and at least two others should be found in Somersetshire.

Larridæ.

Tachysphex.

1. *T. pectinipes* L. G. Wotton; Painswick and Olveston, (H. J. C.). S. Burnham (L. B.); Berrow (T. J.), and doubtless in many other localities.
2. *T. unicolor* Panz. S. Burnham in 1923 (T. J.).

Astatidæ.

Astata.

A. boops Schr. G. Wotton (V. R. P.), but has not occurred there for many years. S. Minehead (Rothney).

VESPOIDEA.

Psammocharidæ.

Psammochares.

1. *P. rufipes* L. S. Shapwick 1922 (R. J.).
2. *P. cinctellus* Sp. G. Willsbridge, on an old wall (H. J. C.). S. Minehead (Rothney).
3. *P. nigerrimus* Sc. G. Wotton, not rare. S. Shapwick (R. J.); Wembdon (R. T.).
4. *P. cardui* Perk. G. Forest of Dean (R. C. L. P.). S. Shapwick (T. J.).
5. *P. plumbeus* F. S. A common sandhill species, very abundant at Burnham (various collectors). Berrow, abundant (T. J.).

   P. viaticus L. This species so common generally in Devon, and frequent on the moor, as elsewhere, appears to be unrecorded from Somerset. It must surely be found in the county, and the much more local *consobrinus* ought to occur on the North coast sandhills. The female is markable from the fact that it hibernates as an image, and is often seen in March.
6. *P. spissus* Sch. G. Wotton, commonly in woods. Not recorded in Jermyn's Somerset list, but it must certainly occur in the county, being a common insect in the S.W. of England, and was taken by the old Bristol collectors at Bristol.
7. *P. chalybeatus* Sch. A common sandhill species. S. Burnham (L. B.); Sand Bay (H. M. H.); Berrow (R. T.).
8. *P. gibbus* F. A common and generally distributed species.
9. *P. unguicularis* Th. G. Occurred freely in the woods near Wotton about 1885.
10. *P. pectinipes* v.d. L. G. Recorded by V. R. P. as rare at Wotton, but a few years ago it was common, and a female was captured with only two cubital cells on either wing, so that it greatly resembled *Evagethes bicolor* (R. C. L. P.).

Salius.

1. *S. fuscus* L. Common in both counties.
2. *S. exaltatus* F. G. Not common in the Cotswold district; Forest of Dean (R. J. and R. C. L. P.). S. Exford (T. J.); Isle Brewers and Crewkerne (R. C. L. P.).
3. *S. notatulus* E.S. G. Olveston (H. A.). S. Shapwick (R. J.).
4. *S. obtusiventris* Sch. S. Near Crewkerne, August 1924 (R. C. L. P.).
5. *S. pusillus* Sch. G. Wotton, numerous in 1914, and Kilcot; Forest of Dean (R. C. L. P.). S. Only recorded from Minehead (Rothney). Generally a common species.

6. *S. parvulus* Dahlb. G. Kilcot (R. C. L. P.). S. Only recorded from Minehead (Rothney), and I have myself captured it at Isle Brewers.

Calicurgus.

C. hyalinatus F. G. A single specimen was captured at Wotton by V. R. P. many years ago.

Agenia.

1. *A. variegata* L. G. Common at Wotton in some seasons, Alderley and Badminton (R. C. L. P.); Selsley (Martineau). S. Sand Bay (M. J. and H. M. H.); Mendips (E. Saunders); Minehead (Rothney); Clevedon (Watkins).
2. *A. hircana* F. G. Wotton, Alderley, Badminton, etc.; Stapleton (H. J. C.); Selsley (Martineau). Often with the preceding. I took dozens of the two mixed in a single morning on old hawthorn trees in Badminton Park in 1886.

Ceropales.

C. maculata F. G. Common locally in the Cotswold district. S. Only recorded from Minehead (Rothney) and Shapwick (T. J.). It is a common insect, and will be found in many localities.

Vespidæ.

Vespa.

1. *V. crabro* L. G. More or less local and irregular in appearance in the county, but occurs in many places. It used to be very common in the Forest of Dean. S. Batheaston (L. B.); Weston-super-Mare (T. J.); Crewkerne (Martineau), and no doubt in many other localities.
2. *V. vulgaris* L. Abundant.
3. *V. germanica* F. Abundant.
4. *V. rufa* L. G. In some seasons as common as the preceding. S. Common (T. J.).
5. *V. sylvestris* Scop. Common in both counties.
6. *V. norvegica* F. G. Not in V. R. P.'s 1892 list, but abundant throughout the surrounding hills in 1922; Stapleton and Olveston (H. J. C.). S. Batheaston (L. B.); Quantocks (T. J.).
7. *V. austriaca* Panz. (*arborea*). G. Once captured many years ago by V. R. P. I have seen one or more other old records for G., but cannot remember the exact locality or author now.

Eumenidæ.

Odynerus.

1. *O. crassicornis* Panz. One specimen at Shapwick in 1916, but not found again (T. J.).

2. *O. gracilis* Br. G. Wotton and Alderley, sometimes common (R. C. L. P.); Olveston (H. J. C.). S. Freshford (H. J. C.); Minehead (L. B.). A common species always attracted by the flowers of Schrophularia, when this grows in its localities
3. *O. sinuatus* F. G. Not common at Wotton. S. Burnham (L. B.); Sedgmoor (R. T.); Shapwick (T. J.).

Ancistrocerus.

1. *A. callosus* Th. Abundant in both counties. The only British species of which the female hibernates.
2. *A. pictus* Curt. A common species in the S.W. of England, occurring freely in both counties.
3. *A. trimarginatus* Zett. Especially common on sandhills. G. The record for Wotton must I think be an error. The species was collected freely by V. R. P. in North Devon and there may have been a confusion in the localities, Wotton being a very unlikely place for the Wasp. S. Minehead, abundant and Weston (T. J.); Sand Bay (H. M. H.); Burnham (L. B.).
4. *A. parietinus* Curt. A common species, abundant in Glos. S. Batheaston (L. B.); Freshford (H. J. C.); Weston (T. J.); Crewkerne (R. C. L. P. and Martineau).
5. *A. antilope* Panz. G. Wotton, common in some seasons, often flying over raspberry canes in gardens. S. Not recorded in Jermyn's lists, but I found it, with all the common species of the genus in my brother's garden at Crewkerne (R. C. L. P.).
6. *A. trifasciatus* Oliv. G. Irregularly at Wotton, but not very scarce in some seasons (R. C. L. P.); Redland (H. J. C.). S. Freshford (H. J. C.); Weston, Banwell and Shapwick (T. J.).
7. *A. parietum* L. This variable species is very common and generally distributed.

Hoplomerus.

1. *H. spinipes* L. G. Formerly there were large colonies in the woods at Wotton, but I could not find any in the last few years; Alveston (H. J. C.). S. Numerous localities; Wembdon, Weston, Dunball, Sedgmoor and Brean Down.
2. *H. melanocephalus* Gm. S. Freshford (H. J. C.); Mendips (Saunders). Taken freely at Bristol by the old collectors. Walcott sent specimens captured in May 1839 and 1840 to F. Smith.
3. *H. lævipes* Sh. Bristol, taken commonly by the old collectors. I believe the actual locality was Leigh Woods. S. Blagdon (R. T.); Shapwick (T. J.); Batheaston (L. B.).

Sapygidæ.

Sapyga.

1. *S. 5-punctata* F. G. Wotton, rare; parasitic on *Osmia cærulescens*. S. Only recorded from Sand Bay (H. M. H.).
2. *S. clavicornis* F. G. Found in some numbers by V. R. P. near Wotton during the later years of his collecting. It is, as he observed, parasitic on *Chelostoma florisomnis*.

Tiphiidæ.

Tiphia.

1. *T. femorata* F. S. Burnham (L. B.).
2. *T. minuta* v.d. L. G. Not rare in the neighbourhood of Wotton 1888–1890 (R. C. L. P.). This small insect is easily overlooked, and has not been recorded from Somerset, though it is common to the West in Devon.

Thynnidæ.

Methoca.

M. ichneumonides F. G. Forest of Dean (F. White).

Myrmosidæ.

Myrmosa.

M. melanocephala F. G. Wotton and Alderley; not rare in some seasons, the male sometimes on white Umbelliferæ. S. Berrow (T. J.).

Mutillidæ.

Mutilla.

M. europæa L. S. Shapwick, where it has been captured by Miss May Jermyn, Mr. A. H. Martineau and others; Weston (H. J. C.'s list.).

Chrysididæ.

This family of small but beautiful insects must have been sadly neglected by collectors in these counties judging by the records I have seen. Walcott of Bristol had a very fine collection of Ruby Wasps, but how many of them were captured in that neighbourhood is quite uncertain

Cleptes.

C. pallipes Lep. G. Common in gardens in Wotton.

Elampus.

E. auratus L. G. Wotton, not very common. Bred from burrows of *Pemphredon lethifer*. S. Shepton Mallet (H. J. C.); Isle Brewers (R. C. L. P.).

Hedychridium.

H. ardens Curt. S. Berrow (R. T.).

Chrysis.

1. *C. ignita* L. Common everywhere.
2. *C. rudii* Sh. S. Shepton Mallet (H. J. C.).
3. *C. viridula* L. G. Wotton. S. Shepton Mallet (*Chrysis ornata* Sm. captured by Hewitson at Bristol, has been supposed to be an extraordinary variety of this species).

FORMICOIDEA.

Poneridæ.

Ponera.

(*P. punctatissima* Rog. This species is rarely found at any great distance from houses, and very often in hothouses, and has little claim to be indigenous. It has been recorded from Minchinhampton G. by Farren White).

Myrmicidæ.

Myrmecina.

M. graminicola Latr. G. Wotton (V. R. P.); Stinchcombe Hill and Stonehouse (Farren White); Durdham Down (Bacchus). S. Batheaston (D.).

Tetramorium.

T. cæspitum L. S. Batheaston (D.); Bossington Hill, Hawkecombe (Crawley).

Leptothorax.

1. *L. tuberum* F. G. Durdham Down, Bristol (Bacchus).
2. *L. nylanderi* Forst. G. Near Stonehouse (D.); Sea Mills, near Bristol (Bacchus).
3. *L. acervorum* F. G. No doubt common in many localities, as at Wotton and near Badminton. Stonehouse, Leonard Stanley, Forest of Dean, etc. (Farren White); Bristol on the banks of the Avon (Bacchus). S. Porlock Hill and Horner Valley (Crawley).

Myrmica.

1. *M. lævinodis* Nyl. A common and generally distributed species.
2. *M. ruginodis* Nyl. Common and generally distributed.
3. *M. scabrinodis* Nyl. Abundant.
4. *M. lobicornis* Nyl. S. Exmoor (Farren White); Leigh (Smallcombe).

Formicidæ.

Lasius.

1. *L. fuliginosus* Latr. G. Wotton, common; Selsey and Cheltenham (Farren White). S. Porlock (Crawley); Shepton Mallet (H. J. C.); Batheaston(L. B.).

2. *L. umbratus* Nyl. G. Stonehouse, abundant, and Forest of Dean (Farren White); Olveston (H. J. C.).
   Race *mixtus* Nyl. G. Common at Dursley (Smallcombe). S. Long Ashton and Leigh (Smallcombe).
3. *L. flavus* de Geer. Abundant generally.
4. *L. niger* L. Very common.
5. *L. alienus* Forat. G. Stonehouse, Stinchcombe Hill and Symonds Yat (Farren White); Durdham Down (Smallcombe and Bacchus). S. Minehead (Farren White); Steep Holm (Hudd).

Formica.

1. *F. rufa* L. Common in many localities.
2. *F. fusca* L. Abundant and generally distributed.
   Race *glebaria* Nyl. G. Common. Brinscombe, Minchinhampton Common, Stinchcombe Hill and Haresfield Beacon (Farren White); Stroud (W. B. Davies); Hills round Wotton, frequent at Kilcot 1887–1890 (R. C. L. P.). S. On marshes near the seashore at Porlock (Crawley).

Recent Earthquakes.

By T. V. T. Baxter, M.A., Camb., B.Sc., Lond.

(*Read October 2nd*, 1924).

THE object of this Paper was to consider a selection of those recent major earthquakes which have been studied by seismologists, and to illustrate the chief results established by modern seismology.

An earthquake is caused by a portion of the inner crust of the earth giving way under increasing stress. The stress may accumulate slowly or rapidly, and its own cause is conjectural. Although earthquakes are probably but a minor accompaniment of vast continuous slow processes within the earth, yet an enormous flow of energy is liberated from the focal space of a major seism, perhaps as much as fifty billion kilowatts.

This energy is transmitted by the rocks deep within the earth, in the form of waves or tremors, some of which travel through the earth in 21 minutes. Rocks transmit tremors because they are elastic, *i.e.*, a cube of rock resists an effort to change its volume, or an effort to change its shape. Rocks have two elasticites; and since the volume or compression elasticity exceeds the shape or screw elasticity, (while the speed of transmission depends partly on elasticity), we shall not be surprised when we find evidence that there are two kinds of tremors from distant earthquakes, of which one kind outstrips the other in the race through the earth from the focus of a shock to the more distant part of the earth's surface.

When an earthquake occurs, accurate records can only be obtained by automatic instruments, whether in the epicentre, where human attention is temporarily otherwise occupied, or at the antipodes, where tremors are too feeble for human observation to record. The modern seismograph consists essentially of a base to conduct the tremors, a frame, a steady point or line, a recorder, and a damping device. In a typical instrument a horizontal boom rests with an end socket against a pillar, and near the other or distal end carries a weight; a certain line in this weight remains steady during the seism. The distal end is supported by a wire, fixed to the pillar at a point not quite vertically above the socket, but a little towards the weight; the outline much resembles the mast, boom and stay of a ship. If a jerk is applied to the pillar, opposite ends of the boom move in opposite directions, and the steady line justifies its name. In the Milne-Shaw instrument, the recorder consists of a thin vertical blade of light, reflected by a mirror coupled to the distal end of the boom.

Supposing tremors to be in transit, we see that the mirror vibrates about its own fixed vertical axis, and the reflected blade of light moves to and fro. This wandering blade always falls upon a horizontal cylindrical lens, which compresses the blade into a pencil, whose point of light always falls within a very narrow slit in the lid of a box. This box contains a ribbon of sensitized paper moved by clockwork athwart the slit; and, as long as the earth tremors are passing, the point of light traces a train of waves on the paper. Development renders the waves visible. Tremors from a shock up to eight thousand miles distant through the earth are feeble on arrival, and the Milne-Shaw instrument magnifies up to 400 times.

There yet remains the damping device. The principle of resonance, which causes the unpleasant vibration of the omnibus floor when the vibration period of the top gear approximates to that of the floor as the vehicle labours uphill, causes the steady line of the boom to err from its steadiness, and to be disposed to take up certain of the earth's vibrations as they pass. In order to keep the line steady, a copper disc projects from the boom and lies between, without touching, the poles of an electro-magnet. The least motion of the disc is resisted by the action between eddy currents and magnetic field, and the steady line is enabled to fulfil its function.

The seismograph records enable the observer to determine the direction of travel of tremors, their time of arrival, range and time of vibration, the angle of emergence from the earth, and indirectly their speed of travel through the earth. By combining the records of three arms of the instrument, an estimate of the actual path of vibration of a particle of rock can be made. It is important to realize that an arm which records horizontal vibrations will only record motion to and fro across the arm, and will ignore any motion directed along the arm.

We will now consider four well-established inferences, which can be deduced from the study of seismograph records: *The record presents a triple division.* The photograph shown of the Petrograd record of the Asia Minor shock of 1909 displays first, a set of short waves, then a jerk and a set of rather longer and wider waves; next, a band of very wide and more open waves. These are P (primary), S (secondary), L (long) waves respectively P waves precede S by a definite interval of time, which increases with distance from the focus or origin of the shock.

Paths of the tremors. Prof. C. G. Knott gave reasons why the conclusion is drawn that P and S tremors travel through (not round) the earth along slightly outward-bent chords. The L waves travel round the earth. Briefly the evidence consisted of seismograph time-readings, which show that, while times of transit for P and S are practically proportional to chord distance from focus to observer, the times for L are proportional to distances round the earth's surface.

The speed of P probably increases from 5 miles per second to 8 miles per second, while L travels at 2 miles per second.

Rapid determination of an epicentre. An epicentre, or area of greatest intensity, is usually of considerable size. An observer, whose seismograph begins to record a distant shock, reads the seconds by which P preceded S. The tables of Prof. Milne and Turner at once tell him the distance of the shock. He draws on a map a circle having himself as centre, and that distance as radius, and often his knowledge of seismic distribution, will fix the probable epicentre, a few minutes after he observed the P waves to arrive. As soon as he obtains the observations of two other observers, suitably situated, he can draw two more circles on his map ; and their common area will be very near to the epicentre. Other methods exist, in which two sets, or even one set, of observations will yield the epicentre.

P tremors are pull and push, S are screw tremors. The slide of the Kingston, Jamaica, shock of 1907 indicates that at Washington, D.C., 1,400 miles N. of Kingston, the seismograph arms pointed one E and W, and one N and S. The E and W arm recorded P tremors $4\frac{1}{2}$ minutes before the N and S arm began to move. When the N and S began to move, there was a slight jerk on the record of the E and W arm. Now the arm only records motion across its own direction ; hence the P tremors had N and S vibration only. But this was the line of travel from Kingston to Washington, and therefore P tremors are compressional, or pull and push vibrations. Further, S tremors moved the N and S arm ; and so S tremors contain vibrations athwart their line of travel, or screw tremors. This argument is based here upon one case only, for conciseness, but other corroborative cases exist.

A conjecture. Now S tremors are sometimes absent from records taken within the antipodes, of radius about 60 degrees, opposite to a focus. Since P and S tremors travel through the earth, it has been concluded that a central core exists impervious to S. Now S are screw tremors, and a liquid has no screw elasticity ; hence arises the conjecture that the rigidity of the earth disappears about 2,400 miles from the surface, and the inner core behaves like a liquid.

Safe buildings and safe sites. The San Francisco earthquake of 1906 occurred at an hour when many workers had lit their morning fires to prepare a meal before going to work, and the damage by earthquake was apparently inextricably entangled with that by fire.

The careful survey instituted by the United States Government succeeded, however, in gathering a large body of accurate observation whose analysis reveals several useful principles.

It appears that for ordinary houses, not specially designed or strengthened, the damage was divisible into four classes, characterized by degree of intensity, which was found to depend on the nature and environment of the ground. On bare rocky ridge tops the damage was slight ; on slopes of rock, covered with thin soil, the danger was rather greater ; the gravelly soils of valleys seemed to convert tremors into slow waves of increased range, with the result that buildings, particularly those freshly built, or ill-tied, or top-heavy, suffered more severely, though collapse was rare ; the made ground and swampy soil, occupying the low lying parts of San Francisco, bordering and encroaching upon the old creeks near the bay east of the city, proved to be a disastrous foundation for all buildings, except those of special design and construction.

It was observed that even on deep loose and marshy foundation, structures of steel frame, founded on very deep piles, withstood the shock, and that well-bonded buildings of brick and cement, some years of age, on similar deep piles, stood equally well, excepting weakly-tied corners, and tall chimneys and chimneys tied to walls. The most treacherous foundation was of made ground filling old creeks ; and in such cases there appeared to be bodily sinking and sliding of blocks of ground.

Tectonic and volcanic earthquakes. One theory attributes the stress, which ends in an earthquake, to a shrinking of the outer crust on cooling, and consequent cracking along planes of weakness ; another has it that the inner core cools and shrinks away from the outer crust, which proceeds to fall inwards. A third theory asserts that a viscous liquid subterranean ocean of lava extends round the world at a depth of some scores of miles, that the rocks of the sea-beds are heavier than those of the highlands, and so the roots of the sea-beds float deeper in this lava ocean than those of the continents, that from time to time, at intervals of perhaps millions of years, the viscous lava becomes heated to fluidity through radio-activity, and large redispositions of land and ocean result. These are the major seisms of which our experience is happily ignorant, while our earthquake phenomena are very minor incidents, which arise out of restricted activity in isolated corners of the lava ocean.

However the truth may be, some seisms are obviously volcanic, and some are not ; the latter are called tectonic, unless there is a doubtful volcanic connection. The epicentral area of a volcanic shock is restricted, on account of a very localized and shallow origin ; but the intensity within the epicentre may be of the greatest order, and the tremors detected at the Antipodes.

Tectonic shocks are often associated with relative movement between opposite faces of faults, which may extend over scores or hundreds of miles. This causes the focus to be very long, and often very deep. The epicentral areas of great tectonic shocks are therefore usually very large, and such great shocks are invariably of the earth-shaking class.

The geographic effects of a volcanic earthquake were well illustrated by the Sakurajima shock of 1914 in Japan. Four thousand acres were covered with lava, ash was deposited to a distance of 30 miles from the origin, with a maximum thickness of 70 inches thinning out to zero, and several villages were destroyed. The loss of life was very small, because Dr. Omori had for three years received increasing warning from his seismographs that the district was becoming acutely seismically sensitive, and through his representations preparations had been made to remove the people in good time.

The topographic effects of tectonic shocks may be illustrated by the San Francisco seism of 1896, and that of Mino-Owari in 1891. The latter shock was of the same order as that of Tokio in September 1923. The Tokio earthquake originated, perhaps through collapse of blocks of sea-bed, at a distance of 60 miles S.W. of Tokio ; the focus according to Dr. Davidson was shallow and 12 miles below the floor of Sagami Bay. Most of the nearer coast was lifted to a maximum of six feet ; but the sea floor of the Bay was depressed in one place by 230 feet, and raised elsewhere by 270 feet. A high sea wave come in from the elevated bed.

Distribution of seismic areas. From a study of the records of 160 thousand earthquakes, de Montessus de Ballore in 1903 concluded that 53 per cent. of all known shocks have originated along a zone from the Alps through the Caucasus and the Himalayas, and 38 per cent. along the shores of the Pacific Ocean. In fact 91 per cent. have originated along one or other of these two belts of discontinuous seismic activity. It is interesting in connection with a theory mentioned above, to note that along these two zones we also find some of the steepest gradients, and the youngest mountain ranges in the world.

Conclusion. The introduction of accurate seismographs has enabled much mapping of seismic centres to be performed. Safe and unsafe areas and types of buildings can be indicated. A limited degree of prevision has been achieved by the late Dr. Omori, and it may be hoped that continued effort in this direction will meet with further success.

The Apterygota of the South-West of England.

By H. Womersley.

Part II.

SINCE the publication of my first list of interesting insects in the Proceedings of the Bristol Naturalists' Society, 4 S., Vol. VI., p. 28, 1923, I have continued to collect and observe them in the area covered by the activities of the South-Western Naturalists' Union, *viz.*: Gloucestershire, Wilts, Somerset, Dorset, Devon and Cornwall, and more especially in the immediate neighbourhood of Bristol. In addition to my own, I have received a number of specimens from other Naturalists whose names I have duly mentioned.

Although no species new to Science can so far be recorded for the area, yet a number of our species are of great interest to the student of Insect Distribution.

We now have on record 1 species of Protura, 9 of Thysanura, and 71 species (one only in its varietal form) and 11 varieties of Collembola.

Again I gratefully acknowledge my indebtedness to Mr. J. M. Brown, B.Sc., F.L.S., F.E.S., for his continued valuable help.

Class — INSECTA.
Sub-Class — Apterygota (Oudemans).
Order — **Protura** (Silv.).
Family — **Acerentomidæ.**
Genus — **Acerentomon.**

1. **A. doderoi** (Silv.).

Under old bark, Blaise Castle Woods, Bristol, February 23rd, 1924. Also in similar habitat at Oldbury Court, Fishponds, Bristol, March 15th, 1924. This is the first record for this interesting order of insects from the West Country.

Order — **Thysanura.**
Family — **Machilidæ.**
Genus — **Proemachilis.**

1. **P. hybernica** (Carp.).

This seems to be generally distributed around Bristol. I now have additional records from Tyntesfield, July 6th, 1924, Brockley Combe, July 12th, 1924; also from Nympsfield, near Stroud, June 28th, 1924; *Evens.*

Genus — **Petrobius** (Leach).

2. **P. carpentari** (Bagn.).

This appears to be the characteristic Rock jumper of the Bristol Channel, at any rate, on the English side. I have no records from the Welsh side. It is far more widely distributed than P. maritima, reaching as my previous records show, almost to Bristol, along the Somerset side of the Avon. Search for it in suitable localities, higher up than the mouth of the Avon, so far has been negative.

I have also taken it at Sand Point, Somerset, July 5th, 1924, mostly immature, but a few adults, and Mr. C. W. Bracken has sent me specimens taken at Fistral Beach, Newquay, August 28th, 1924.

6. **P. maritima** (Leach), Carp.

Specimens of this species, so far, I have only received from Fistral Beach, Newquay, August 28th, 1924, through the kindness of my friend Mr. Bracken. These specimens, however, differ in minor details from the original description of Carpenter.

Family — **Campodeadæ** (Lubbk.).
Genus — **Campodea** (West).

7. **C. devoniensis** (Bagn.).

Described from Torquay by Bagnall, E. M. M. 1918, p. 277.

8. **C. gardneri** (Bagn.).

Two specimens along with C. lankesteri under stones, Lawrence Weston, Bristol, May 24th, 1924.

Family — **Lepismatidæ** (Burm).
Genus — **Thermobia.**

9. **T. furnorum** (Revelli).

This species is recorded from Great Bedwyn, Wilts., by Mr. C. P. Hurst, in the Report of the Marlborough College Society for 1923.

Order — **Collembola** (Lubbk.).
Sub-Order — **Arthropleona** (Börner).
Section — **Poduromorpha** (C.B.).
Family — **Hypogastruridæ** (C.B.).
Sub-family — **Hypogastrurinæ** (C.B.).
Genus — **Hypogastrura** (C.B.).
(Achorutes, Temp. Lubbk. L.)

3. **H. purpurascens** (Lubbk.).

On cliff-face along with S. aureus, var. ochropus, Oldbury Court, Bristol, 1924. Under stones, Lawrence Weston, Bristol, May 13th, 1924.

H. purpurascens var. trispina (Axels.).
Under bark, Leigh Woods, Som., November 18th, 1923.

4. **H. viaticus** (Linn.) Tullb.

Abundant on wet farm yard ruts, Lawrence Weston, May 24th, 1924.

Genus — **Xenylla** (Tlbg.).

8. **X. grisea** (Axels.).

Under bark and in moss, Cadbury Camp, Tickenham, Som., April 6th, 1924. In moss, Blaise Castle Woods, Bristol, April 5th, 1924. On shore under wood debris, Minehead, June 8th, 1924.

58. **X. humicola** (O. F.) Tlbg.

Under bark in farm yard, Lawrence Weston, Bristol, May 24th, 1924.

Genus — **Willemia** (Börn.).

59. **W. anopthalma** (Börn.).

One specimen of this species occurred in moss from Blaise Castle Woods, Bristol, February 23rd, 1924.

Sub-family — **Achorutinæ** (C.B.).
Tribe — **Pseudachorutini** (C.B.).
Genus — **Pseudachorutes** (Tlbg.).

60. **P. subcrassus** (Tlbg.).

Several specimens were found at Leigh Woods, Som., November 21st, 1923.

Genus — **Friesia** (D.T.).

61. **F. claviseta** (Axels.).

One specimen under bark along with Acerentomon doderoi at Blaise Castle Woods, Bristol, July 19th, 1924.

62. **F. mirabilis** (Tlbg.).

In moss Charterhouse on Mendip, Som., April 19th, 1924; also from similar habitat, Blaise Castle Woods, Bristol, July 19th, 1924.

Genus — **Anurida** (Laboulb.).

10. **A. maritima** (Guer.).

Additional to previous list, I have found it at Exmouth, Devon, June, 1924; Sand Point, Som., July 5th, 1924; and specimens were sent me from Lansallas Bay, Cornwall, August 8th, 1924, by the late Col. Jermyn.

63. **A. granaria** (Nic.).

I found specimens under stones in Banwell Caves, Som., February 3rd, 1924, and also under stones in the open at Bristol, 1924.

Family — **Onychiurinæ** (C.B.).
Genus — **Onychiurus** (Gerv.) Börn.

14. **O. armatus** (Tlbg.).

Under stones in Banwell Caves, Som., February 3rd, 1924, and under bark, Oldbury Court, Bristol, March 15th, 1924.

15. **O. fimetarius** (Linn.) Lubbk.

Under stones in Banwell Caves, February 3rd, 1924.

Section — **Entomobryomorpha** (C.B).
Family — **Isotomidæ** (Schffr.).
Sub-family — **Isotominæ** (Schffr.).
Genus — **Isotoma s. str.** (Bourl. C.B.)

17. **I. viridis** (Bourl.).

Oldbury Court, Bristol, March 15th, 1924.

19. **I. maritima** (Tlbg.).

A number of specimens of this small greyish Isotoma were taken amongst marine debris on the shore at Portishead, September, 1924.

64. **I. notabilis** (Schffr.).

This interesting and delicate spring tail I have taken in moss by means of the Berlese funnel, Cadbury Camp, Tickenham, Som., April 6th, 1924; Kewstoke Woods, Weston-super-Mare, April 13th, 1924; Charterhouse on Mendip, April 19th, 1924; Blaise Castle Woods, Bristol, July 19th, 1924.

Genus — **Archisotoma** (Linnaniemi).

24. **A. besselsi** (Pack.).

Abundant on the shore at Sand Point, nr. Weston-super-Mare, July 5th, 1924. Probably occurs on the coast throughout our area.

Genus — **Folsomia** (Willem.).

26. **F. quadrioculata** (Tlbg.).

Abundant in moss, Blaise Castle Woods, Bristol, April 5th, 1924; also at Cadbury Camp, Tickenham, Som., April 6th, 1924.

Family — **Tomoceridæ** (Schaffr.).
Genus — **Tomocerus** (Nic.).

28. **T. minor** (Lubbk.).

Oldbury Court, Bristol, March 15th, 1924.

30. **T.** (Pogonognathus) **longicornis** (Lubbk.).

Oldbury Court, Bristol, March 15th, 1924.

Family — **Entomobryidæ** (C.B.).
Sub-family — **Entomobryinæ** (C.B.).
Tribe — **Entomobryini** (C.B.).
Genus — **Sinella** (Brook) Burm.

65. **S. cavernarum** (Doniez.).

This cave-inhabiting species I found under stones in the caves at Banwell, Som., February 3rd, 1924.

Genus — **Pseudosira** (Schött) Börn.

66. **P. domestica** (Nic.).

Mr. J. V. Pearman took several of this indoor species at Aust Farm, Lawrence Weston, Bristol, July, 1924, and I took one myself on my study table August 10th, 1924. This genus differs from Sira in having the dentes scaled ventrally.

Tribe — **Orchesellini** (C.B.).
Genus — **Orchesella** (Templ.).

47. **O. flavescens** (Bourl.).

This, in my opinion, the most magnificent spring-tail, was again taken in its previously recorded habitat amongst dog's mercury at Flax Bourton Combe, Som., May 17th, 1924.

Sub-Order — **Symphepleona** (C.B.).
Family — **Neelidæ** (Fol.).
Genus — **Neelus** (Fol.).

67. **N. murinus** (Fol.).

These minute creatures may be obtained in moss by aid of the Berlese funnel. I have taken them from Blaise Castle Woods, Bristol, January 26th, 1924, and since.

Genus — **Megalothorax** (Willem.).

68. **M. minimus** (Willem.).

This species, which is even smaller than the last, approx. 0.2 mm., occurs in similar habitat. I have it from Blaise Castle Woods, March 2nd, 1924; Oldbury Court, Bristol, March 15th, 1924; also Kewstoke Woods, Weston-super-Mare, April 13th, 1924.

Family — **Sminthuridæ** (Lubbk.).
Sub-family — **Sminthuridinæ** (Börn.).
Genus — **Sminthurides** (Börn.).

69. **S. malmgreni** (Tlbg.). var. **elegantula** (Reut.).

One specimen of this usually aquatic species I took under a damp stone, Banwell, Som., February 3rd, 1924.

Genus — **Sminthurinus** (C.B.).

50. **S. aureus** (Lubbk.).

The type of this species occurred at Bristol, November 2nd and 7th, 1923; also at Blaise Castle Woods, Bristol, November 10th, 1923.

S. aureus var. **ochropus** (Reut.).

This black variety of S. aureus occurred plentifully on rock-faces in Oldbury Court Grounds, Bristol, March 15th, 1924, along with H. purpurascens. A few were also found in similar habitat at Blaise Castle Woods, Bristol, April 5th, 1924.

Sub-family — **Sminthurinæ** (C.B.).
Genus — **Bourletiella** (Bank) C.B.
(Deuterosminthurus, Börn.)

52. **B. bicinctus** (Kock.).

On dog's mercury, Flax Bourton Combe, Som., May 17th, 1924.

B. bicinctus var. **repanda** (Agr.) Axels.

Abundant everywhere on dog's mercury in the Exmouth district, June 1924. On clover, Lawrence Weston, Bristol, September 6th, 1924.

B. bicinctus var. **pallipes** (Lubbk.).

A black to violet variety—was plentiful but localised along with var. repanda between Woodbury and Exmouth, Devon, June 17th, 1924; also on clover, Lawrence Weston, Bristol, September 6th, 1924.

70. **B. bilineatus** (Bourl.).

This small, but prettily marked Sminthurid was fairly numerous on heather Woodbury Common, near Exmouth, Devon, June 19th, 1924.

71. **B. hortensis** (Fitch.).

In moss, Blaise Castle Woods, July 19th, 1924.

Sub-family — **Dicyrtominæ** (C.B.).
Genus — **Dicyrtomina** (C.B.).

56. **D. minuta** (O.F.).

The type of this insect occurred amongst herbage in Blaise Castle Woods, Bristol, May 11th, 1924.

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Bristol Botany in 1924.

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

A FEW months ago there passed away a life-long lover of plants, whose observations had been of service in the compilation of the district *Flora*. David Williams was gardener on the Failand House Estate for more than forty years, and during the whole period it was evidently his delight to make friends of the flowers that grew upon and around the property on which he was employed. In his annotated Catalogue of British Plants, one finds a mention of practically all the flowering plants—if the more difficult genera which he did not attempt to deal with be omitted—that have been recorded from the Failand neighbourhood, he being the first to notice some of the more interesting. Assuredly no part of the Bristol area has been more closely examined. Among the entries are a few that should have had a welcome in the *Flora*. *Thalictrum flavum*, in a field off the lane from Failand to Portbury from 1886 onwards, had disappeared by 1912. *Ranunculus hederaceus*, too, in a streamlet near Failand House, seemed to die out after many years. *Fragaria elatior* was found "wild" in 1884 between Failand and Charlton House. *Caucalis daucoides* grew between Shirehampton and Avonmouth, 1886—1892. Of *Chenopodium urbicum* he writes, with acute discernment, "Two plants in Durbins, Failand, 1907. Growing with *C. rubrum*, but distinct with seeds much larger." A quaint story under *Solanum nigrum* makes interesting reading seeing that the berries of this species are commonly banned as poisonous. "Constant as a garden weed at Failand House where a gentleman visitor ate them freely. As he was fond of black currants, and could not get the bushes to grow in Natal where he spent twelve years, he said he took to eating Solanum berries because they resembled currants, and got to like them." The garden weeds Williams encountered, and that persisted often for many years, in spite of a fairly intensive cultivation make a surprising list that includes many rarities, British and foreign. Their source could seldom be traced, unless it lay in imported manure, and chicken-corn, but their occurrence was always recorded with a kind of sympathetic interest, and it can be imagined that they were regretfully destroyed. How far more complete would be the knowledge of our flora if here and there among his fellows there were some who could take such notes as these with the care and industry that characterized our friend.

In the *Journal of Botany* for January there appeared another ecological study of our Channel coast-line from the pen of Mr.

H. S. Thompson, who on this occasion discusses in scientific fashion the vegetation and other features of Steart Island and Steart Point, two unattractive bits of salt-marsh, sand and alluvial mud lying at the mouth of the Parrett. The facts revealed are not of peculiar importance botanically as no species or variety was noted that does not occur on the neighbouring seaboard between the Brue and Brean Down. But it is cheering to find that some handsome flowering plants—Horned Poppy and Sea Holly in particular—that have become lamentably scarce on the more frequented mainland still survive in fair quantity. It has been assumed hitherto, on good authority, that Steart Island pertained to the vice-county of North Somerset, and belonged accordingly to our botanical district. But Mr. Thompson contends that as the main channel of the river Parrett actually separates it from the coast at Burnham, Steart Island should be attached to the southern division of the county.

A more detailed account and analysis of the Steep Holm flora than had been availabe has been published in the June number of the same Journal by Dr. R. C. McLean and Mr. H. A. Hyde, as the result of a visit to the island by a party of Cardiff naturalists. Whereas the total number of flowering plants and ferns had been previously estimated at 150, these botanists give a list of 220, so far recorded from the Holm. This list includes, however, a few errors and extinctions.

Draba muralis L. Very sparingly on Kingdown Crags, Mendip; *H. S. Thompson.* It was gladly noted also that the entire-petalled form of the Cheddar Pink is persistent on those rocks.

Lepidium latifolium L. Naturalized in a lane near Tockington, G.; *Miss Roper.*

Sagina ciliata Fr. Abundant at Sand Point, S., on the grassy top of the ridge; all very glandular; *H. S. Thompson.*

S. nodosa Fenzl. The form of dry limestone, in one spot on Hampton Down, Bath; *Rev. E. Ellman.*

Geranium sanguineum L. A fine plant on a ledge in Cheddar Gorge; *B. A. Lowe.* Long known at Ebbor, but this is the first report from Cheddar.

G. purpureum Vill. (*G. modestum* Jord.). On the north side of St. Vincent's Rocks; *C. Wall.* A new record for West Gloucester.

Erodium neglectum Baker and Salmon. Sand dunes, Burnham, S.; *W. Watson.* Probably the plant previously recorded from the locality as *E. cicutarium* var. *glandulosum.*

Melilotus arvensis Wallr. (*M. officinalis* Lam.) Well established between Burnham and Highbridge; *Lady Davy.*

Trigonella ornithopodioides DC. By the top of a wood at Hanham Green, G. Stems up to 10 inches long; *H. J. Gibbons.*

Agrimonia odorata Mill. Charlton Woods, Portbury, S.; *Rev. E. Ellman* and *Noel Sandwith.*

Rubus. In reviewing the work of an American botanist (*Journ. Bot.* LXII, pp. 83–86) the Rev. H. J. Riddelsdell writes some pertinent paragraphs well worth the attention of field-workers who attempt to deal with bramble problems in this country. The suggestion that variations in the genus may be often due to an inherent fluidity which arises from some unknown cause independent of crossing, and that forms are actually changing from year to year, well expresses what has long been a supposition of my own. For I can conceive no more likely explanation of peculiar loss of recognized varieties and the appearance of others in our own area.

Sedum sexangulare L. Looks more than ever like a native plant at Wyck Rocks, where it now covers large spaces of exposed limestone on both sides of the valley; *Colin Trapnell.*

Bidens tripartita L. Growing as a strand plant at the mouth of the Brue. Doubtless carried down by drainage from the peat moors; *H. S. Thompson.*

Sonchus arvensis var. *glabrescens* Hall. A rare form of the Corn Sow-Thistle. Casual at Avonmouth Dock, G.; *C. and N. Sandwith.*

Cnicus eriophorus Roth. var. *anglicus* Petrak. Frequent on hillsides and field-borders between Marshfield and Cold Ashton, G.; *H. S. Thompson.* Rather rare in West Gloucester, and unrecorded from this locality which has been seldom visited.

Erythræa pulchella Fr. (*E. ramosissima* Pers.) Is still quite scarce on our coast line. It may be worth noting that while in the dry summer of 1915 Mr. Thompson saw plants 1 inch high bearing a single flower, he gathered in the same spot during the late abnormally wet season specimens of 11 inches.

Solanum nigrum. L. In view of the poison-taint that still sullies the reputation of this plant the quoted note by David Williams is of some value. This is a cosmopolitan weed. In America, where the "stubble-berry" is abundant throughout the Northern States, its leaves have been commonly used as a resolvent, and the plant is classed among the non-poisonous medicinal herbs of the country. In Equatorial Africa it is equally prevalent. Mr. E. Brown reports from Uganda that the natives do not uproot it from their cultivations, but eat it as a potherb, cooking the leaves and young shoots like Spinach. There is indeed no unassailable evidence that berries of the Black Nightshade are more deleterious than those of its relative, the Tomato. A suggestion has been made that the toxic alkaloid of the family (solanine) may be erratic and uncertain in its distribution; but the opinion expressed in *Fl. Brist*, that whenever unpleasant symptoms follow consumption of these fruits the trouble is due to idiosyncrasy of the individual, is more likely to prove correct.

Cynoglossum officinale L. Persistent in fields to the south of Lansdown above Weston, S., but never more than two plants in the same place; *B. A. Lowe.* A new locality. The peculiarity stated, with others pertaining to this species, is mentioned in *Fl. Brist.*

Lithospermum officinale L. A clump near the Chewton end of Workhouse Lane, Keynsham, S.; *W. H. Stephens.* The extreme scarcity of the plant in the Keynsham district, pointing apparently to its intense dislike to Lias, renders this note of interest.

Lysimachia vulgaris L. In the Avon Gorge near the Black Rock, G.; *Miss Roper.*

Verbascum Blattaria L. Plentiful and luxuriant in thickets on a steep slope of Purn Hill, Bleadon, S.; *H. S. Thompson.* The finder writes that he has never seen so many plants together nor any in so secluded and wild-looking ground, difficult to approach.

V. virgatum Stokes. In two or three spots among the sand dunes at Berrow; and on the site of old glass works at Nailsea, S.; *C. and N. Sandwith.* Like other Mulleins this rarity is a prolific seeder. One hopes, therefore, that it may become permanently established in the localities given.

Chenopodium polyspermum L. var. *spicatum.* Waste ground near the Bishop's Palace, Redland; *H. J. Gibbons.*

Myrica Gale L. Is generally described as diœcious, but the careful examination of a number of plants on Shapwick Moor by Miss Roper in the early spring showed that four other variations exist in the arrangement of the sexes. Staminate and pistillate catkins grew on adjoining twigs, or together on the same twig of a bush; while a third mingling of the sexes was noticed one above the other in the same catkin. In addition, catkins were found consisting solely of hermaphrodite flowers.

Pinus sylvestris L. The largest of those ancient and interesting Scotch Firs in the peat of Walton Moor near Clevedon, (see *Fl. Brist.* p. 552) have lately been felled. It was grievous to see their big boles being hauled away in May last.

Orchis hircina Crantz. In the Report of the Botanical Section of the Somerset Arch. and Nat. Hist. Society presented in January by the Secretary, W. D. Miller, is this entry: "*Orchis hircina* Crantz, Burnham; *Miss Stewart.*" On enquiry for details of so astonishing a discovery in Somerset of a rarity hitherto known to occur solely in two or three south-eastern counties, the matter was found to be shrouded in an impermeable veil of secrecy, such as, happily, is seldom encountered under like circumstances. It must not be thought there was the least wish for unrestricted publicity, but as Burnham lies within the Bristol district it seemed imperative that those who for the time are responsible for local botanical history should be acquainted with the facts. The veil was ultimately raised, and in early July I had the pleasure of seeing this splendid orchid for the first time. There were many fine plants upon the site—so many as 84 have been counted—some at least three feet in height. They grow within the fencing of a private domain, on an artificially made bank adjoining the garden, and under trees that were planted say 40—50 years ago. Their number and luxuriance shew that the soil and situation, where it is surmised they must have flourished for some years, is entirely congenial. Although so extremely scarce in Britain this Orchis (*Satyrium* and *Himantoglossum* are its synonyms) is frequent throughout France, Belgium and Central Europe, whence the seed could be readily procured.

O. incarnata L. The true plant in a boggy field near Falfield, G.; *Miss Roper.*

Habenaria bifolia Br. On high ground above Cheddar Gorge; *F. Samson.* In this district the plant is usually found in moist peaty soil.

Potamogeton panormitanus Biv. Bern. A pondweed gathered on Walton Moor some years ago by Mr. H. S. Thompson was submitted to Mr. Arthur Bennett who thus named it, " a species which all Italian botanists simply regard as a synonym of *P. pusillus* L., but which Hagström has clearly shown to be distinct." It is possible that much of our so-called *pusillus* is really this plant. See *Bristol Botany* in 1920–21.

Aponogeton distachyon Thunb. Is still thriving in the pond at Englishcombe, where Dr. Prowse and I have lately seen it in flower. (See *Fl. Brist.* p. 612.) Here we have a subtropical species adapting itself to our climate, and doing quite well in waters that must be sometimes frozen.

Iris fœtidissima L. var. *citrina* Bromf. Near Kelston, S.; *Rev. E. Ellman.* A single clump, that may have been planted.

Narcissus poeticus L. Sparingly in woodland on the Battlefields, Lansdown; *B. A. Lowe.*

Carex muricata L. The plants included under this name in *Fl. Brist.* are now known to comprise two species, *viz. C. contigua* Hoppe and *C. Pairæi* F. Sch. The latter has been identified near Keynsham by N. Sandwith, and may certainly be expected elsewhere about Bristol.

C. extensa Good. In fair quantity at a spot on the Channel shore between Portishead and Walton Bay; *H. J. Gibbons.* This new locality for a rare sedge is most welcome.

C. pseudo-cyperus L. var. *minor* Hampe. Peat moor near Shapwick, S.; *N. Sandwith.* A very distinct and pretty variety.

Alopecurus bulbosus Gouan. Between Highbridge and Burnham, S.; *H. J. Gibbons*.

Festuca arundinacea Schreb. Seems to have gone from the shingly shore at New Passage, but a larger colony has been observed higher up the Severn at Aust Cliff. While quite distinct in this, its typical form, there are intermediates that connect it with *F. elatior*.

ALIENS.

Lotus siliquosus L. (*Tetragonolobus* Roth.). In July the Rev. E. Ellman reported this leguminous perennial to be abundant in a rough hilly pasture S.W. of Marshfield, G.—so plentiful in fact over several acres as to suggest that it must have been sown, although no mention can be found of its cultivation either at home or abroad; and observation tends to shew that cattle do not like it. This field is said to have been in cultivation until 1915, when it was laid down for grazing on account of scarcity of labour; but the plant is remembered there for at least forty years. The adjoining fields, in which the plant also occurs in less quantity, had likewise borne crops for a long period. *L. siliquosus* has only lately been noticed in this country. It occurred in Berkshire in 1913; and Dr. Druce tells me he has recently found it quite naturalized near the Thames at Henley in a chalky pasture, and very plentiful. Nothing is known of the method of importation. On the Continent this Lotus is not uncommon in damp meadows near streams.

Iva xanthifolia Nuttall. Twenty plants or more on some waste ground near Wee Lane, Stapleton, G.; *H. J. Gibbons*. A North American composite. Annual, often eight feet high. Common in the N. Western States, and known as Marsh Elder or Half-breed Weed. This seems to be its first appearance in the Bristol area, though it has been met with once or twice elsewhere.

Note on an Exposure of Old Red Sandstone at St. Monica's, Durdham Down, Bristol.

By F. S. Wallis, Ph.D.

(*Bristol Museum*).

In 1921 (reappointed 1922, 23 and 24) a British Association Committee, with Dr. H. Bolton as chairman, was formed " To investigate the stratigraphical sequence and palæontology of the Old Red Sandstone of the Bristol District." During the course of this investigation an exposure of more than usual interest was observed at St. Monica's, in that, besides displaying the junction beds between the Old Red Sandstone and Carboniferous strata, an interesting Fish-bed was noted. This research has been carried out under the auspices of the Bristol Museum and Art Gallery.

The quarry is situated on the northern edge of the Durdham Down plateau, in the north-west corner of, and abutting a north and south footpath to the west of the Hospital grounds (O.S. 6-in. map. Sheet LXXI. Glos.).

Operations were commenced in 1921, and the whole of the stone required for the Hospital buildings, with the exception of the freestone dressings, was supplied by the exposure here noted.

The upper beds of Avonian age are shortly to be described by Prof. S. H. Reynolds and Dr. Stanley Smith in the Geological Magazine. The Old Red Sandstone is conformable to these Avonian rocks, and a gradual transition between the typical deposits of both periods is clearly shown. The actual line of demarkation has been determined arbitrarily in consultation with the above mentioned authors.

The descending sequence (Dip. 38°N. 120°E) is as follows :

		ft.	ins.
Carboniferous (Avonian K_m.).	Red shales with bands of decalcified limestone		

		ft.	ins.
Old Red Sandstone	1. Slaty-grey fissile shale, very persistent and weathering to a deep-red colour	0	10
	2. Thinly-bedded reddish (weathering green) quartzite	1	4
	3. Red and green sandy shales ...	3	0
	4. Two soft sandstone beds with intervening shaly band	1	0
	5. Soft thinly-bedded shaly sandstones passing laterally into red shale ...	1	10
	6. Massive greenish sandstone	5	0
	7. Massive sandstone, with intervening shaly bands, becoming shaly and fissile towards the top	12	0
	8. Conglomeratic sandstone	2	0
	9. Fossiliferous quartz - conglomerate. (Fish-Bed)	4	0
	10. Conglomeratic sandstone, with shaly partings		
	11. Soft micaceous shaly sandstones (Base not visible)	1	0
	Total	34	6

Additional points of interest have been summarised in the following notes (numbering as in above tabulation) :—

1. This distinctive fine-grained shale, containing no admixture of sandy particles is clearly of a different origin to the other Old Red Sandstone rocks. Though apparently formed under deeper water conditions than the remaining rocks in the section, Avonian life had not yet made its appearance, and hence the bed is classed with the Old Red Sandstone.

2. Bands 1 and 2 are the only deposits in which calcareous material is absent. The quartzite is composed of a mossaic of quartz grains of uniform size (0.4 mms.), closely interlocking and crowded with inclusions. Rounded fragments of a fine-grained quartz mosaic, riddled with hæmatite are common. Muscovite and felspar are present in small quantities.

3. Small thrust planes occurring within these sandy shales give rise to swellings in the band and arching of the immediately overlying strata.

4. The fine-grained, micaceous sandstones are chiefly composed of angular to sub-angular quartz grains of uniform size (0.08 mms.) devoid of inclusions. Abundant muscovite, and a few flakes of a green, pleochroic (darkest when its length is parallel to the light vibrations) mica. The mica flakes are often bent and twisted against the resistant quartz grains. The cement is composed of small rhombs of dolomite with scattered grains of calcite.

5. The sandstones are very similar to 4, except that the more abundant cement is indeterminable.

6. Coarse-grained sandstones with varying amounts of soft greenish cementing material. In thin sections the quartz grains are seen to be of two types—large (0.40 mms.), well rounded, abundant inclusions, many of vein quartz, and some showing strain shadows, and smaller (0.8 mms.) angular to subangular, and devoid of inclusions. A green pleochroic mineral with high interference colours (Ottrelite ?) occurs as pipes and strings in some of the larger quartz grains. Grains of calcite, rounded fragments of fine grained quartz mosaic, and a coarser-grained gneissose quartzite, flakes of muscovite and grains of microcline are fairly common. The cement is composed of small dolomite rhombs, with scattered calcite grains (differentiated by micro-chemical staining methods). The cement also occurs as small rounded included pebbles.

7. Symmetrical or oscillation ripple marks occur in the shales at the base and top of this division. At the base the ripples are parallel to the strike, whereas at the top they cross the strike at right angles. They probably denote wave action in the absence of currents.

The sandstone is reddish and compact, but in the portions immediately adjacent to the shales a number of lenticles (measuring up to 10–11 cms. in length) and rounded pellets of a fine-grained sandy micaceous shale occur. The lenticles are always arranged with their long axes parallel to the bedding planes. This feature is paralleled by the occurrence of mud pellets on the sandy foreshore at Uphill, Som., and other places. The mud pellets are generally oval shaped (from 1–6 cms. in length) or may be spherical. The coast at Uphill is sandy with mud flats exposed at low tide. The incoming tide picks up small quantities of this mud, rolls it into lenticles or spheres and finally deposits it on the sand area. Some pellets are taken back by the receding tide, but many come to rest on the sandy foreshore, generally in a small depression formed by the swirling action of the retiring waters.

The rock is chiefly composed of closely packed quartz grains of varying sizes from 0.12 to 0.65 mms. Rounded fragments of a fine-grained quartz mosaic, a coarser-grained gneissose quartzite, small calcite plates, a cement similar to that found in 6, and a small cavity filled with chalcedonic quartz are all present.

8 and 10. Both are termed conglomeratic sandstones, the quartz pebbles not being sufficiently abundant to justify the term conglomerate. Otherwise the rock is identical with 9.

9. This is the Fish-bed level, and the rock is a polygenetic conglomerate. Large rounded quartz pebbles of vein and milky quartz (of varying grades up to 5 cms. diameter), smaller jaspers and rounded pellets of a fine-grained sandy micaceous shale are the chief constituents. Sometimes this latter material is squeezed in between the other pebbles, and acts as a cement. In thin section the chief cement appears as a mass of interlocking quartz grains,

(0.40–0.16 mms.), with numerous inclusions some of the ottrelite ? pipe variety, and generally coated with hæmatite. Calcite plates a coarse-grained gneissose quartzite, and rounded masses of a fine-grained quartz mosaic also occur.

11. This sandstone is composed of small angular quartz grains embedded in a hæmatite-stained cement. The quartz grains are approximately of two sizes, 0.04 and 0.08 mms. respectively, arranged in definite alternate bands parallel to the bedding planes. Muscovite and green mica are present as twisted flakes, and dolomite rhombs may be distinguished in the cement.

It is a significant fact, that, as far as present research has progressed, organic remains in the Old Red Sandstone, generally occur in a conglomeratic rock which, though on different horizons, has very constant features. The only known exception is at Portishead, where fish remains have also been found in a fine-grained micaceous flaggy sandstone. Remains of three distinct fishes have been found in the Fish-bed at St. Monica's. They all occur in a very broken state, and the unweathered nature of the freshly-quarried rock renders specific determinations difficult.

The most conspicuous are the incomplete portions of the scales of *Holoptychius nobilissimus*, Ag. The fusiform body of this fish was covered by a number of cycloidal ganoid scales, of which the crescent-shaped area of fine tubercles, arranged radially between the posterior ridged portion, and the anterior finely granulated area are prominent characteristics. Another feature is the concentric arrangement of the granules on the anterior portion. The furrows in the longitudinally ridged posterior part are finely pitted, whilst the ridges are slightly tubercular. A maximum width of 5 cms. was observed on one specimen in situ.

The small, thin, rhomboidal scales of *Glyptopomus kinnairdi*, Huxley, are easily recognised. The variable sculpture consists of a system of ridges and valleys, with smooth bands on two sides to allow for the overlapping of adjacent scales.

Less common are the paddle-like pectoral appendages (arms) of *Bothriolepis* cf. *hydrophila*, Ag. The proximal portions are broad and denticulated on the outer margin, whilst the distal segments are of a more slender character. No portions of the body armour of this animal have been found.

In Proc. B.N.S., Vol. I, n.s. 1874–6, p. 143, Dr. S. Martyn describes two small exposures near the top of Stoke Hill in which he found fish remains in an Old Red Sandstone conglomerate. Neither exposure can now be definitely located, but from an examination of the specimens now in the Bristol Museum collections there is little doubt that the exposures occurred on the same horizon as the Fish-bed at St. Monica's.

My thanks are due to Mr. E. D. Evens, B.Sc., for much helpful discussion on the mineralogical content of the rocks, and to Messrs. H. Willcock and Sons (Contractors) for kindly allowing me free access to the exposures.

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MCMXXVI.

TABLE OF CONTENTS.

FOURTH SERIES. VOL. VI., PART III., 1925.

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List of Members, December, 1925.

A Associate Member. *S* Section Member. † Life Member.
* Has contributed Papers to the "Proceedings."

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S	Alden, C.	63, Picton Lane, Stokes Croft
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*	Bolton, H., D.Sc., F.R.S.E., F.G.S.	The Museum, Bristol
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†	Darell, D., F.G.S.	Hillfield House, near Dartmouth
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	Davies, T .H.	Down House, Stoke Bishop, Bristol
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	Drew, Miss H., M.A.	Colston Girls' School, Bristol
	Dunscombe, Miss	199, Redland Road, Bristol
S	Ellis, F.	59, Berkeley Rd., Bishopston
	Evens, F. W.	8, Rokeby Avenue, Redland, Bristol
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	Ford, Roger	Hartfield, Cotham Park, Bristol

	Fox, Mrs.	Brislington House, near Bristol
	Francis, H. A.	10, Victoria Square, Clifton
S	Fry, T.	1, Niblett's Hill, St. George's, Bristol
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	Griffiths, William	Pembroke Hall, Pembroke Rd., Clifton
	Griffiths, Miss G.	
	Gummer, Horace	Herbert Lodge, Cotham Park, Bristol
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S	Hallett, Miss J.	3, Logan Rd., Bishopston
S	Hallett, Miss L.	3, Logan Rd., Bishopston
	Harding, Miss E. M.	Bower Ashton, near Bristol
	Hellyar, R. H.	18, Redland Grove, Bristol
A	Heslop, J. R. P.	34, Henleaze Gardens, Westbury-on-Trym
*A	Hewer, T. F.	24, West Shubbery, Redland, Bristol
	Higham A. P.	*Western Daily Press* Office, Bristol
	Hodgson, C. J.	5, Cotham Terrace, Bristol
	Horder, Miss M. G.	115, Cotham Brow, Cotham
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	Humphries, Lady	Eastfield Lodge, Westbury-on-Trym
*	Hunter, C., M.Sc., F.L.S.	The University, Bristol
	Ivens, H. P.	18, Alexandra Rd., Clifton, Bristol
A	Ivens, W. B.	49, Ravenswood Rd., Bristol
S	Jahans, G., B.Sc.	26, Hampton Park, Bristol
	Jeffcoat, Rev. R., M.A.	5, Berkeley Square, Clifton
	Jenkins, Mrs.	10, Napier Rd., Redland, Bristol
	Jenkins, F. G.	31, Berkeley Square, Clifton
S	Jennings, D. A.	Queen Elizabeth Hospital, Bristol
	Jervis, W. W., M.Sc., F.G.S.	The University, Bristol
S	Jones, F. G., F.G.S.	8, Clifton Vale, Clifton
	Knight, H. H., M.A.	The Lodge, All Saints' Villas, Cheltenham
	Knowlson, Mrs.	9, Downfield Rd., Clifton
S	Kromler, A.	45, Summerleaze, Fishponds
A	Lee, Miss E. M., M.Sc.	55, Logan Rd., Bishopston
	Llewellin, W. M., C.E.	8, Cotham Lawn Rd., Bristol
S	Lucas, H. J.	14, Walcot Parade, Bath
S	MacDonald, T.	50, Hampton Park, Bristol
S	Madkins, W. E., B.A.	Fairfield Secondary School, Bristol
	Mappin, S. W.	100, Pembroke Rd., Clifton, Bristol
	Martineau, P. E.	Hillside, Cleveland Walk, Bath
*A	Matthews, L. H.	Hillcroft, Nore Rd., Portishead
S	May, J. L.	25, Abbotsford Rd., Bristol
	Melvin, A. D.	3, West Mall, Clifton
	Miller, M.	7, All Saints Rd., Clifton
*	Morgans, Thos., M.I.C.E.	7, Elton Rd., Tyndall's Park, Bristol

	Morgans, Mrs.	7, Elton Rd., Tyndall's Park, Bristol
A	Mountfort, G. R.	8, Royal Park, Clifton
	Nierenstein, M., Ph.D.	30, Cavendish Rd., Bristol
	Norgrove, J. W.	22, Alma Rd., Clifton
	Nuell, F. H.	63, Springfield Rd., Bristol
S	Onn, H. A....	Westleigh, West Town, near Bristol
*	Palmer, L. S., M.Sc., Ph.D. ...	The College of Technology, The University, Manchester
S	Peach, A. H.	5, Hanbury Rd., Clifton
	Pearman, J. V	6, Westbury Park, Bristol
	Pepperell, R.	Ormond House, Russell Grove, Westbury Park, Bristol
S	Pook, J. W.	Waterloo House, Clevedon
	Powell, J. J., M.D.	2, Gloucester Rd. Bishopston
S	Putnam, S. A.	Silverthorne Lane, St. Philip's, Bristol
	Rafter, J., M.A.	6, West Shrubbery, Redland, Bristol
*	Reynolds, S. H., Sc.D., F.G.S.	13, All Saints' Rd., Clifton
	Richardson, Frank	15, Percival Rd., Clifton
	Robbins, F.	38, Tyndall's Park Rd., Clifton
	Robbins, G. A.	3, Lower College St., Bristol
*	Roper, Miss I. M., F.L.S. ...	4, Woodfield Rd., Redland, Bristol
*	Rudge, C. K., L.R.C.P., M.R.C.S.	145, Whiteladies Rd., Bristol
	Rudge, Miss E. L.	145, Whiteladies Rd., Bristol
	Rutter, Miss E. M.	Cambridge House School, St. John's Rd., Clifton
S	Ryder, T. A., B.Sc.	The University, Bristol
A	Salmond, P. W.	20, Tyndall's Park Rd., Clifton
S	Salmond, Mrs.	20, Tyndall's Park Rd., Clifton
	Sampson, Miss D.	30, St. John's Rd., Clifton
	Samson, F....	4, Woodfield Rd., Redland, Bristol
*	Sandwith, Mrs.	26, Canynge Square, Clifton
A	Sandwith, N. Y.	Royal Botanic Gardens, Kew
S	Selley, A.	116, Coronation Rd., Bristol
S	Selley, F.	116, Coronation Rd., Bristol
	Selman, Miss M. M.	Kington Langley, Chippenham
	Shaw, Miss T.	Walton-in-Gordano, Som.
A	Sinnott, Jas.	15, Beaufort Rd., Clifton
A	Smith, Miss A. M.	70, Pembroke Rd., Clifton
A	Smith, Miss E. J.	70, Pembroke Rd., Clifton
	Smith, Stanley, D.Sc., F.G.S.	The University, Bristol
	Smith, W. A., M.A., M.B. ...	70, Pembroke Rd., Clifton
A	Smith, Rev. W....	17, Vyvyan Terrace Clifton
A	Smith, Mrs. W.	17, Vyvyan Terrace, Clifton
	Stanton, D. W.	42, Alma Rd., Clifton
	Stanton, Mrs.	42, Alma Rd., Clifton
S	Steel, Miss E. M.	5, Caledonia Place, Clifton
S	Storey, R. G.	8, Oxford Chambers, St. Stephen's St., Bristol
	Sully, H. T.	Woodrange, Westbury-on-Trym
	Taylor, R. E.	Fonthill Villa, Keynsham
	Thompson, H. S.	33, Southleigh Rd., Clifton
S	Trelease, C.	37, Fernbank Rd., Redland
S	Trelease, Mrs.	37, Fernbank Rd., Redland

	Tuckett, C.	5, Beaufort Buildings, Clifton
	Turner, H. W., B.A. (Oxon.), F.G.S.	The University, Bristol
*	Tutcher, J. W.	57, Berkeley Rd., Bishopston, Bristol
S	Tyrrell, E. B., B.A.	17, Camden Terrace, Clifton Vale
S	Tyrrell, Mrs.	17, Camden Terrace, Clifton Vale
	Vaughan, Mrs.	42, Fernbank Rd., Redland, Bristol
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	Walton, T. C. H.	18, West Park, Bristol
S	Weaver, Miss M.	95, Kingsdown Parade, Bristol
S	Welch, F. B. A., B.Sc.	The University, Bristol
	White, E. Barton, F.E.S. ...	Mental Hospital, Fishponds, Bristol
*	White, Jas. W., F.L.S.	18, Woodland Rd., Clifton, Bristol
	White, Mrs.	18, Woodland Rd., Clifton, Bristol
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†	Wills, W. Melville	Bracken Hill, Leigh Woods, Bristol
	Wingate, Miss H. M., M.A. ...	48, College Rd., Clifton
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*	Yabbicom, T. H., M.I.C.E. ...	23, Oakfield Rd., Clifton

Honorary Members.

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

Prof. C. Lloyd-Morgan, LL.D., F.R.S., F.G.S., 5, Victoria Square, Clifton, Bristol.

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

A. B. Prowse, M.D., F.R.C.S., 5, Lansdown Place, Clifton (deceased).

W. G. Scott, 25, Duke Street, 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.

Sir W. A. Tilden, D.Sc., F.R.S., Professor of Chemistry in the Imperial College of Science, S. Kensington, S.W.7

William Whitaker, B.A., F.R.S., F.G.S., Wellesley Court, Wellesley Road, Croydon (deceased).

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

REPORT OF COUNCIL

To December 31st, 1925.

THE activities of the working members have been well maintained during the year, but it is difficult to awaken an increased interest in the Society amongst the general public. The Sections have attracted a number of new members at low fees, and a few of them have joined the Society as full members, in addition to ten others enrolled through the ordinary channels. A few inevitable resignations have taken place, but none caused by death, although we record with much regret the passing of two Hon. members: Dr. A. B. Prowse, who had filled so many offices during his forty years of membership, died a few months after his election, and Mr. William Whitaker, F.R.S., the veteran geologist resident at Croydon, who had been an Hon. member for the long period of forty-seven years.

The open night in March, when a Lecture was given by our Hon. member, Prof. W. J. Sollas, F.R.S., of Oxford Museum, the attendance of members and the outside public was most gratifying. Quite 250 were present, which must have extended the knowledge of the Society's existence amongst the citizens. The Summer Excursion, however, was not well supported, although Stinchcombe Hill has many attractions for the Naturalist.

Another form of activity has been the revival of the Botanical Section, which had long ceased to be in operation, and with our President at the head of it, and Miss Bowen as the Secretary, it has great claims on those who desire a knowledge of our local Flora, and botanists should avail themselves of its advantages.

Early in the year Mr. F. W. Evens, a member of the Council, brought forward the question of the better protection of Wild Plants, and a resolution by him was carried to urge public authorities to encourage this effort, and if necessary to establish sanctuaries in appropriate places. The resolution was sent to a number of kindred Societies, and to *The Times*, and excited considerable interest and correspondence, stimulated by leading articles in the Press. Mr. Evens still has the matter before him, and hopes to combine with other bodies to obtain further results.

The members were invited to visit in a body the new buildings of the University to show appreciation of all the University is doing to encourage the Society to arouse an interest in Nature and its ways amongst the public. They inspected the arrangements and beauty of the architecture, and were joined by the Bristol Field Club, so that a good number of Naturalists took part in this pleasant function.

The Secretary represented the Society at the Jubilee of the North Staffordshire Field Club, with whom we have been long associated. The occasion was marked by a week of motor coach excursions from Stoke-on-Trent to the beauty spots of the adjoining counties, and the fifteen delegates who attended were cordially welcomed and spent an enjoyable time together.

The Proceedings for 1924 were published early in the year, and distributed to the British and Foreign Societies with whom we exchange. It contained records of much original work carried out within the district. Correspondence with scientific students in all parts shows that articles published years ago in our *Proceedings* are still consulted and sought for as valuable guides, so that the sales of back parts have been exceptionally good.

The Government Committee on the Severn Barrage applied for a geological paper that we published on the district affected, and the demand for Vaughan's *The Avonian of the Avon Gorge* has nearly exhausted the supply.

IDA M. ROPER,

Hon. Secretary.

THE HON. TREASURER in Account with THE BRISTOL NATURALISTS' SOCIETY.

Dr. GENERAL ACCOUNT FOR THE YEAR 1925. *Cr.*

	£	s.	d.
To Members Subscriptions :—			
Ordinary ...	43	10	0
Associate ...	3	0	0
,, Entrance Fees	2	2	6
,, Subscriptions in advance	4	0	0
,, Arrears collected	4	10	0
, Donations :—			
Bookbinding	30	13	6
Publishing	16	0	0
,, Sale of Publications, etc.	5	3	3
, Profit on Excursion ...	0	8	6
,, Interest on deposit ...	1	14	5
,, Balance Forward :—			
General Account	48	19	3
Bookbinding Fund	8	12	9
	£168	14	2

	£	s.	d.
By Subscriptions to Societies :—			
Ray	1	1	0
Commons and Footpaths	0	10	6
S.W. Naturalists' Union	0	13	6
Geological Magazine ...	0	15	0
Zoological Record ...	2	10	0
,, Cost of "Proceedings" for 1924 ...	40	10	0
,, Printing and Postages ...	5	12	9
,, Rent and Fire Insurance ...	1	3	6
,, Gratuities	0	15	0
,, Advertising	2	12	0
,, Bookbinding ...	11	18	0
,, Cash in hand :—			
General Account...	73	5	2
Bookbinding Fund	27	8	3
	£168	14	2

December 31st, 1925.

Audited and found correct,

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

LIBRARIANS' REPORT

For the Year 1925.

THE splendid work of the late Librarian, Dr. A. B. Prowse, in planning the arrangement of the books on the shelves has been still further carried out in detail, supplemented as it has been by the binding of so many more books, and by bringing his catalogue into such an effective state that a book wanted can be readily found by members.

Appreciation of the facilities appears to promote a more active interest amongst the Sectional members, which it is hoped will spread to others in search of wider general information.

In last year's Report an appeal was made for a further £25 to carry out the binding of accumulated publications received by exchange, and it is gratifying to record that this sum has been already exceeded by the generosity of some members, and a second liberal donation from Mr. Horace Gummer. The publications of British Societies are now bound complete to date, and the foreign ones are well advanced. But members must realize that each year the Library needs money to expend on bookbinding, and its only source is by special gifts to this Fund.

The catalogue on the table is now a record of the Library, and the position of each book on the shelves is clearly entered in it.

The gifts to the Library by members have been more numerous than usual, especially of works on Ornithology, and our thanks are given to the donors and the Sections for their continued gifts of specialized publications. We have further to thank some Exchange Societies at home and abroad for their courtesy in supplying missing parts, which had gone astray during the years of storage, and we were glad to reciprocate by making complete if necessary their sets of our " Proceedings."

Progress has been made in the preparation of a card catalogue of Papers published in British Journals. These include : Our own " Proceedings," and those of Societies from North Staffordshire to Cornwall, ten counties in all ; the *Journal of Botany*, 58 volumes from 1862 onwards, for which in addition a subject catalogue has been made ; and good portions of the *Quarterly Journal of the Geological Society* and the *Entomological Monthly Magazine* are ready. Further helpers are wanted for this work, as well as donations to procure a cabinet for the cards, which will make available this important addition to the usefulness of the Library, and will add greatly to the credit of the Society.

IDA M. ROPER, *Hon. Librarian.*

T. CHARBONNIER, *Hon. Sub-Librarian.*

Additions to the Library in 1925.

Darwin, C.	Insectivorous Plants, 1908.
Dewar, G. A. B. ...	Wild Birds through the Year, 1913.
Horsfield, H. Knight	Side Lights on Birds, n.d.
Hudson, W. H. ...	A Shepherd's Life, 5th ed., 1920.
	Jour. of the Asiatic Soc. of Bengal, 1912–15.
	Journal of Botany, 1896–1912 ; 1917–1924.
Kearton, R.	British Birds' Nests, 12 parts.
Do.	Birds' Nests, Eggs and Egg collecting, 1915.
Do.	Fairyland of Living Things 1914.
Do.	Nature's Carol Singers, 1912.
Do.	Our Bird Friends, 1913.
Do.	Wild Life at home, how to study and photograph it, 1907.
Do.	Wild Nature's Ways, 1914.
Do.	With Nature and a Camera, 1911.
Do.	Wonders of Wild Nature, 1915.
	Lancashire and Cheshire Fauna Committee Repts., 1914–1924.
	Palæontographical Society, Vol. LXXVI, 1922. (*By Purchase*).
	Science Gossip, 1871–1888.
Soar, C. D. and Williamson, W. ...	The British Hydracarina, Vol. I, 1925. (*By Purchase.*)
Walpole-Bond, J. A.	Bird Life in Wild Wales, 1904.
Withering, W.	An Arrangement of British Plants, 4 vols., 7th ed., 1830.
	Zoological Record, Vol. LX, 1923. (*By Purchase.*)

Further gifts of standard books of reference on Natural History are desirable.

BOTANICAL SECTION.

1925.

THE Botanical Section has been revived with Prof. O. V. Darbishire as President, and the year closes on it, three meetings old, with a membership of seventeen.

At the first meeting on 20th October, there was a goodly number of members present, which augured well for the future of the Section. The exhibits have been very numerous, and the other meetings in November and December have centred almost entirely round them. The Section, although realizing the importance of good field work, has no intention of confining its efforts to the naming and exhibiting of specimens. It has interest in the life histories of plants ; in the times of fruiting and flowering of certain species (the members have undertaken the phenological observations required by the Board of Agriculture) ; in the results of any experimental work carried out by its members : and in short intends to discuss any botanical subject—so that all botanists are sure of not only a seat at the Library table, but also a niche in the Section's work into which they can fit their own interests.

At each of the last two meetings there has been a splendid collection of fresh Fungi from Leigh Woods and Clevedon, including Giant Earth-Star (*Geaster maximum*), Bird's-nest fungus (*Crucibulum vulgare*), Witches' Butter (*Exidia glandulosa*), *Clitocybe gigantea*, 13 inches across the cap, the Orange-peel Elf Cup (*Otidia aurantia*).

M. BOWEN, *Hon. Secretary and Treasurer.*

ORNITHOLOGICAL SECTION.

1925.

ONCE again this Section has good reason to congratulate itself on the work done by its members. The previous year it will be remembered it was observations on the local breeding of the Curlew (*Numenius a. arquata*) that was outstanding, and this year two members working together report a new breeding place in Somerset for the Redshank (*Tringa t. totanus*) between Weston-super-Mare and Clevedon. The Redshank had been known to breed at Porlock Marsh and Shapwick, but though it had been suspected of nesting below Weston, it had not before been proved so near to Bristol. It is rather surprising that local ornithologists have not discovered it before, since " Redshank territory " is difficult to pass by without having the fact brought home to one, although of course the actual finding of the nest and eggs is in a different category.

Going rather further afield the same two members (as has been described at Sectional meetings) spent a very useful fortnight in the Isle of Purbeck, Dorset, where they enjoyed many hours in the company of the beautiful little Dartford Warbler (*Sylvia undata dartfordiensis*). They had visited Dorset with the intention of obtaining photographs (in which they were successful) of the Black Headed Gull (*Larus r. ridibundus*), of which there are large colonies round Poole Harbour, but by good fortune they were able to meet with in addition such interesting birds as the Dartford Warbler, the Water Rail, and one of the Harriers.

Elsewhere in these " Proceedings " will be found a paper by one of our members on " Bird Photography." It is a subject of interest to an ever increasing number of naturalists, and the Section is fortunate to include within it so successful an exponent of this branch.

COLDSTREAM TUCKETT, *Hon. Secretary and Treasurer.*

ENTOMOLOGICAL SECTION.

1925.

On the death of Mr. G. C. Griffiths, F.E.S., in December, 1924, the Section lost both its President and a home. Mr. Charles Bartlett who for nearly 30 years so ably served as Honorary Secretary, was unanimously elected to the Presidency, and Mr. J. V. Pearman was subsequently elected Hon. Secretary. Thanks to the generosity of Dr. C. King Rudge, a new home was found, and meetings have been held at that gentleman's house.

Financially the year ends with a small deficit, due, in the main, to the cost of replacing missing numbers of the Journals to which the Section subscribes, but in part to the defections of a few members, with the consequent loss of arrears of subscriptions. At the end of the year the " live " membership stands at 21, losses having been partly made good by new elections.

Although no field excursion was held (weather preventing) the activity of all members during the working season was demonstrated by the exhibits at the indoor meetings held towards the end of the year.

The following list of exhibits has been restricted to the more noteworthy finds in the area covered by the South-Western Naturalists' Union :—

Lepidoptera. *Leucania pudorina*,—Portishead, (new to the district) by Mr. C. Bartlett.

Cloantha conspicillaris—Somerset. *Polia xanthomista* (*nigrocincta*)—North Devon and *A. grossulariata*, a striking series of vars. from Bristol larvæ, by Dr. E. Barton White.

Drepana harpagula—Leigh Woods by Mr. A. Kromler.
Many interesting species have been shown by Messrs. W. Griffiths, Norgrove, Peach and Chamberlain.

Coleoptera. *Hydrous piceus*, and *Blethisa multipunctata*—Shapwick, by Mr. R. Beck.

Hymenoptera. *Trichiosoma* sp. by Mr. C. K. S. Howard.

Siphonaptera. *Ceratopsylla farreni*, alive, from a long unused nesting box, Dr. C. King Rudge.

Psocoptera. *Troctes bicolor*—Lawrence Weston, new to Britain, and *Embidotroctes rectivenis*, n. sp.—Bristol, by Mr. J. V. Pearman.

Mallophaga. *Philopterus testudinarius* on teal, River Avon and *Trichodectes melis*, on badger—Glos., by Mr. C. Tuckett.

Collembola. *Folsomia fimetaroides*—Bristol. New to Britain and *Protanophurus pearmani*, n. sp. (named in honour of our member)—Lawrence Weston, by Mr. H. Womersley.

Acarina. Gall of *Eriophyes geranii*, 1902—Cornwall. The earliest record for Britain, by Miss Ida M. Roper.

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

GEOLOGICAL SECTION.

1925.

THE year has been one of steady progress in many directions. Once again we are able to report an increase in membership (the total is now 48) and our finances show a credit of £1 0s. 10d.

Six evening meetings have been held during the year, and the average attendance of 24 certainly indicates an increased interest. This is probably partly due to the fact that we have been favoured by two lecturers from outside the Bristol area. In March Dr. A. G. Trueman (Swansea) gave an original lecture on the hackneyed subject of "The Natural History of Coal." He clearly showed himself to be a partisan of the growth-in-situ school, and not the peat-to-anthracite theory. Later in the year Mr. E. H. Davison, B.Sc. (Camborne) made a special visit to Bristol to speak on the Geology of Cornwall. He painted some very clear word pictures of the physiographical conditions holding in Cornwall at various geological periods and explained in detail the general arrangement and direction of metallic lodes.

At the opening of the winter Session we were pleased to welcome back our President from his world tour. At one of our meetings he gave a lecture on the great national "Yellowstone Park," and with the aid of lantern slides he clarified and amplified our conception of a geyser. Mr. L. G. Anniss gave a talk on Microscopy, and stressed the importance of convergent light, whilst Mr. F. Ellis dealt with Prehistoric Man and made reference to local finds.

The Exhibition meeting proved very successful in bringing to light a number of local fossils which had been collected by members.

Excursions to the following places were held during the summer : Abbot's Leigh, Dundry and Wick, and attracted an average attendance of 12. Many members also took advantage of the kind invitation of The Bristol Field Club to participate in their general excursions.

Attention may be here profitably drawn to the Geological Notebook initialled by our Vice-President, Mr. J. W. Tutcher. Many entries have recently been made in this book, but in view of the large amount of road construction and alteration now being made and likely to be made in the future, it is hoped that more advantage will be taken of this means of recording small but important exposures.

F. S. WALLIS,

Hon. Secretary and Treasurer.

Account of the Annual and General Meetings.

THE 62ND ANNUAL MEETING.

January 15th, 1925.

The election of officers was confirmed, with Mr. C. Bartlett becoming a Vice-President. Various circumstances led to the re-arrangement of officers, and the following were elected: Mr. R. P. Gait, Treasurer; Miss Roper, Librarian; Mr. T. Charbonnier, Sub-Librarian; and Mrs. Vaughan, Reporting Secretary. Prof. O. V. Darbishire was elected President for the second time, and delivered his first presidential address, entitled "Adaptation in Plants and Animals" (printed in full on page 122).

THE 514TH GENERAL MEETING.

February 5th, 1925.

"The Sea Birds of Scilly," by Mr. R. P. Gait.

The lecturer explained that one of his main motives in giving the paper was to convey to the parent society some idea of the work that the ornithological section was doing, and also to popularise bird photography as a means of observing the intimate life of birds.

A number of slides of the greater and lesser black backed gulls and the herring gull were shown, taken from a hiding tent pitched in the middle of the breeding colonies, of which there were two kinds, those on the beach and those on the grass. The manx shearwater was seen at the entrance to its burrow, sitting on its egg and perched on a rock, while the activities of the section were further illustrated by a picture of ringing one of these birds for migration records in accordance with a scheme started by Messrs. Witherby Bros. The life histories of oyster-catchers and ringed plovers were among the subjects chosen, together with pictures of razorbills, guillemots, puffins, and that unpleasant and destructive bird the shag.

The lecturer stated that one of the most delightful bird experiences that he had ever had was a few hours spent on a very small island, a mere rock, which was literally covered with the eggs of that beautiful bird the common tern. The birds were of a very restless and nervous disposition, and at the merest trifle —or it might have been just caprice—they all rose from their eggs in a white and grey chattering cloud, soon to return with much quarrelling to their various eggs, which were mostly on the point of hatching.

A series of pictures, distant and close up, were shown of the rock pipit feeding a young cuckoo, and the wheatear. Though not strictly sea-birds these are common in the islands, particularly the rock pipit, which, the lecturer said, could be seen in numbers on every beach, and whose nest, built under a shelving stone, was very difficult to discover.

The lecturer mentioned that the cormorant was only sparsely represented compared to the ubiquitous shag, and as he had nearly been swamped trying to land on one of their breeding islands, he had no slides to show of this bird.

Exhibits by Prof. O. V. Darbishire of the lichen *Peltigera horizontalis* in fruit ; by Miss I. M. Roper of the fungus *Sarcoscypha coccinea*.

THE 515TH GENERAL MEETING.

March 5th, 1925.

"Men and Apes," by Prof. W. J. Sollas, Sc.D., LL.D., F.R.S., (*Oxford Museum*).

Prof. Sollas pointed out in the course of an interesting paper the close resemblances between the higher apes and man, and concluded the apes were man's nearest blood relations. The common ancestor of existing apes and man was probably in a group of apes, (*Dryopithecus*), whose fossil remains were found in the Miocene strata of Europe and India. Later there was an ape's jaw at Heidelberg, which combined a simian jaw with distinctly human dentition, and a human fossil skull at Piltdown (*Eoanthropus*) with a jaw resembling somewhat a chimpanzee. The separate genus of these two are regarded as belonging to the Hominidæ, and not to Homo.

Our own species of *Homo sapiens* was probably a direct descendant from Eoanthropus, and came into existence perhaps some 30,000 years ago, reaching Europe as an immigrant from Asia at a later period.

The higher apes progressed by a different and unknown course, and even now the gorilla does not possess a brain capacity in excess of 600 c.c. in volume. The history of man on the other hand is a record of continual advance, marked stage after stage by important discoveries. In Monsterian times, when our knowledge of him started in Europe, we find man as a hunter knew the art of kindling a fire, of fashioning weapons and using them, and believed in a future life, as shown by a leg of beef provided for his journey in the next world.

Following periods of the Palæolithic Age witnessed rapid improvements in implements and weapons, and most remarkable of all, man had developed an art in sculpture, line drawing and painting, which is a marvel to all seeing the results. With the Neolithic epoch came another great forward step, for man had learnt to domesticate the animals of the chase, and so had become himself domesticated.

No great period separates the Neolithic age from the early civilization of Mesopotamia and Egypt, with its advances in every direction, including the analysis of spoken words into their elementary sounds, to result in that great achievement of the art of writing. At that stage the realms of History are entered.

In Palæolithic times there may have existed men endowed with great mental abilities, but it is for modern times to work out scientifically the search for truth.

THE 516TH GENERAL MEETING.

April 2nd, 1925.

"The Movements of Plants," by Miss Ida M. Roper, F.L.S.

It was pointed out that interesting observations could be easily made in the garden or in the countryside on certain movements, which were needful in the active life of a plant to bring about its full development. Instances were given and illustrated by lantern slides of how certain plants, like the hop and honeysuckle, climb upwards to the light by twisting their stems in one direction only around a support, while others, like the kidney bean, coil in the opposite direction, or raise themselves by the help of delicate tendrils or leaf stalks. Other movements explained were the downward drag of the roots of the daisy and dandelion to preserve the plants from injury, the underground extension of runners to produce new growths or to bind together the loose sand dunes of the coast, the shifting year by year of the corms of crocus and tulip, and the so-called "sleep of plants" due to the effects of darkness, or moisture threatening the active vitality of the plant.

Exhibits by Miss Roper of a Marble Gall on the Oak, opened to show the larva of the wasp, *Cynips Kollari*. Mr. R. P. Gait mentioned that he had seen the greater Spotted Woodpecker actually engaged in cracking open these galls to secure the grub, which, on the authority of Messrs. Witherby was a unique sight ; by Mr. C. Wall, a visitor, the Mycetozoa, *Trichia scabra*, from the Leigh Woods.

THE 517TH GENERAL MEETING.

May 7th, 1925.

I. "The Lepidoptera of a Country Garden,"

by Mr. J. W. Norgrove.

The lecturer pointed out that Nature was not brought into being for the specialist, and he had therefore observed the butterflies and moths to be found in his own garden at Frenchay, near

Bristol. He knew that very few who start the study of Nature ever give up that allurement—the little will lead to the greater, and we shall find an increasing number of people taking an intelligent interest in the beautiful creatures, whose ways are not as our ways, but the study of whom is an education, and a very real delight. The district is not a particularly good one for lepidoptera, the surrounding country being too cultivated, but he had observed 14 different species of butterflies, and more than 130 different moths in plenty in his garden, some of the moths being of rare species. The most uncommon of the butterflies, frequently seen, was Vanessa C-album (the Comma), and amongst the rarer moths were Heliothis armigera (the scarce Bordered Straw) and Lithophane semibrunnea (the Tawny Pinion). A large number of Noctuæ, and often some of the Hawk moths were attracted by the Valerian that had been planted, and many more were taken at sugar. A little perseverence and patience would enable amateur naturalists to discover many beautiful and interesting insects in their own gardens. To a large extent his opportunities of making observations were limited to Sundays, and most of the collecting at night time. He thought that " summer time " was adverse to the entomologist by making dusk so late. Mr. Norgrove had prepared a list of the lepidoptera that he had taken, and also exhibited some of the more striking species.

II. " Nature: Curious and Beautiful,"

by Miss E. Bolton, M.Sc., F.L.S.

Plants were curious either in appearance, or in behaviour, or in methods of living. Among the first-mentioned plants were the Cacti and Euphorbias, which had a peculiar appearance, due to adaptation to environment, in their case, desert lands. Others, like the Rose of Jericho, rolled their branches into the form of a ball during the dry seasons, opening and flowering during the rains. A very interesting desert plant was the Manna lichen which was used by the natives of S.W. Asia as a substitute for bread in time of famine. Parasites were also of interest. The parasite *Rafflesia Arnoldi* of Sumatra, had the largest flower in the world. It was interesting to study the many types of plant galls and fungi, among the latter being the curious " caterpillar " fungus. Insectivorous plants had a peculiar way of obtaining part of their food supply. All Nature was beautiful, and it was instructive to note the beauty of common everyday objects, such as the fruit heads of the dandelion, goatsbeard, daisy and violet, the symmetry of the unfolding buds, and the changing beauty of the woods and hedgerows.

Exhibits by Prof. O. V. Darbishire of a few Finnish lichens; by Mr. H. J. Gibbons of Natural history objects from East Africa.

THE SUMMER EXCURSION.

June 20th, 1925.

This was made by motor coach to Stinchcombe Hill, Glos., and proved a most enjoyable experience for all present. The Sections were well represented by workers, and the finds in this prolific district proved satisfactory. It was to be wished that more of the general members had shown an active support of the Society by joining in a well organized and pleasant afternoon.

THE 518TH GENERAL MEETING.

October 1st, 1925.

"An African Tour," by Prof. S. H. Reynolds, M.A., Sc.D.

The lecturer undertook the journey during leave of absence from his duties at the Bristol University, and his object was mainly the study of African geology. He landed at Cape Town early last January, and spent about two months travelling over the Union of South Africa. He visited most of the chief towns from Cape Town and Port Elizabeth in the south, to Salisbury in the north, and from Durban in the east to Kimberley in the west. He spent much time in the semi-desert district of the Karroo searching for the remains of the extraordinary fossil reptiles for which the region is noted. At Kimberley he was shown over the diamond mines, which are situated in the material filling the pipes of long extinct volcanoes. In Rhodesia he visited the remarkable Matoppo Hills, where Cecil Rhodes and Dr. Jameson are buried. The greatest sight of Rhodesia, and, indeed, of the whole of South South Africa is the Victoria Falls of the Zambesi, which he visited in the unhealthy wet season when the falls were at their grandest. Prof. Reynolds left South Africa from Beira, in Portuguese territory, and, landing at Mombasa, spent six weeks in Kenya and Uganda. His travel in Kenya—a country of immense possibilities—was perhaps the most interesting part of his whole tour. It was difficult to say whether the wonderful richness of animal life or the geographical features, such as the great Rift Valley and the huge volume of Mount Kenya, were the more impressive. Returning to Mombasa, he sailed to Port Sudan, on the Red Sea, an unattractive spot save for the marvellous display of living corals in the harbour. After a short stay at Khartoum, he made his way down the Nile, partly by boat, to Assuan, and then, *via* Luxor, to Cairo, which at the time was full of British troops. From Cairo the lecturer went by rail to Jerusalem, and then home. The lecture was illustrated by many slides and photographs.

THE 519TH GENERAL MEETING.

November 5th, 1925.

Exhibits of Natural History by the Members.

All sections were represented, and the exhibition showed that steady, progressive work was being done.

In Geology, new fossils from the Radstock coal-measures were shown by Mr. J. W. Tutcher ; Trilobites and Rhætic specimens by Mr. W. H. Wickes. British and American algal limestones, fossil reptiles from the Karroo beds of S. Africa, and photographs illustrating the Lake Superior mining regions by Prof. S. H. Reynolds.

In Entomology, Coleoptera, including specimens taken from the timber of torpedoed boat at Morthoe by Mr. C. Bartlett ; Crane flies and Diptera by Mr. H. L. Audcent ; 225 variations of the Common Lady-bird by Mr. R. Beck ; drawings showing the venation of insects' wings by Mr. J. V. Pearman ; British Lepidoptera by Messrs. W. Griffiths and H. Womersley.

In Botany, collections of local Ferns by Miss Roper ; of Desert plants and Economic fruits by Prof. O. V. Darbishire ; dried plants of Steep Holm by Mr. H. S. Thompson ; and from Scotland and the Lake District by Mr. F. W. Evens ; coloured pictures of Alpine flowers by Prof. S. H. Reynolds.

In Ornithology, a fine series of photographs of local Birds and their nests by Messrs. R. P. Gait and C. Tuckett.

Coffee was served during the Meeting.

THE 520TH GENERAL MEETING.

December 3rd, 1925.

I. " Early Man," by Mr. R. H. Fitzjames.

Emphasis was laid on the fact that though tens of thousands of his implements lie in our museums, there are only three fossil finds of man in Early Pleistocene deposits which are accepted by all the experts. These are : (1) Pithecanthropus, found in Java ; has a skull intermediate between the highest anthropoid ape and the lowest man ; in close proximity was found a human thigh bone, which may have belonged to the same individual. (2) Heidelburg man, found in Germany. Unfortunately, only the lower jaw was found. It is simian in character, but with human teeth. (3) Piltdown man, with an essentially human skull, which may be associated with a simian jaw close to it in the same layer of gravel.

The great geographical distance apart of these three separate finds indicates the immense range of distribution of these ancestral types. Most scientists are of opinion that these three fossil men relate to three different species of man, all of which have died out, as was indicated on a genealogical chart, and that they are not the direct ancestors of man. The distance in time separating us from that remote age can only be measured in geological terms. It was possibly at the time when the present North Sea did not exist, and England was so much more elevated that the estuary of the Thames stretched out as far as the Dogger Bank, where it joined a mighty Rhine, whose outlet to the sea was as far north, perhaps, as the Faroe Islands.

The Middle and Late Palæolithic periods (the length of each of which is calculable only in geological terms) was passed hurriedly in review, and the paper ended with a reminder that there are, or were till very recently, savage tribes living, not in the Neolithic, but the Palæolithic stage of culture. There are backward races who do not know the art of agriculture, and there were in Australia in historic times people who had not the art of making fire.

II. "The Mycetozoa: some questions," by Mr. F. W. Evens.

The Mycetozoa are a little group of living organisms, of which mainly identical species are found in all parts of the world. They flourish on decaying leaves, stems, rotten trunks, straw heaps and the like. For fruiting they produce spore-cases, which vary greatly in form and are often of brilliant colours.

The particular feature of their strange life history is the formation of plasmodium from the swarm spores, and this may be described as a mass of naked protoplasm, creeping about and abounding in nuclei. The sequence of the life stages, and the world-wide distribution suggest they are a primitive type of life, which has stood aside from the main stream of evolutionary progress. They would seem to hover on the borderland of the animal and vegetable kingdoms, and this doubtful status gives rise to four questions: what and whence are they, how do they act, and the causes producing such habits and functions. These questions were examined in detail and illustrated by some fresh specimens as well as by charts and microscopic slides.

Exhibits by Mr. H. J. Gibbons of the fungus *Crucibulum vulgare*; by Miss Roper of an Ichneumon fly bred from gall on Willow leaves formed by the Saw fly, *Pontania salicis*.

In Memoriam

ARTHUR BANCKS PROWSE,

M.D., F.R.C.S.

BORN near Plymouth in 1856 Arthur Bancks Prowse died at his residence in Lansdown Place, Clifton, Bristol, on April 26th, 1925.

He duly qualified as a Medical man, being the third generation of his family to follow that profession, and took his degree of M.D. in 1881 in London. He passed with honours in all the subjects and thus showed at the start of his career that thoroughness in all he undertook, which was a characteristic feature with him for the rest of his life. And it may be pointed out that Dr. Prowse undertook many subjects of study and work, shown by a long list of activities in varied directions.

Setting the plans of his life on a broad base he exercised control in carrying them out, as well as using the utmost method, whereby he maintained interest in them to the last. The out standing influences, apart from his medical career, were his strong and ever present Evangelical religion, admiration for any effort well-done, and his love for all that concerned his native county of Devon. For these no labour was too exacting or prolonged, and the benefit of such sentiments came to the Bristol Naturalists' Society in the 42 years of his membership. He was elected a member on May 28th, 1883, and within two years started to hold every office in its service, one after another, except the Secretaryship, until within four months of his death. The chief periods were fifteen years as Hon. Treasurer and twenty-one as Hon. Librarian, with three years Presidency 1901–1903. The Library received his unceasing attention, and when he left it, his early desire to make it really useful to members had been attained. He arranged the books and publications under subjects, catalogued them, and found means to have much binding carried out, so that when he secured the use of the present fine room at the Museum the books were a credit to any Natural History Library. He has gone from us soon after Council had gladly conferred upon him the position of Honorary Membership, the highest honour within its power to offer, and the Society has lost a wise adviser and a sincere worker for its prosperity.

Amongst the Papers he contributed to the *Proceedings* were two on Ancient British Remains on Clifton Downs and near Long Ashton, and he followed up in private this taste for Antiquity by a thorough search in the county to trace the line of the Wansdyke from Maes Knoll to below Dundry, and for this painstaking set of observations he has this year been thanked in the *Proceedings* of the Somersetshire Archæological and Natural History Society. He also contributed a " Retrospect " of our Society on its Diamond Jubilee in 1923, full of details within his personal knowledge.

Flowers, however, were his chief love in the world of Nature, and of these he had an extensive knowledge, which would surprise those who were not admitted to intimacy with him. During his long churchwardenship of nearly thirty years at Clifton Parish Church he turned God's Acre into the charming scene of beauty that we now know, decorated with its peaceful avenue of trained Lime trees, and full of the influences of Nature from the many rare flowering shrubs he reared and planted there.

In his own tiny garden he cultivated curious plants, or others gathered on his holidays to Scotland or Dartmoor, to be disclosed only to the few who overcame his reserved disposition.

The methodical turn of his mind showed itself clearly during the War after he was appointed Administrator of the 2nd Southern General Hospital in Bristol, with the rank of Lieut-Colonel, and his work and medical skill caused him to be looked upon as a good friend to all the soldiers under his care.

Thoroughly upright and trustworthy he formed his own well-thought out opinions, and if these did not always meet with acceptance from others, they were genuine and did not lessen the respect felt by everybody for his character and personality.

I.M.R.

PRESIDENTIAL ADDRESS, 1925.

"Plants of the Sea."

By Prof. O. V. Darbishire.

TO-DAY I am going to talk to you about the plants of the sea. I hope that will tempt some of those present to take up the collection and study of seaweeds.

Let us imagine ourselves approaching the sea from inland. Long before we reach the coast we can observe the influence of the sea on vegetation. Trees become reduced in height. Instead of growing upright they bend over, and away from the direction of the sea, and develope their foliage mainly on their landside. This is due to the seawinds. Even smaller herbs show us that the area is wind-swept. The leaf of the dandelion under the influence of the seawinds is succulent and fleshy as compared with the thin papery leaf of the inland plant.

As we get still nearer the sea we may find a sandhill area, if the fore-shore is sandy, a saltmarsh if it is muddy, or a rocky coast. It is the latter only which is of interest to us here as the number of sea-plants growing on a sandy or muddy shore is negligible. Before we actually reach the first seaweed proper we may come across some characteristic flowering plants like the scurvy grass and others with their succulent leaves. On the bare rock we may observe the brillantly orange coloured lichen *Xanthoria parietina*. This may form a distinct band running along the coast.

When we leave the last true land-plant behind us we enter a quite new world. The land-plant with its dependance on fresh-water in the soil does not descend into the salty sea. The more conspicuous members of the vegetation of the dry land are vascular plants only. We cross the frontier of lichens and enter the area which at high tide is covered by the sea, and we find no vascular plants (with very few exceptions) but merely non-vascular members of the lower flowerless plants. Very few sea plants venture ashore or even into freshwater.

The plants in the sea live more or less submerged in seawater. They are water plants proper. The most remote ancestors of our present day land-plants are supposed to have arisen from organisms which came from the sea. When they emerged from the sea they were very simple in structure, but as they developed they became adapted to the land habit. Shortage of water and the threat of being dried up owing to their exposure to the air compelled them to get the water current under control. Thus they developed the epidermis, and the cork layers which are impervious to water, in order to reduce transpiration. They also developed pores or stomata and lenticels in order to keep in touch with the outside air. They developed vascular tissues in order to transport water and food material over long distances. Land-plants may descend into the water, but mainly freshwater, as aquatics, but they never completely give up their land characters, except in a few instances. They still retain, however, much modified, their air spaces though much enlarged, and their vascular tissues though much reduced.

The remote ancestors of the seaweeds too were already to be found in the sea. But the most highly developed seaweeds of to-day have grown out of their simple ancestors without emerging from their watery cradle. They therefore represent as no other plants growing in water do, pure water plants. They have no vascular tissue. They have no air-spaces, they have no stomata and no cork. This is a list of the most important differences which separate vegetatively seaweed from landweed.

Everybody knows that the sea does not cover the whole of the coast permanently. There are tides, ordinary tides, neap tides and spring tides. During the lowest neap tides some of the algæ remain exposed to the air for several days, and during the biggest spring tides some algæ become uncovered which are otherwise never exposed to wind and rain. The degree of exposure naturally depends on the height at which the particular alga grows. These zones of exposure on the coast correspond very accurately with the zone-like distribution of certain seaweeds along the coast. This is very clearly seen if we follow out the occurence of the large olive brown algæ (*Phæophyceæ*) from high water mark to low water mark. The budding algologist should make himself familiar with these large brown algæ, and he can then see at what level he is collecting. I will enumerate these important plants and briefly describe them.

Pelvetia canaliculata, the channelled wrack, occurs quite high up on the coast forming a distinct zone running along the rocky shore in the form of a darkish line. The plants are small and are moistened only by flying spray, and as the waves dash up against the rocks. They are 2-ins.—6-ins. in height, and form dense bunches.

Fucus spiralis (or *platycarpus*), the spiral wrack, is like the previous species attached by a flat disc. It has a flattened frond, provided with a midrib, and reaches a height of about 12-ins. The flattened oval shaped reproductive receptacles are winged along two sides.

Ascophyllum nodosum, the knobbed or knotted wrack, is the first of the big brown weeds, measuring up to nearly 10 feet on occasions. It is attached by a disc, and has bladders in the stem. These act as buoys when the plants are submerged. A small red alga, *Polysiphonia fastigiata*, is very generally found growing epiphytically on this wrack. The reproductive receptacles of the latter are pearshaped.

Fucus vesiculosus, the bladderwrack, is found mostly below the knotted wrack, but may occasionally ascend above it, when however it loses its bladders and remains sterile. The bladders are arranged roughly in pairs on either side of the midrib. Except that they form oils and fats instead of starch the brown algæ generally build up their food in the same way as the green land-plants. They are green under their brown covering. By boiling in water the brown colouring matter can be removed, and the fronds then become a brilliant green, which is of the same nature as the chlorophyll of the land-plants.

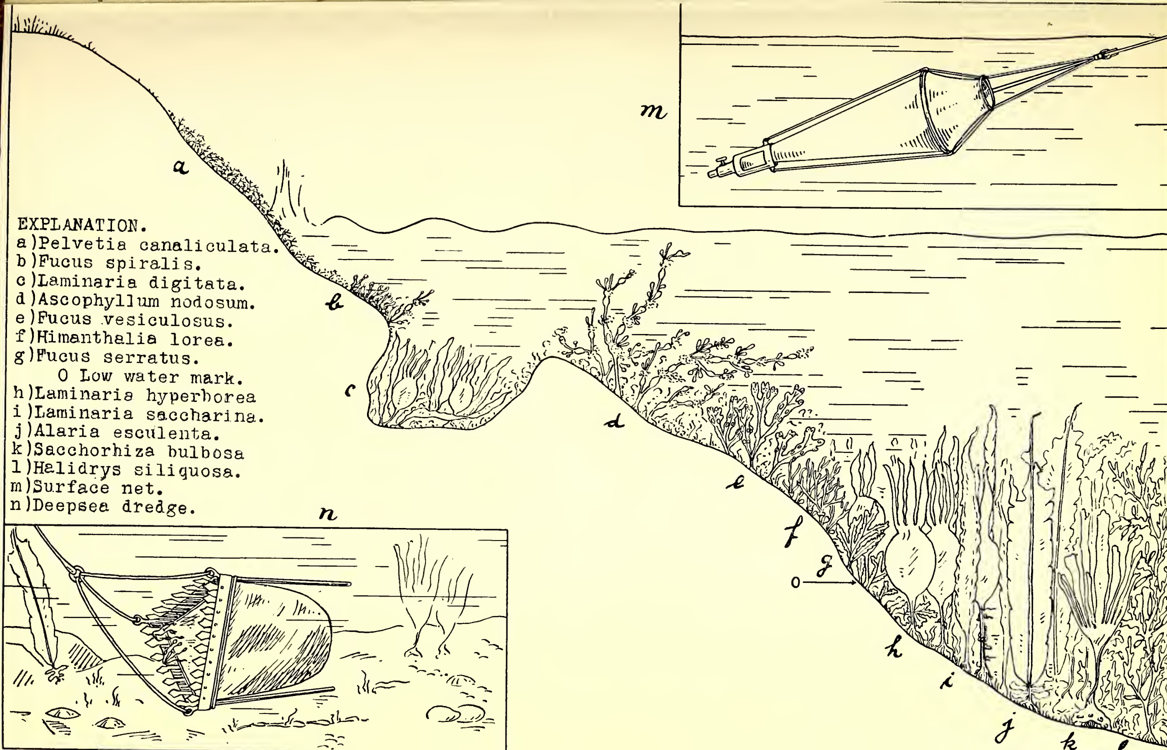
Fucus serratus, the serrated wrack, can easily be distinguished by the serrate margin of its bladderless flat fronds.

Most of the plants so far mentioned are exposed at practically every tide, and they are therefore adapted to such exposure, and are not injuriously affected by rain and sun-heat. The channelled wrack is of course exposed longest. The larger weeds grow very close together and form a dense covering of vegetation under which numerous small algæ and animals shelter during low tide. Their sexual cells mature in small depressions or conceptacles on specialised branches or receptacles. When exposed these branches force out the small orange coloured spermcells into the open, and also the darkish eggcells. When the tide comes up the motile spermcells soon come into contact with, and fertilise the non-motile eggcells. The latter soon germinate and attach themselves to the rock, at first probably sheltered by their large parental plants. This process can easily be observed by collecting some of the spermcells and eggcells in a watch glass and keeping them a few days for examination under the microscope.

There now follow a number of weeds which become increasingly less exposed.

Laminaria digitata, one of the kelps or tangles, has a flat frond, and a slightly flattened cylindrical stalk. It is attached by numerous root-like fibres. The new frond arises at the junction of old frond and stalk.

Himanthalia lorea, the seathongs, consists of a small button-like portion hardly more than an inch in height. From this grows out a huge receptacle which is strap-shaped in form and much branched. It may reach a length of 5 or 6 feet.


EXPLANATION.
a)Pelvetia canaliculata.
b)Fucus spiralis.
c)Laminaria digitata.
d)Ascophyllum nodosum.
e)Fucus vesiculosus.
f)Himanthalia lorea.
g)Fucus serratus.
O Low water mark.
h)Laminaria hyperborea
i)Laminaria saccharina.
j)Alaria esculenta.
k)Sacchorhiza bulbosa
l)Halidrys siliquosa.
m)Surface net.
n)Deepsea dredge.
a
b
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Laminaria saccharina, the sweet tangles or sea belt, is a flat and long kelp with a fibrous attachment organ, and an uneven puckered surface.

Alaria esculenta, the eatable fucus, is a broad and very long weed, up to 12 feet and more in length, with a very marked midrib. The frond grows at its lower end, and the reproductive leaves are found laterally on the stalk.

Laminaria hyperborea, the tangles or sea-girdles, a kind of kelp, differs but little from *L. digitata.* It has a cylindrical stem however, and exhibits a sharper demarcation between frond and stalk. It is a very much larger and stouter plant.

Halidrys siliquosa, the pod-bearing fucus, has small pod-like bladders. This plant is often found to be quite 8 feet in length. It has a small disc as attachment organ.

Sacchorhiza bulbosa, sea-furbelows, is but rarely seen actually growing, as it occurs only well below low water mark. Even when portions of it project above the water it is not often noticed by the young collector, and distinguished from *Laminaria hyperborea.* Specimens can generally be obtained fresh only by going into the water. Young plants should be got if at all possible. Young specimens possess narrow ribbon-like fronds, and a thin stalk attached to the rocky substratum by numerous fibres. Then there arises a short distance up the stem a collar-like outgrowth which gradually grows down and covers the fibres by a bell-shaped structure which in its turn sends our numerous fibrous attachment organs. It may in the end be 12-ins. across and 6 to 8-ins. high. A slight twist in the lower part of the stem which is flattened supplies the whole plant with a universal joint so that the water-currents can make it bend in any direction without injury. The life history has only been made out during the last decade. The spores escape from sporangia situated on a frill-like portion of the stem, and they grow up to female and male prothallia. The former carry the eggcells and these when fertilised give rise to the ordinary *Sacchorhiza*-plant. So we have here a definite alternation of generations characteristic of the higher plants, ferns, mosses and so on.

Among the larger brown algæ are found too many smaller ones, which can however only be properly separated by the aid of the microscope. I do not wish to refer to these here further.

The red algæ (*Rhodophyceæ* or *Florideæ*) differ very much from the brown weeds. They are generally smaller and more delicate and therefore also more sensitive to changes of temperature and saltiness of the sea water. They are for this reason only, or mainly found near low water mark. Rockpools which contain water even when the tide is out, frequently harbour good numbers of red algæ, otherwise met with only at low tide and lower on the coast. In the forests formed by the larger laminarians every available spot is covered by small red algæ. The rocky substratum, and the lower portions of the laminarians have growing on them many specimens of calcareous algæ, and then we get numerous delicate fronds of the larger but still small *Rhodophyceæ*, like *Plocamium coccineum*, *Hydrolapathum sanguineum*, *Delesseria sinuosa*, and many others. *Sarcophyllis edulis*, and *Rhodymenia palmata* are rather coarser in build, and are found higher up the coast. Some red seaweeds are found higher up, but at low tide these are generally well protected by lying under the larger brown plants. The red colour of the *Rhodophyceæ* can be removed, though rather slowly, by boiling in fresh water when the green becomes visible. Starch is formed, but it is slightly different from the starch of the potato.

The green algæ (*Chlorophyceæ*) are characteristic of the higher portions of the coast. In many cases we can see them practically swarming up a freshwater brook which runs into the sea, and which would interfere with the growth of red or most brown algæ. We have filamentous species of *Cladophora* and flat species of *Ulva* and *Monostroma*, but most of these can only be distinguished by the aid of the microscope. I will leave these also.

Seaweeds die, sea animals die, and much dead animal and plant matter is washed into the sea. This decays through the activity of numerous *Bacteria* and a few fungi which break up the organic compounds of the dead animals and plants and return them as simple and inorganic compounds to the sea. In this way chemical elements are kept in circulation in the sea.

The area of the sea which is inhabited by seaweeds is very small when compared with the vastness of the oceans. A few fish may feed on seaweeds, but most of them obtain their food from the drifting population or plancton, animal and plant, of the upper layers of sea some miles out from the coast and beyond, over the whole ocean. According to Johnstone grazing land may yield 76 pounds of flesh, for food purposes, per acre per year, but the North Sea yields only 15 pounds of fish for food per acre, per year. On the other hand grazing land actually produces 1,500 pounds of organic matter per acre per year, but for the same time and area the Baltic produces 1,350 pounds. This large amount of organic matter is produced almost entirely by certain small plant-organisms belonging to the *Diatomaceæ* and *Dinoflagellatæ* (*Peridinieæ*). It is the latter which give rise to the phenomenon of phosphorescence of the sea.

Seaweed is used as manure in this country, and its rich nitrogen contents, and the absence of fungus spores make it desirable. Successful experiments have been made in France in feeding horses on sea weeds. Certain species again are used extensively in China and Japan for human consumption.

Seaweeds can easily be prepared for the Herbarium. They should be deprived of all superfluous salt by rinsing rapidly in clean seawater. They may then be floated out under seawater on paper and finally pressed between absorbent paper. Some muslin should be placed over each specimen to prevent it adhering to the absorbent paper. Slight pressure only is subsequently necessary. The use of a microscope is necessary when trying to separate some of the smaller species.

Apart from Harvey's *Phycologia Britannica,* published about 70 years ago, there is no good book on British seaweeds in the English language. There is every chance however of one appearing at no very distant date. There does exist however, a French book[1] which is modern and useful, though it does not include all British species. I can recommend it to the beginner.

I hope that these few remarks will encourage some members of our Society to take up the study of seaweeds. In the Bristol district seaweeds are found at Pill, and, of course, in larger numbers at Portishead.

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[1] *Les Algues Marines des Côtes de France,* by E. Wuitner. Published by Paul Lechevalier, 12, Rue de Tourmon, Paris, VI, 1912, with 112 plates and 134 figures. Price 15 francs.

Explanation of Plate.—The drawing shows an imaginary portion of the English coast, and the succession of the larger brown seaweeds. The order in which these make their appearance has been put in after careful levelling measurements carried out by the author at Port Erin, I.O.M., and the algæ are not drawn strictly in proportion as regards size, but very nearly.

Bird Photography.

By R. P. Gait.

THERE are many aspects to the subject of Bird Photography, but the most important from the ornithologist's point of view is that it affords a means by which the intimate family life of birds can be studied at close quarters, the photographic records of which can be utilized to fix the knowledge gained, or to impart it to others.

I commenced bird photography merely to obtain photographs of birds and their nests, but after a year or two I found that some other element had crept into my hobby, which it was difficult to define. There was an added attractiveness about the whole business, which had nothing to do with the mere acquisition of successful negatives. This new attraction I found to be the element of sport, the matching of one's wits against those of wild creatures ; the alteration of one's methods to suit individual cases and the charm of the unexpected, all helped to make bird photography as exciting a sport as most other out-door pursuits, which provide relaxation, exercise and fresh air for the city dweller.

The whole appearance of a bird seen from the peep-hole of a hiding tent seems to be quite different to the ordinary view seen through a pair of binoculars, and one notices all kinds of details of plumage, which often escape the attention of the ordinary observer. For instance one finds that the oyster catcher has a red rim to the eye as well as a red bill and legs ; the little dabchick seen at close quarters has more reddish brown on the breast than had been noticed before, and the kingfisher seems to be sprinkled with amethyst dust all over the crown of his head.

Individuality of character is another point which impresses one forcibly. Two pairs of yellow wagtails building in the same field of horse beans were found to be very different in temperament. Against one nest, quite near a road, a small sack was placed on a stick about 20 feet away from the nest, whilst, owing to circumstances, a full sized hiding tent had to be erected within six feet of the other nest, which was situated far away in the middle of the field. The first pair of birds deserted, whereas the second pair took no notice of the tent whatsoever. A moorhen, quite used to passers-by, with her eggs just pipping refused to come anywhere near her nest to be photographed, but a dabchick faced a hiding tent, which had only been put up the previous night, and she could only be moved from her nest by the vigorous ejection of a cap through the door of the tent.

One treasures up many a little comedy or delightful experience seen during the long waits ; the jays, which came down to try and

BLACKHEADED GULL
alighting on Nest.

Photo. by *R. P. Gait.*

steal those moorhen's eggs and were driven off by father moorhen; the cock chaffinch, who tried each of his five youngsters with a caterpillar, which was far too big for them, and then finally jammed it down the throat of one unfortunate nestling with a "Well! *you have* got to have it" sort of air; and that tremendous twenty foot dive, which a kingfisher did whilst we were waiting for the dabchick to return.

It would be misleading for me to describe bird photography as an easy task, for the difficulties which attend systematic photography call for an inexhaustible amount of patience, perseverance and determination. The rewards, however, are pictures which are of some definite value, a knowledge of the habits of birds unobtainable by ordinary methods and the good health resulting from long days spent tramping the countryside in search of subjects.

With regard to the apparatus required, a good strong camera of the wood and brass type, which focusses on to a screen, is absolutely essential, and it must be mounted on a perfectly rigid threefold wooden tripod, which will bear both weight and the effects of high winds without moving or vibrating.

The lens is of course the principal item, and should be the best obtainable (either Ross, Goerz, Cooke or others of the first-class makers) working at least at F6. After trying many lenses, including a telephoto, I have personally found a 7-in. Goerz lens working at F6, which covers a half plate, give excellent results when used in a quarter plate camera, the long focal length giving a maximum of size, and the quality of the lens the necessary sharpness to enable the negative to be enlarged many diameters.

Great care must be taken with focussing the nest or twig on which one hopes to get one's bird, and should preferably be done with the aid of a magnifying focussing glass, or disappointment will be the result when the negative is placed in the enlarger.

Plates and developer are naturally the choice of the individual, but after a long trial I find that the Imperial Eclipse plate (backed) gives the maximum amount of detail with the shortest exposure, and is admirably suited for the purpose. The next requirement is the hiding tent, which can be either elaborate or simple as the worker requires. One that I am using at present is 3½ feet square by 4½ feet high, made of unbleached calico dyed in a bath of weak permanganate of potash. The framework consists of ¾-in. bamboo poles, 5 feet in length, cut in half and joined by the ordinary fishing rod brass joints. Galvanised iron wire, fitting into brass sockets, form the top square, and when guy ropes are attached to the corners and pegged down, it is simply amazing the amount of rough weather and high winds that a tent of this kind will stand.

The whole of the outfit collapses into a 3½ foot bag.

The camera lens is better for having a brass tube attached to it to act both as a hood and to enable the lens to be projected through the tent without fear of the fabric being blown over it ; also a hood minimizes the eye-like appearance of the lens, which has such a disturbing effect on birds.

As to general methods of working, our subjects are usually found during one week-end and prepared for photography during the next. The distance from the nest at which the hiding tent is first erected depends on the nature of the bird, and whether there are eggs or young in the nest. With a curlew 30 feet would not be too far to commence operations, but a bird like the reed bunting would tolerate a tent within less than half that distance. The tent should be moved closer once or twice before the appointed day for photography, and any cutting out of branches, etc., or removal of undergrowth done gradually, leaving the final preparations until immediately before entering the hiding tent.

If time is of no object a preliminary observation of the site from the hiding tent is often invaluable, as it reveals the direction and the method of the bird's approach, which is frequently the reverse to what one would expect. A factor which is of more importance in bird photography than in most other branches of the art is background. It is most annoying, after spending a couple of hours in a hiding tent, to find that one's bird is so mixed up with the background that it is difficult to pick it out. A careful examination of the focussing screen will frequently suggest some alteration, which will bring the subject against the skyline, or the elimination of twigs, grass, etc., behind the focus point will form a space sufficient to throw the bird into relief.

Before settling down in the tent be sure that you are comfortable, everything is to hand and above all, that you can see your focus point easily. A friend to help you focus, and then to walk openly away in full view of your bird will add a hundred per cent. to your chance of success, indeed with some birds this subterfuge is the only method.

Correct exposure will only come with practice, but it should not be forgotten that as the subjects are close to the lens, a longer exposure is required than in ordinary photography, especially if the bird is dark in colour. Slight over-exposure and short development with a weakened developer will usually give the best results. A favourable stop is F.11, and the exposure 1/25th or 1/10th of a second, unless the site is highly lit, when the lens may be stopped down to F.16, or even F.22, on the sand of the seashore, according to the colour of the subject.

The above remarks are a rough outline of the subject of bird photography, and are intended to induce bird lovers to take up this fascinating branch of ornithology. Further information and every assistance will be accorded to any member who joins the Ornithological Section of the Society.

The Apterygota of the South-West of England.

By H. Womersley, F.E.S.

Part III.

CONTINUED working at this primitive and exceedingly interesting division of the Insecta has produced several notable records for the area.

One species of Isotominæ taken at Lawrence Weston, near Bristol, by Mr. J. V. Pearman, is new to science, and has been described and figured by myself as *Protanurophorus pearmani* in the E.M.M., November, 1925. The genus itself is also new, and is based on a species *P. oxoniensis* discovered at Oxford by Mr. R. S. Bagnall, to which our own species is very closely allied. Protanurophorus is a very interesting genus being intermediate between Anurophorus and Tetracanthella (not yet found in our area), Protanurophorus possessing two anal horns while Anurophorus is without and Tetracanthella has four.

Another new British record *Folsomia fimetarioides* (Axels) allied to the common F. fimetaria, but differing in having an additional tooth to the mucro, situated proximately, is also described in the same article.

Such discoveries as these greatly stimulate the study of these lesser known groups of insects, and if others would but give some time to them, the area covered by the S.W.N.U. should produce much of real scientific interest and value.

The species so far known to occur in the above Faunal Area number 82, two only in their varietal form and 13 other varieties.

My best thanks are again due to Mr. J. M. Brown, B.Sc., F.L.S., F.E.S., etc., and to Mr. R. S. Bagnall, F.L.S., for much valuable expert help, and also to the several members who have collected specimens for me.

Order	—	**Collembola** (Lubbk.).
Sub-Order	—	**Arthropleona** (Börner).
Section	—	**Poduromorpha** (C.B.).
Family	—	**Hypogastruridæ** (C.B.).
Sub-Family	—	**Hypogastrurinæ** (C.B.).
Genus	—	**Hypogastrura** (C.B.).
		(Achorutes Temp. Lubbk. L.).

2. **H. armata** (Nic.).

Under bark, West Town, Som., April 11th, 1925. In nesting material of Talpa, Chelvey, Som., April 12th, 1925.

3. **H. purpurascens** (Lubbk.).

Dursley, Glos., March 24th, 1925.

82. **H. strenuus** (Brown).

The record of H. purpurascens (see p. 30) for (*a*) face of cliffs, Kewstoke, October 21st, 1923, is this species, and most probably the record (*b*) embankment wall, Avon Gorge, November 17th, 1922, applies to the same. This species was diagnosed by Brown in 1923, and appears to favour a littoral habitat, such as occupied by species of Petrobius.

Genus — **Xenylla** (Tlbg.).

8. **X. grisea** (Axels.).

Under moss, West Town, Som., February 22nd, 1925. Under bark, Dursley, Glos., and in moss, Bream, Forest of Dean, March 24th, 1925.

Sub-Family — **Achorutinæ** (C.B.).
Tribe — **Pseudachorutini** (C.B.).

Genus — **Pseudachorutes** (Tlbg.).

58. **P. subcrassus** (Tlbg.).

In moss, West Town, Som., April 10th and 25th, 1925.

Genus — **Friesia** (D.T.).

61. **F. claviseta** (Axels.).

Few in moss, West Town, February 22nd, 1925; Goblin Combe, Som., March 15th, 1925.

Family — **Onychiurinæ** (C.B.).

Genus — **Onychiurus** (Gerv.) Börn.

12. **O. burmeisteri** (Lubbk.).

Nursery Gardens, Cleeve, January 25th, 1925. Cannington, Som., September 5th, 1925.

14. **O. armatus** (Tullb.).

Cleeve, January 25th, 1925. Generally distributed. Seven Wells Combe, Quantocks, Som., September 6th, 1925.

O. armatus var. inermis (Axels.).

In moss, Dursley, Glos., March 23rd, 1925.

Genus — **Tullbergia** (Lubbk.) Börn.

75. **T. krausbaueri** (Börn.).

A few under stones, Backwell Quarry, Som., May 10th, 1925.

76. **T. quadrispina** (Börn.).

A-few under stones, Backwell Quarry, May 10th, 1925; West Town, Som., September 7th, 1925.

Section — **Entomobryomorpha** (C.B.).
Family — **Isotomidæ** (Schffr.).
Sub-Family — **Isotominæ** (Schffr.).

Genus — **Protanurophorous** (Bagn.).

78. **P. pearmani** (Womersley).

Under lichen, on oak, at Lawrence Weston, Glos., by Mr. J. V. Pearman, April, 1925. This species is new to science. (See E.M.M., November, 1925.)

Genus — **Anurophorous** (Tullb.).

16. **A. laricis** (Tullb.).

Under lichen on gorse, Backwell Hill, Som., April 19th, 1925. Lawrence Weston, Glos., April, 1925. (J.V.P.)

Genus — **Isotoma s. str.** (Bourl. C.B.).

18. **I. olivacea var. griscescens** (Schffr.).

Plentiful in Talpa nests at Chelvey, April 12th, 1925. Under bark, Brockley Woods, Som., July 18th, 1925.

66. **I. notabilis** (Schffr.).

West Town, February 22nd, 1925 ; Goblin Combe, Som., March 15th, 1925. Bream, Forest of Dean, Glos.; March 24th, 1925.

73. **I. minor** (Schaffr.).

In moss, Goblin Combe, Som., March 15th, 1925 ; Dursley, Glos., March 24th, 1925. One specimen.

Sub-genus — **Vertagopus** (C.B.).

21. **V. sensibilis** (Tullb.).

In moss, Dursley, Glos., March 24th, 1925.

22. **V. cinerea** (Nic.).

Cleeve, Som., January 25th, 1925 ; Plymouth, May 29th, 1925.

Genus — **Proisotoma** (C.B.).

23. **P. minuta** (Tullb.).

In Talpa nests, Chelvey, Som., April, 1925.

Genus — **Folsomia** (Willem.).

26. **F. quadrioculata** (Tullb.).

In moss, West Town, Som., February 22nd, 1925 ; Bream, Forest of Dean, and Dursley, Glos., March 24th, 1925.

72. **F. fimetarioides** (Axels.).

Under stones in Bristol Coal Wharf, Glos., March 7th, 1925. This is the first British record. (See E.M.M., November, 1925).

Family — **Entomobryidæ** (C.B.).
Sub-Family — **Entomobryinæ** (C.B.).
Tribe — **Entomobryini** (C.B.).

Genus — **Lepidocyrtus** (Bourl.).

73. **L. albus** (Pack.).
Under bark, Backwell Common, Som., March 14th, 1925.

80. **L. sexoculatus** (Schott.).
One specimen under stones, Broad Plain, Bristol, Glos., July 30th, 1925; several the following day. Under bark, Brockley, September 10th, 1925.

65. **L. (Sinella) cavernarum** (Doniez.).
Under bricks, Seven Wells Combe, Quantock, September 6th, 1925.

Genus — **Sira** (Lbk.).

44. **S. nigromaculata** (Lbk.).
Plentiful at West Town, Som., June 28th, 1925, and since.

Genus — **Pseudosira** (Schött) Börn.

66. **P. domestica** (Nic.).
Hot house, Cannington, Som., September 5th, 1925. Knowle, Bristol, Som., 1925.

Tribe — **Orchesellini** (C.B.).

Genus — **Orchesella** (Templ.).

46. **O. villosa** (Geof.).
Plymouth (C. W. Bracken), June 16th, 1925.

47. **O. flavescens** (Bourl.).
Bourton Combe, July 4th, 1925, Brockley Woods, Som., July 19th, 1925. My previous records must be referred to var. pallida (Reut.).

47*a*. **O. flavescens var. pallida** (Reut.).
Bourton Combe, July 4th, 1925; Brockley Woods, Som., July 19th, 1925. (See above.)

Sub-Order — **Symphepleona** (C.B.).

Family — **Neelidæ** (Fol.).

Genus — **Megalothorax** (Williem.).

65. **M. minimus** (Willem.).
Goblin Combe, Som., a few, March 15th, 1925.

Family — **Sminthuridæ** (Lubbk.).

Sub-Family — **Sminthuridinæ** (Börn.).

Genus — **Sminthurinus** (C.B.).

50*a*. **S. aureus var. ochropus** (Reut.).
One specimen on Quarry Wall, West Town, Som., April 13th, 1925. One specimen on lichen-covered rocks on Gutter Tor, Dartmoor, May 30th, 1925.

74. **S. niger** (Lubbk.).
In hot house, Cleeve, Som., January 25th, 1925. Cannington September 5th, 1925.

Genus — **Arrhopalites** (Börn.).

77*a*. **A. coecus var. attenuatus** (Carp. and Evens).
One specimen, probably this species, under stone, West Town, Som., May 10th, 1925.

Sub-family — **Sminthurinæ** (C.B.).

Genus — **Bourletiella** (Banks, C.B.).

51. **B. insignis** (Reut.).
Common at Shapwick, Som., July 11th, 1925.

52. **B. bicinctus** (Kock.).
Brockley, Som., July 19th, 1925.

52*a*. **B. bicinctus var. repanda** (Agr.).
Cawsand, Cornwall, May 29th, 1925; Brockley, Som., July 19th, 1925.

Genus — **Allacma** (Börn.).

54. **A. fusca** (Linn.).
Brockley Woods, Som., July 19th, 1925.

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A Short Account of British Psocids.

By J. V. Pearman.

THE object of this paper is to draw attention to a neglected group of British insects, of which no connected account has been published since McLachlan's *Monograph* in 1867 (*Entom. Monthly Mag.*, Vol. III). Considerations of space have necessitated condensation, and the omission of much of interest ; I have aimed to be suggestive rather than informative.

GENERAL DESCRIPTION.

Frequently confused with certain small insects of other orders, Psocids may be most readily identified by the peculiar inflation of the facial mid-region (*clypeus*) and the large globular eyes. The majority are four-winged with proportionately large wings carried along the sides of the body, but meeting by their hinder edges over the back. In these species the thorax is large and convex, giving the insects a hump-backed appearance, and the legs are relatively long and slender. Although capable of flight they do not readily take to wing, trusting rather to their fleetness of foot and powers of jumping. The abdomen, which in life measures about half the total body-length, is oval and soft ; it shrinks much in dried specimens.

Apterous and semi-apterous species occur differing from the winged species by the relatively larger and more globose abdomen and the smaller, simpler thorax, which is not elevated above the level of the top of the head.

Most species are more or less gregarious. They are to be found in almost any situation which provides growths of pleurococcus for food and crevices for lurking places, especially on the bark, and amid the foliage of trees. A few occur in dusty or damp places in houses, feeding on micro-fungi and organic detritus.

Many of them are beautifully coloured and marked, but unfortunately the colours are to a great extent lost or altered after death.

All species, in all stages, are capable of producing from an organ near the mouth a silken thread similar to that of a spider, but the utilisation of this power varies among the species. With some it seems to be used merely to provide a safety line when exploring unfamiliar surfaces. One species spins a close web over its hiding place ; others weave a covering over their eggs.

LIFE HISTORY.

The eggs are laid on or near the feeding ground, and may be either naked or enveloped in a secretion which hardens to form a close fitting sheath. The manner of disposal varies. Some species place them hap-hazard, others aggregate them in smaller or larger patches, either irregularly or in neat quadrilateral formation, and many spin a close web over each patch. The common form of egg is a symmetrical smooth oval, but that of *Hyperetes* and allied genera is somewhat boat-shaped, ridged and pitted. There are considerable specific differences in size, both absolutely and relatively to the parent, and in the number laid.

Although unmistakably stamped with its psocid characters, the young insect is of a simplified form. When newly emerged immaturity is grotesquely emphasised by the disproportionately large head, small abdomen, and relatively thick legs. In the early larval condition all three segments of the thorax are small, simple, and of nearly equal dimensions, the tarsi two-jointed, and the antennæ with fewer segments than in the adult.

As growth proceeds, in stages marked off by periodical moultings of the integument, the adult proportions are gradually assumed, and, in the winged forms, the future wings develop as fleshy pads but do not acquire their true character until after the final moult. Ocelli, three simple eyes placed triangularly midway between the true eyes, are usually correlated with the possession of wings. Apterous species are, in general, very similar to larval forms.

There does not seem to be any detailed account of the complete transformations of any species. There are probably five or six moultings (*ecdyses*), and the duration of each stage (*instar*), and the total period of development is dependent upon weather conditions, and the quantity of food available.

Embryonic development also awaits thorough investigation. With some species the eggs hatch in a few weeks, with others they may remain unhatched for nearly three quarters of the year. As regards at least some of the latter it may possibly be found that the independent larval condition is reached at an early date, the immature psocid remaining quiescent within the shell for a lengthy period. If this surmise be correct it would help to explain the occurrence of a winter larva in certain species (at least four) whereas it seems more usual for the winter to be passed over in the egg.

From records of captures it is possible that there is occasionally hibernation by adults. Some species normally occur very late in the year, but the season of greatest abundance is during the months of June, July and August. The earliest appearing species are found in May. In general our Psocids are single brooded; perhaps a few are double brooded.

Immature forms are sometimes subject to attack by an ectoparasite, probably a Chalcid,* and in all species examined the intestinal tract has been found to contain numbers of gregarines.

* My attempts at rearing the parasite have been unsuccessful.

EXTERNAL ANATOMY.

Only so much of the anatomy as is primarily of use in the discrimination of species can be discussed.

The general characters of the **head** are sufficiently indicated in the figures (fig. 4). The *ocelli* may be distinct or closely aggregated to form a single tubercle. The *antennæ* have two short, stout, basal joints, and a flagellum of 11 (most winged species), 13 (*Troctidæ*), or over 20 (*Atropidæ*, etc.) segments. It is difficult in a line drawing to show the true form of the *mandibles*. Their stout basal portion bears a ribbed molar area which in the right mandible is convex, and in the left concave with a surrounding ridge. The apical incisory part terminates in one or more pointed teeth. Internally between the two areas is a deep channel in which lie the maxilla and pick when the mouth is closed. The "pick," the homology and functions of which are not definitely established, is variously divided at the tip.

Thorax and **abdomen** (fig. 1–3) call for no comment. Towards the apex of the abdomen, beneath, is found the genital armature, a complex assemblage of processes differing in details among the species.

Except in *Troctes*, where the hind femora are much enlarged, the **legs** are slender but strong. The *tarsi* are either two—or three-jointed, the terminal joint bearing a pair of claws furnished with elongate processes (*empodia*).

The **wings** (fig. 5) are shaped somewhat like those of the *Hymenoptera*, and, like them, locked in flight. In the *Psocoptera* this is accomplished by the engagement of two ridges formed by a bending downwards of part of the hind margin of the forewings, and a corresponding upward bending on the fore margin of the hind wings. (LL fig. 5).

The venation, especially of the forewings, was the basis of the first satisfactory plan of classification and still affords the readiest means of separating genera. We may regard the main nervures as parts of two reciprocal systems of forked veins. The upper system consists of the *Radius* (R) with its branches (R*a*, *b*) and the *Stigmal* vein (S), the lower comprising the *Medius* (M) with its branches (M*a*, *b*, *c*) and the *Cubitus* (C) and its branch. Thus the Cubital, or Posterior, Cell (CP) is regarded as the homologue of the Pterostigma (PS), and these two areas usually undergo sympathetic modifications, though not always to an equal degree. For instance in the genera *Stenopsocus* and *Graphopsocus* (fig. 8) each is connected to the adjacent longitudinal vein by a transverse veinlet (hyphen); in *Psocus* (fig. 6) the cubital cell coalesces with the medius and the pterostigma tends towards the radius. Exceptions are seen in *Mesopsocus* where a greatly enlarged cubital cell is associated with a comparatively small pterostigma, and in *Peripsocus* where the cubital cell is wholly absent. (Figs. 5, 9).

The manner in which the two systems of veins are joined (R+M) should be observed. (Fig. 12.) Examples of the three conditions sessile, hyphenate and petiolate, are shown in figs. 6—8.

The keys which follow are sufficient for the determination of genera. The nomenclature in the list of species is that most usual in British references ; some generic names of doubtful value have been ignored. Species not yet recorded from the Bristol area are indicated by prefixing the letter N.

KEYS TO GENERA.

References, unless otherwise noted, are to forewings ; lettering as in figures.
T=tarsal joints. A=antennal joints.

I. Wings functional.	
CP wanting	
T3. **PS** wanting	Embidotroctes ♂
T2. **PS** clavate (fig. 9)	Peripsocus
T2. **PS** oblong (fig. 10*e*)	Ectopsocus
CP free	
T3. **PS** clavate **CP** tented, moderate (fig. 10*a*, 11*a*)	Elipsocus
PS prolate **CP** tented, very large (fig. 5)	Mesopsocus ♂
PS simple **CP** simple (fig. 7)	Psyllipsocus
T2. (**CP** usually domed)	
PS clavate (fig. 10*b*, *c*, *d*,)	
Veins ciliated	
Hind wings R+M intimate	Caecilius
Hind wings R+M hyphenate	Reuterella ♂
Veins bare	Pterodela
PS prolate (fig. 10*g*)	
R+M petiolate	Kolbia ♂
R+M hyphenate	Bertkauia ♂
PS oblong (fig. 10*f*)	Trichopsocus
CP adherent to **M.** **PS** free (fig. 6) **T2.**	Psocus
CP hyphenate to **M.** **PS** hyphenate to R (fig. 8)	**T2.**
PS clavate	Graphopsocus
PS elongate, narrow	Stenopsocus
II. Wings wanting or much reduced	
T2.	
Winglets minute, ocelli present	Kolbia ♀
Winglets absent, ocelli absent	
Antennæ long, colour pitchy black	Bertkauia ♀
Antennæ short, colour buff brown	Reuterella ♀

T3.

A 2+11.

Completely apterous	PSEUDOPSOCUS
Winglets present, minute	MESOPSOCUS ♀

A 2+13 (Insects minute, form flattened)

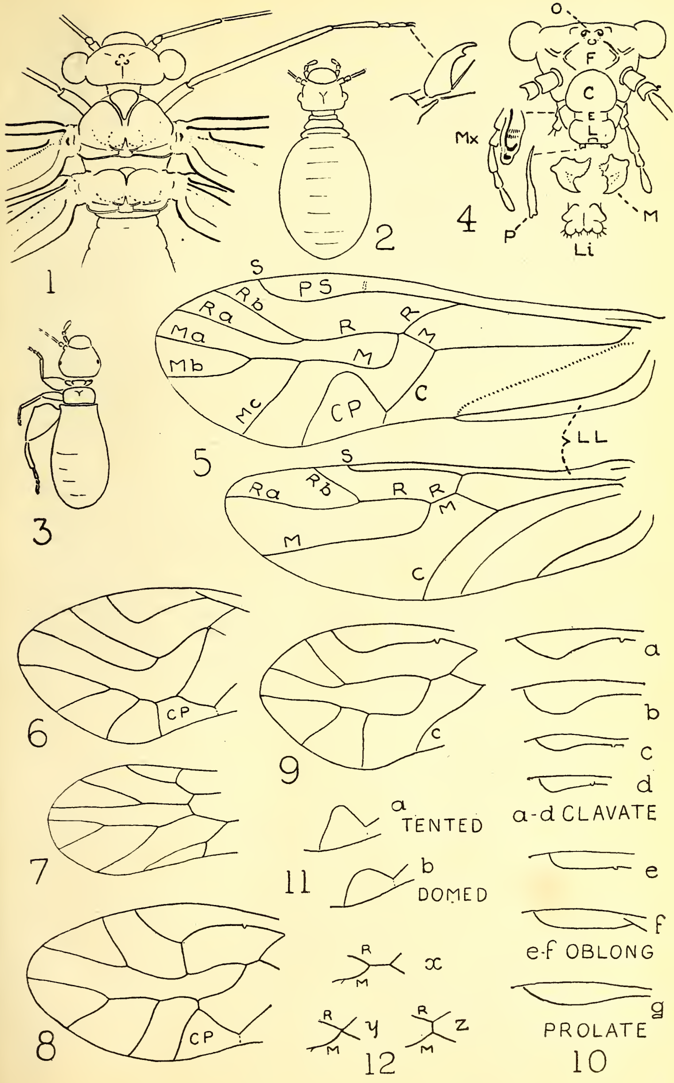
Hind femora much dilated and angulated	TROCTES
Hind femora slightly dilated, not angulated	EMBIDOTROCTES ♀

A 2+20, or more.

Completely apterous	HYPERETES
Winglets present	
Body without scales, winglets rounded.	
Ocelli present, winglets with evident neuration	NYMPHOPSOCUS
Ocelli generally absent, winglets without neuration	
Colour whitish	ATROPOS
Colour pitchy	LEPINOTUS
Body with scales, winglets pointed	PTEROXANIUM

LIST OF BRITISH PSOCOPTERA.

PSOCUS	*Latr.*
longicornis	*Fabr.*
nebulosus	*Steph.*
bifasciatus	*Latr.*
variegatus	*Latr.*
fasciatus	*Fabr.*
sexpunctatus	*Linn.*
N quadrimaculatus	*Latr.*
N bipunctatus	*Linn.*
N morio	*Latr.*
STENOPSOCUS	*Hagen.*
immaculatus	*Steph.*
stigmaticus	*Imhoff.*
GRAPHOPSOCUS	*Kolbe.*
cruciatus	*Linn.*
MESOPSOCUS	*Kolbe.*
unipunctatus	*Müll.*
ELIPSOCUS	*Hagen.*
flaviceps	*Steph.*
hyalinus	*Steph.*
westwoodi	*McL.*
abietis	*Kolbe.*
cyanops	*Rost.*
PSEUDOPSOCUS	*Kolbe.*
rostocki	*Kolbe.*
CAECILIUS	*Curt.*
fuscopterus	*Latr.*
N atricornis	*McL.*
flavidus	*Steph.*
N obsoletus	*Steph.*
burmeisteri	*Brau.*
perlatus	*Kolbe.*
N kolbei	*Tet.*
piceus	*Kolbe.*
TRICHOPSOCUS	*Kolbe.*
dalii	*McL.*
KOLBIA	*Bertk.*
N quisquiliarum	*Bert.*
BERTKAUIA	*Kolbe.*
lucifuga	*Ramb.*
(=prisca	*Kolbe*)
REUTERELLA	*End.*
helvimacula	*End.*
PTERODELA	*Kolbe.*
pedicularia	*Linn.*
quercus	*Kolbe.*
PERIPSOCUS	*Hagen.*
N alboguttatus	*Dalm.*
subpupillatus	*McL.*
phæopterus	*Steph.*
ECTOPSOCUS	*McL.*
briggsi	*McL.*
PSYLLIPSOCUS	*Selys.*
ramburii	*Selys.*
NYMPHOPSOCUS	*End.*
destructor	*End.*
ATROPOS	*Leach.*
pulsatoria	*Linn.*
N annulata	*Hagen.*
LEPINOTUS	*Heyd.*
inquilinus	*Heyd.*
HYPERETES	*Kolbe.*
guestfalicus	*Kolbe.*
N britannicus	*Harr.*
PTEROXANIUM	*End.*
squamosum	*End.*
TROCTES	*Burm.*
divinitorius	*Müll.*
bicolor	*Banks.*
N formicarius	*Hagen.*
EMBIDOTROCTES	*End.*
rectivenis	*Pear.*



O
F
C
E
L
Mx
M
P
Li
1
2
3
4
5
S
PS
Rb
Ra
Ma
Mb
Mc
R
M
C
CP
LL
6
7
8
9
10
11
12
a TENTED
b DOMED
a-d CLAVATE
e-f OBLONG
g PROLATE
x
y
z

EXPLANATION OF FIGURES.

1. Type of winged psocid. 2. Type of larval and apterous psocid. 3. Type of Troctes. 4. M. unipunctatus, Head, front view,—O. ocelli ; F, frons ; C, clypeus ; E, epistoma ; L, labrum ; M, mandibles ; Mx, maxilla ; P, pick ; Li, labium. 5. The same, wings. 6. Psocus variegatus, apex of forewing. 7. Psyllipsocus, the same. 8. Graphopsocus, the same. 9. Peripsocus, the same. 10. Types of PS—*a*, Elipsocus, *b*, Cæcilius, *c*, Reuterella, *d*, Pterodela, *e*, Ectopsocus, *f*, Trichopsocus, *g*, Bertkauia. 11. Types of free CP—*a*, Elipsocus, *b*, Cæcilius. 12. Types of R+M junction—*x* petiolate, *y*, sessile, *z*, hyphenate.

List of Slugs Found in the Bristol District.

By A. D. R. Bacchus.

ALTHOUGH perhaps better known in Bristol for his work on the Rhyncota and the Formicidæ, the late Mr. A. D. R. Bacchus had studied the Mollusca with equal enthusiasm. After the War, when he settled in Bristol, he recorded several species as new to Gloucester West, Somerset and Wiltshire. Several of his Notes were published in the *Journal of Conchology*, Vol. XVI. The following List of Slugs was compiled by him in 1921 and 1922, and will undoubtedly prove of great value to all future students of this somewhat neglected Group. His characteristic zeal in unearthing old records is well shown in the following List. His untimely death from injuries received while on active service is an irreparable loss to Zoology, not only in the Bristol district, but throughout the South Western area.—*N. G. Hadden.*

BRITISH SLUGS.

		Glos. W.	Som. N.
1.	Testacella haliotidea, Drap....	X	
2.	T. scutulum, G. B. Sowerby ...		X
3.	T. maugei, Fêrussac	X	X
4.	Limax maximus (Linn.)	X	X
5.	L. cinero-niger (Wolf)		X
6.	L. tenellus, Müller		
7.	L. flavus, Linn.	X	X
8.	L. arborum, Bouch. Chan. ...	1	X
9.	Agriolimax agrestis (Linn.) ...	X	X
10.	A. laevis, Müller		X
11.	Milax gagates (Drap.)	X	X
12.	M. sowerbyi (Fêrussac)	X	X
13.	Arion ater (Linn.)	X	X
14.	A. subfuscus (Drap.)	X	X
15.	A. hortensis (Fêrussac)	X	X
16.	A. circumscriptus (Johnston) ...	X	X
17.	A. intermedius, Normand ...	1	X
18.	Geomalacus maculosus, Allman	Found only in a few localities in Ireland.	

X Bristol District. 1 In vice county but not in Bristol district.

Testacella haliotidea, Drap. First record, G. Garden, Carville, Alexandra Park, Bristol, May, 1888, J. W. Cundall; Kingsdown Parade, W. W. Stoddart; Clifton Gardens, Miss Jones; Hampton Park (rare).

T. scutulum, G. B. Sowerby. First record, S. Leigh Woods, rare, T. G. Ponton, 1862, (Leipner's Bristol List, 1875). G. Gardens, Clifton, T. G. Ponton, 1862.

T. maugei, Ferussac. First record, G. Found in 1812 in Miller and Sweets' (now Garaway's) Nurseries by Mr. Drummond. Original site now built over. Gardens at Redland, Cotham, Horfield, etc. S. Bath, Brislington, Clevedon. One dead shell found by D. B. near allotments at Westbury-on-Trym; am told they are common on allotments, April 27th, 1921.

var. *griseo-rubescens*. Bristol, November, 1883, J. W. Cundall.

var. *aurea*. Gardens, Cotham, 1883, Miss F. M. Hele.

Limax maximus (Linn.). First record, G. Common, Redland, T. G. Ponton, 1883; Gardens, Clifton, Miss Jones, 1875; Sea Mills, two or three under stones, November, 1920, D. B.; Blaize Castle, Henbury, under bark, May, 1921, D. B. S. Clevedon, October, 1920, D. B.

L. cinero-niger (Wolf.). First record, (see var. *maura*).

var. *maura*. S. Cleeve Combe, Norman (Som. Moll., 1860, p. 139).

L. flavus, Linn. First record, G. Common in Bristol gardens, E. C. Jellie (Naturalist, 1867). S. Type and var. *grisea*, Bath, 1884, C. J. Waterfall. S. Clevedon, common, October, 1920, D. B. G. Common in garden at 29, Abbotsford Road, April, 1921.

L. arborum, Bouchard-Chantereaux. First record, S. Cleeve and Brockley Combes, Norman (Som. Moll., 1860). G. Stroud, common on beech, October, 1883, E. J. Elliott. S. Clevedon, October, 1920, D. B.

Agriolimax agrestis (Linn.). Common everywhere in fields.

A. lævis, Muller. First record, S. Among stones by side of lane from Walton to Portishead, and among decaying vegetation by side of sluice on Portishead Moor, Norman (Som. Moll., 1860). Confirmed first part of record October, 1920, D.B.

Milax gagates (Draparnaud). S. Specimens in Bristol Museum labelled Bath, J. E. Daniel.

var. *plumbea*. S. One sent to J. W. Taylor by D. B. from Clevedon, who wrote "remarkably fine specimen."

var. *benoiti*. G. Three half-grown specimens found in overgrown road at Redland, D. B. Mr. Taylor writes: "if the yellow keel persists till adult, should be var. *benoiti*."

M. sowerbyi (Ferussac). First record, G. Clifton, Rev. B. J. Clarke (Ann. and Mag. Nat. Hist., 1843) ; Gardens, 1884, W. B. Waterfall. S. Gardens, Clevedon, Norman (Som. Moll., 1860). Confirmed by D. B., October, 1920. G. Redland in overgrown road ; Westbury allotments.

Arion ater (Linn.). First record ?

var. *aterrima.* (Body shield and creeping disc uniformly black.) G. One on roadway, Redland Green, May 11th, 1921, D. B.

var. *castanea* (uniformly brown). S. Bath, June, 1884, C. J. Waterfall. G. Blaize Castle, May 14th, 1921, D. B.

var. *plumbea.* S. Bank above Leigh Woods, D. B. G. Overgrown road, Redland, D. B.

var. *aurantia.* G. Under an old sack outside allotments, Westbury-on-Trym, three or four, April, 1921, D. B.

var. *alba.* S. Leigh Woods, fairly common. D. B. Sub-var. *cinero-nebulosa* (?) is fairly common. (Foot-sole pale yellow, tentacles blackish.)

var. *bicolor*, sub-var. *scharffii* (Back black, sides yellowish). S. The commonest form in fields and hedgerows at Clevedon, October, 1920, D. B.

A. subfuscus (Drap.). S. Clevedon, October, 1920, D. B. Flax Bourton, April, 1920. D. B. G. Stoke Bishop side of Coombe Dingle, May, 1921. Disused road, Redland Green, very common, May, 1921. (Some grey-green in colour.)

A. hortensis (Ferussac). First record, G. Too common in Bristol gardens. E. C. Jellie (Naturalist, February, 1867). S. Common in Clevedon gardens. Norman (Som. Moll., 1860). Common almost everywhere.

A. circumscriptus (Johnston). First record, S. Bristol, W. B. Waterfall, 18—. G. Bank above Leigh Woods, April, 1921, D. B. G. Under stones at Stoke Bishop side of Coombe Dingle, D. B. Blaize Castle, May 14th, 1921, D. B.

A. intermedius, Normand. S. Clevedon, October, 1920, D. B.

Bristol Botany in 1925.

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

A WEST COUNTRY volume hitherto unknown has been brought to my notice by a friend who possesses a rare faculty for finding scarce books of local interest. *The Bath and Bristol Magazine; or Western Miscellany*, was published at Bath. It seems to have been issued quarterly, and to have ceased with the twelfth number. The third and last volume—1834—is the one under review. Its contents provide a vivid glimpse of provincial journalism a century ago, for they were indeed miscellaneous: theology, biography, poetry, science, philosophy, reviews and "whimsicalities" all being included. The "Originator," however, had been bitterly disappointed by the result of his adventure; and for this failure he held Bristol to be mainly responsible. "Against the people of that city," he says, "we bring no other charge than this, that their past history and present habits do not warrant the expectation of success to *any* literary periodical dependent upon *them* for its support and circulation. For every single copy of our miscellany sold in Bristol there is a score sold in Bath. Bridgwater, again, with its population of three or four thousand, sells quarterly more copies than does the city of Bristol, with its hundred and twenty thousand souls, in a year. Moreover, in Bridgwater the *Western Miscellany* is supported as a literary undertaking: in Bristol it is neglected and opposed." Added to this lament we have in detail—for the distracted editor was a verbose writer—a sad story of pecuniary loss, of waspish criticism, and of the "virulent slanders" that were cutting short the life of his illused magazine.

For ourselves as field botanists to whom the historical record has an appeal the primary interest of the book lies in two articles. The first is a lengthy—but by no means laudatory—review of Babington's *Flora Bathoniensis*, then just issued. The author's adoption of a natural system of classification in place of the Linnean sexual arrangement received half a page of condemnation! The change was intolerable to this reviewer, who in fact was not happy in what he said nor in his way of saying it. The other article is of more importance. It is a *Botanical Notice of Somersetshire* by "A.G.", a subscriber and evidently Dr. A. Gapper of Bridgwater, who later took the name of Southby. He was an acute and able observer. He assisted Hewett Watson in compiling the *New Botanist's Guide*, 1835–1837; and *Topographical Botany* so far as the counties of Gloucester and Somerset were concerned. But this list of Somerset localities begins with St. Vincents Rocks, the Downs, Sea Mills, Brandon Hill and Wyck Cliffs ! Dr. Gapper, apparently, was as badly informed on county boundaries as were many other folk of his generation, who, as Turner and Dillwyn stated " had in many instances no means of determining whether localities ought to be arranged under Gloucestershire or Somersetshire." Be that as it may, and although a majority of the plants mentioned are among rarities of the district well known at the present day, it must be owned that had this list been available when the *Flora of Bristol* was written some of its entries would have taken another form. And there can be no doubt that the authors of the *Flora of Somerset* and its *Supplement*, had they survived, would have made a like admission. The occurrence of *Lactuca virosa* on St. Vincent's Rocks, vouched for by Swete, is here antedated by twenty years, and the note is probably responsible for the plant being mistakenly credited to Somerset in the *New Bot. Guide*. The rare *Orobanche elatior* at the same locality is similarly antedated. The first records for *Pyrus torminalis* in Leigh Woods ; *Moenchia erecta* and *Trigonella ornithopodioides* on Brandon Hill ; *Obione portulacoides* near the Powder House ; and *Lathyrus palustris* on the Turf Moor must all be transferred to Dr. Gapper. On the Turf Moor he noted *Cicuta virosa* and *Rynchospora fusca*, two plants that seem to have died out and are possibly now extinct in the county. *Ranunculus hirsutus* at Cheddar ; *Sedum Telephium* in Leigh Woods ; and *Inula Helenium* at Penpole are new to us. The *Scirpus caricinus* he detected at Burnham remained there unsuspected until Mrs. David Fry came upon it more than 50 years later. As can be seen this botanist missed very little in the districts he visited. Grateful thanks are due to Mr. H. S. Thompson for unearthing an article of such interest.

No species new to our area has shewn itself during the season, though some welcome varieties have been detected. Aliens, imported with exotic food-stuffs, are still plentiful about our docks and fowl-runs. One or two plants long lost to sight have been rediscovered, and one feels that hardly anything can be more gratifying than the confirmation of an old record that after many years may have faded into doubt.

Thalictrum minus L. As stated in *Fl. Brist.* the belief was entertained at one time that two forms of *Thalictrum* existed at Cheddar, though no sufficient reason was ever stated, and the view was ultimately dropped. Lately, however, Mr. A. J. Wilmott of the British Museum has revived the idea. He finds some examples almost subglabrous with short, stout fruit, and others that are glandular with longer fruit ; and he will be glad to receive for further study specimens collected when the fruit is quite ripe.

Ranunculus Drouetii F. Schultz. Pond near Brockley, S.; *Miss Roper.*

Helleborus viridis L. Between Hinton and Wellow, S.; *Rev. E. Ellman.*

Papaver Lecoqii Lamotte. Dunkerton, S.; *Id.*

Viola Riviniana Rchb. f. *villosa* Neum. Densely pubescent, especially on peduncles. In quantity with *V. silvestris* and *Riviniana* hybrids, in Churchill Batch Wood, S.; *Colin Trapnell.*

Arenaria serpyllifolia L. var. *viscidula* Roth. (*glutinosa* Koch). $=$*A. viscida* Lois. On walls in Bleadon village, S.; *Id.*

Vicia sepium L. subvar. *alba* Rouy. Between Abbots Leigh and Lower Failand, S. A new station for this beautiful form; *Miss Bolton.*

Rubi. The Rev. H. J. Riddelsdell and Mr. G. C. Brown, working together, have recently observed the following in our district. *R. imbricutus* Hort., Wraxall, S. *R. Bakeri,* F. A. Lees, and *R. lentiginosus* Lees, Clifton Down, G. *R. Schlechtendalii* Whe. Wood at Wraxall, S. *R. scaber* W. and N. (a weak form) by an abandoned colliery, Old Nailsea, S.

Petroselinum segetum Koch. (*Carum* Benth.) Lovers' Lane, Hallen, G. Wraxall, S.,; *Miss Roper.*

Smyrnium Olusatrum L. Appears to be spreading. Abundant in a field-hedge and lane at Elberton; and by the Roman road at Lawrence Weston, G. *Id.*

Hedera Helix L. var. *borealis* Druce. Hedge bottom, Alveston, G.; *Id.*

Sedum Telephium L. Mr. H. S. Thompson finds in his herbarium a sheet of this Orpine gathered at "Woodborough, September, 1881"; and has little doubt that it came from the bank by the railway on the Axbridge side of Winscombe, where at the present time it is well and widely established; a locality hitherto unrecorded. I learn that the date of Thos. Clark's specimen from Cheddar Gorge is 1824.

Drosera rotundifolia L. On the peat moor near Ashcott where Sundews are plentiful Mr. Thompson noticed one that had captured and consumed a Meadow Brown butterfly. With so large an insect such an occurrence must be extremely rare.

Onopordum Acanthium L. Bank of the Brue at Bason Bridge, S.; *W. Watson.*

Matricaria inodora L. flore pleno. Mrs. Sandwith found a double-flowered Mayweed among the double Pyrethrums cultivated in her garden at Tickenham.

Tanacetum vulgare L. This aromatic herb, partial to watersides, and local in distribution, is abundant in a damp meadow by the Little Avon at Middlemill, G.

Cnicus Forsteri is the hybrid between *C. palustris* and *C. pratensis*. Boggy field, Churchill, S. With the parents ; *Miss Roper*. *C. pratensis* var. *polycephalus*. On Ashcott Moor, S. ; *Id.*

Tragopogon porrifolius L. Railway bank, Keynsham, S. ; 8 or 10 plants flowering in May ; *R. E. Taylor*.

Orobanche minor L. Parasitic on *Sedum album* (locality not given) ; *C. Wall*. No published record of this host is known, but about the same time Mr. N. G. Hadden noticed a similar association in his garden at West Porlock.

Verbascum Blattaria and *V. virgatum*. We are glad to know that these conspicuous flowers still survive by the railway near Winscombe, S., where they were established before the construction of the line. The less common creamy-white flowered form of *V. Blattaria* has a rosy flush on the underside of the two upper corolla segments, a peculiarity that has been mentioned by writers in *Journ. Bot.* and elsewhere.

V. phlomoides L. " A Mullein shown to me by Mr. A. T. Davies from quarry ground at Tytherington, G., first noticed in 1924, proved to be this handsome continental species. On visiting the locality this year I found upwards of 20 plants, some of them over six feet in height ; " *Miss Roper*.

Euphrasia Kerneri Wettst. Limestone cliffs, Avon Gorge G., 1924 ; *A. E. Wade* and *G. C. Brown* in *Report B. E. Club*. First record for the Gloucester division of the district.

Mentha longifolia Huds. (*sylvestris* L.) Has re-appeared at Walton-in-Gordano after being apparently lost for 40 years. See *Fl. Brist.* p. 466. Streamside near Keynsham towards Queen Charlton, S. ; *Mrs. Bell*. By the Upper Frome near Gurney Slade, S.

M. piperita L. var. *officinalis* Hull. By the Upper Frome at Gurney Slade with the last species. In small quantity with *M. hircina* above Weston-in-Gordano, S.

M. rubra Huds. Streamside below Queen Charlton, S. ; *Mrs. Bell*.

M. arvensis var. *Allionii* Bor. Cog Mill, Frampton Cotterell, G. ; *Miss Roper*.

Rumex sanguineus L. Two large plants on a laneside at the foot of Stinchcombe Hill, G. ; *Id.*

Urtica dioica L. var. *angustifolia* Wimm. and Grab. Bank of the Frome at Fishponds, G. ; *H. J. Gibbons*. This variety was originally described by Fischer in 1819 (pro specie) as having " upper leaves linear-lanceolate." These should also be " rounded but hardly cordate at the base," *Bab. Man.* Mr. Gibbon's specimen closely corresponds. The plant by the roadside at Stone Edge Batch, Tickenham, of which I have an excellent specimen, is said to be no longer there. I last saw it in 1917.

Orchis Morio L. Two plants on Durdham Down ; *C. Wall.* An interesting survival.

Ophrys muscifera L. About a dozen flowering stems were seen in May in another part of the same woodland above Tickenham where the plant was discovered some years ago ; *D. H. White.*

Habenaria bifolia R. Br. (*Platanthera* Rich.) One plant on Stinchcombe Hill, G., during the Society's Summer excursion ; *Mrs. Sandwith.*

Narcissus biflorus Curt. Several clumps by the Chew above Stanton Drew ; not the locality recorded by Mr. D. Fry ; *Miss Roper.*

Ornithogalum umbellatum L. A fair quantity in a meadow at Bishport, S., verifying a record made 75 years ago by Dr. Thwaites in *Swete Fl.* As the leaves were narrowly linear, not recurved but erect when young, this may be the var. *angustifolium* Boreau, but as the plants did not blossom the number of flowers on a stem could not be counted in confirmation ; *Id.*

Gagea lutea Gawler. Border of wood by Markham Bottom, S. ; *Colin Trapnell.*

Scirpus sylvaticus L. By the Chew below Compton Dando, S. ; *H. S. Thompson.* The sedge has long been known on the upper reaches of the river.

Chara fragilis Desv. Pond at Rudgway, Alveston, G. ; very rare in our Gloucestershire division ; *C. Trapnell.*

C. delicatula Agardh. Now classed as a full species. Large quantities this year in rhines on Walton Moor, S. Approved by Mr. J. Groves ; *Id.*

ALIENS.

Lepidium graminifolium L. A common weed in central and southern Europe. Some stout bushy plants by the Avonmouth Docks ! *C. and N. Sandwith. Brassica adpressa* Boiss. and *B. juncea* Coss. Both plentiful with the preceding ! *Id. Staphylea pinnata* L. The bushes recorded by Capt. Gordon from a streamside near Wickwar still flower sparingly though very closely trimmed; *Miss Roper. Trigonella fœnum-græcum* L. Garden weed, St. Michael's, Bristol ; *Mrs. Bell. Carum copticum.* Unknown to me. "Bristol" ; *C. and N. Sandwith. Linaria dalmatica* Mill. A native of Eastern Europe ; has escaped from cultivation on the Burnham sand-hills, where it was first noticed in 1913 (*Herb. Kew.*). *Artemisia biennis* Willd. North American. Avonmouth Docks, G. and Gas Works, Bath, S. *Amaranthus deflexus* L. Fowl run, Syston, G. ; *H. J. Gibbons. Nectaroscordum siculum* Lindl. Still exists on St. Vincent's Rocks where it was planted years ago. See *Fl. Brist.* p. 594.

The Avonian Succession between Wickwar and Chipping Sodbury (Glos.).

By Margaret C. Tuck, M.Sc., F.G.S.

I. Introduction and Summary of Previous Work.
II. Stratigraphy and Topography of the Area.
III. Lithological Description of Zones.
IV. Lists of Fossils.
V. Description of Exposures.
VI. Comparison with other Areas and Conclusions.

I. INTRODUCTION AND SUMMARY OF PREVIOUS WORK.

THE Avonian or Lower Carboniferous which forms the rim of the Bristol Coalfield is exposed between Almondsbury and Chipping Sodbury, as a narrow but continuous outcrop of limestone, the form of which is that of an irregular horseshoe open to the south. At the places above mentioned, the limbs of the horse shoe are overstepped by Mesozoic rocks, and the rim is concealed both on the west and on the east for some miles. The present paper is concerned only with the eastern limb—the part of the outcrop between Wickwar and Sodbury.

The limestones of Wickwar and Sodbury were mentioned by Buckland and Conybeare as far back as 1824,[1] and the area is alluded to by H. B. Woodward in the Geological Memoir on the District in 1876.[2] The Wickwar quarries were described in detail by Prof. C. Lloyd Morgan in 1898,[3] and by Prof. S. H. Reynolds in 1921.[4] A general account of the faunal zones of the Lower Carboniferous within the area was given by the late Arthur Vaughan in 1905.[5]

The present paper amplifies with further detail the work already done by the authors named, and links up the Tytherington-Wickwar area fully described by Dr. F. S. Wallis[6] with the Sodbury Railway Cutting the faunal succession of which has been worked out in detail by Arthur Vaughan[7] and the lithology minutely examined by Prof. S. H. Reynolds.[8] The author's earlier work

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1 *Trans. Geol. Soc.*, Ser. 2, Vol. 1, pp. 215 and 249.
2 *Geology of East Somerset and the Bristol Coalfields* (Mem. Geol. Survey) pp. 17 and 21.
3 Handbook British Association, Bristol, Excursion 17, Tortworth.
4 Geological Excursion Handbook for the Bristol District, pp. 192–4.
5 *Quart. Journ. Geol. Soc.*, Vol. LXI, pp. 236–9.
6 *Proc. Brist. Nat. Soc.*, Ser. 4, Vol. VI, pp. 57–74.
7 *loc. cit.*
8 *Geol. Mag.*, 1923, pp. 111–119.

was carried out in collaboration with Miss Edith Bolton. This work was considerably extended by Miss Bolton, and published in abstract.[1] Since the publication of this abstract the investigations have been further extended both in scope and detail.

II. STRATIGRAPHY AND TOPOGRAPHY OF THE AREA.

Between Wickwar and Chipping Sodbury—a distance of about four miles—the outcrop of the Lower Carboniferous is where fully exposed nearly a mile wide, but the unequal extension of the Lias over the Palæozoic on the eastern side, and the patches of Trias on the western, partially conceal the boundaries and render the width of outcrop very irregular.

The underlying Old Red Sandstone is only exposed in the northern part of the area west of Wickwar, and in the immediate vicinity of Brimsham Bridge; between these places the Lias oversteps both the Old Red Sandstone and Tournaisian and finally rests on the *Seminula*-zone. The junction between the Carboniferous Limestone and the Millstone Grit is concealed by Trias, except between Yate Court and Yate Rocks, a distance of three-quarters of a mile, and for a similar distance east of Sodbury. To the south of Sodbury the Carboniferous entirely disappears under Lias, but the G.W.R. cutting half a mile west of Chipping Sodbury Station exposes a fine section from the base of K to the top of D_1.

The Lower Carboniferous rocks dip westwards at angles varying from 28 degrees to 45 degrees. A complete calcareous succession extends up to the top of D_1, but D_2 is represented by an arenaceous facies since Millstone Grit conditions here come in earlier than in the Avon Section.

The limestones form nearly level country standing about 300 feet above sea level, but rising slightly to the south. The Lias occupies gently rising ground, but gives place abruptly to the steep scarp of the Cotteswolds which at a distance of about $2\frac{1}{2}$ miles to the east runs parallel to the low Avonian ridge.

III. LITHOLOGICAL DESCRIPTION OF ZONES.

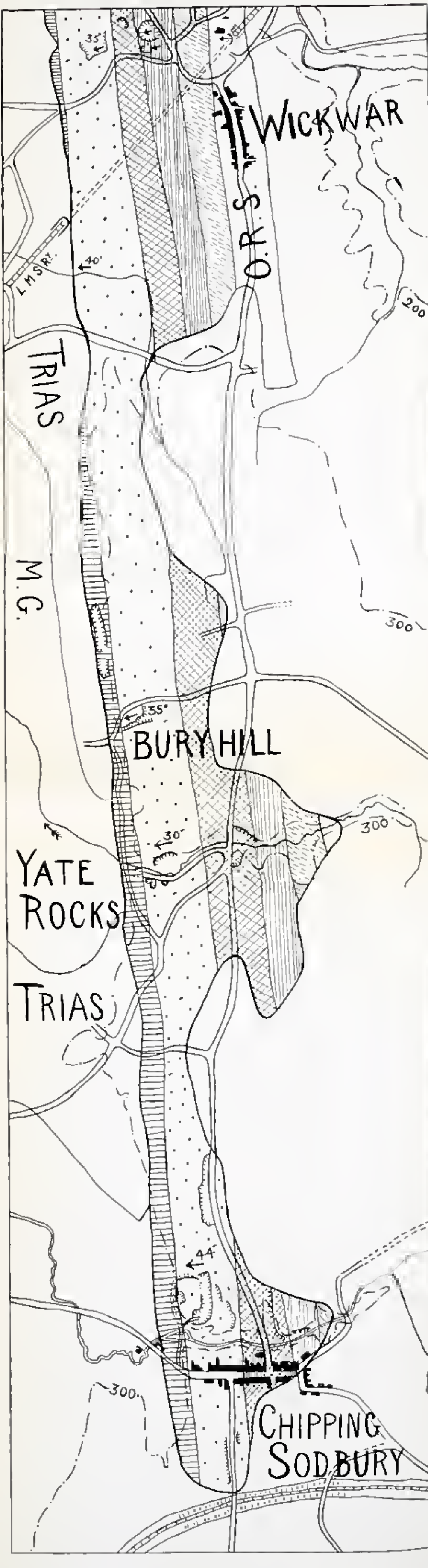
Dr. Vaughan's zonal notation is used throughout this paper.

TOURNAISIAN.

CLEISTOPORA-ZONE. K.

The beds of this horizon are not well exposed at any point in the area since they weather easily and tend to become overgrown by vegetation. Where seen their junction with the underlying Old Red Sandstone is a conformable one. A fine grained sandy

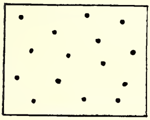
[1] *Abs. Proc. Geol. Soc.*, 1920, pp. 30, 31.



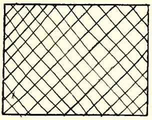
GEOLOGICAL MAP OF THE WICKWAR CHIPPING SODBURY AREA.

Scale ... 1 Inch = ½ Mile.

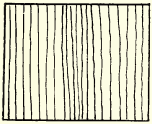
D ZONE



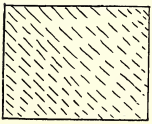
S ZONE



C ZONE



Z ZONE



K ZONE

limestone which weathers yellow and probably lies low down in the series is exposed a little to the north of Wickwar Church in a lane leading from the Railway Station. The slight depression at the junction of the road from the Station with the Charfield Road is due to the presence of these soft K-beds.

The zone is again exposed 2½ miles further south near Brimsham Bridge. By following the stream eastwards from the bridge, blocks of highly fossiliferous K-material can be obtained from its bed. The lowest K-beds immediately overlying the Old Red Sandstone are thin-bedded sandy limestone. Exposures of horizon a (the Bryozoa bed) have not been found although they have been particularly looked for.

Zaphrentis Zone. Z.

Wickwar. Z_1. The lowest Z-beds are exposed in an old quarry (qu. 1 on map) north of the village and east of the Charfield Road by the side of a copse. They consist of dark crinoidal limestone weathering to a yellowish grey. The beds are much weathered and overgrown.

Z_2 and γ. The higher part of the zone—Z_2 and γ is well exposed in a quarry (Qu. 2) west of the Charfield Road. The Z_2-beds are highly crinoidal, dark and often dolomitized limestones, in places of "petit granit" type, similar to beds of the same horizon in the Avon Section. Small round patches of crystalline calcite, due to the recrystallization of calcareous mud are a prominent feature.[1]

The highest beds exposed (Hor. γ) are strongly dolomitized, and therefore not very fossiliferous, nevertheless, crinoids and a few zaphrentids which have escaped dolomitization have been obtained.

Brimsham Bridge. Z-beds are only poorly exposed here. The lower beds consist of thinly-bedded dark crinoidal limestones which proved highly fossiliferous. No satisfactory exposures of Z_2 were found.

Chipping Sodbury. Coarse crystalline limestone succeeded by beds of the petit granit type are exposed on the north bank of the Frome, north of the main street. Z-beds have not hitherto been recorded here.

Syringothyris Zone. C.

Wickwar. About 10 feet or so of the lowest beds of the *Syringothyris*-zone are exposed in quarry 3. These are dolomites in which only a few crinoidal ossicles have escaped destruction.

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[1] See E. E. L. Dixon and A. Vaughan, *Quart. Journ. Geol. Soc.*, Vol. LXVII (1911), pp. 483, and S. H. Reynolds, *ibid*, Vol. LXXVII (1921), pp. 221.

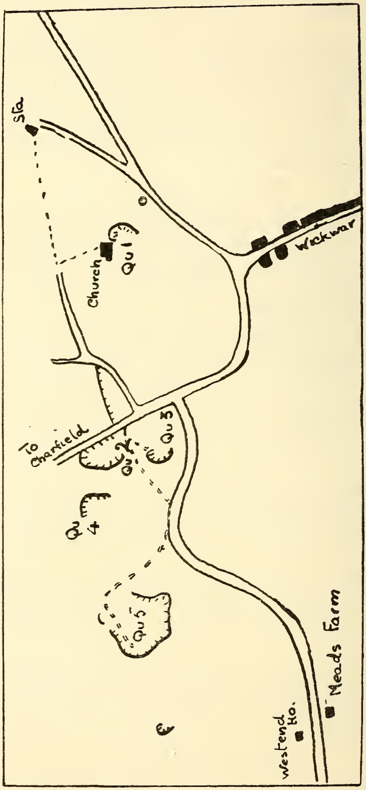

DIAGRAM OF QUARRIES AT WICKWAR.

Quarry 4 exposes the "sub-oolite" bed, a fossiliferous level below the *Caninia*-oolite which is a constant feature throughout the district, and specially thick in the Wickwar-Tytherington area to the north.[1] The overlying white oolite is less markedly oolitic, and is more fossiliferous than in the Avon Section. The higher beds of the zone (*Caninia*-dolomites) occupy the hollow between the quarry and quarry 5, but are not exposed.

Brimsham Bridge. The *laminosa*-dolomite level is represented by fine grained unfossiliferous dolomites, followed by light coloured crinoidal dolomitized limestone. Above this comes the *Caninia*-oolite which has the usual white, current-bedded, unfossiliferous character. The Wickwar-Sodbury road runs in a depression formed by the rapid weathering of the oolite and on the west side of this, in a field sloping southwards to the stream, light coloured dolomite (*Caninia*-dolomite) is exposed as bare patches outcropping through the soil.

Chipping Sodbury. Limestones of the *Syringothyris* zone are now being quarried on the east of the Wickwar road, opposite the Church. The beds mainly belong to the *laminosa*-dolomite, and they consist of dark crinoidal, dolomitized limestones and fine grey dolomites and include an algal band.

The "sub-oolite" occurs as a fossiliferous band at the top of the quarry. On the opposite side of the road a path leading westwards to the large town quarries exposes bands of dolomite and algal limestone.

SEMINULA ZONE. S.

Wickwar. The top of S_1 and lower S_2 are exposed in Qu. 5. The lowest beds consist of dark limestone with thin black shale partings, followed by massive limestone, chinastone, oolite, an unpersistent development of pisolite, and an algal band. A thin bedded grit band (firestone) is taken as the base of S_2. Above the grit occurs about 40 feet of massive limestone with well marked bands of *Lithostrotion*, and some oolite. No further good exposures of S-beds are met with until Bury Hill, 2 miles south of Wickwar is reached, but the outcrop of this zone is easily traced in isolated exposures, under hedges, etc., not meriting detailed description.

Bury Hill. The section seen in the Bury Hill Quarry includes the upper fifty feet of S_1, and the whole of S_2. The S_1 beds consist of oolitic limestone algal in places, and S_2 of a varied series including limestone of various types, as well as shale and grits. At the base of the S_2 series is fairly massive limestone with shale partings, this is followed by the *Seminula*-oolite, with its algal bands and penecontemporaneous breccias. The highest part is often strongly algal, and is more argillaceus than the rest. Above this thick develop-

[1] F. S. Wallis, *Proc. Bristol Nat. Soc.*, Series 4, Vol. VI, Pt. I (1923), p. 66.

ment of oolites comes a remarkable development of red and green grits, often laminated and ripple marked, and inter-bedded with brightly coloured shales, and thin bands of concretionary (algal) limestones.

Chipping Sodbury. The large town quarries at Chipping Sodbury show beds from practically the base of S_1, to the highest calcareous D beds. S_1 consists of Concretionary (algal) limestones and calcite mudstones, with some oolite and shale partings. A bed of gritty limestone is taken marking the base of S_2, this is succeeded by more massive limestone and oolite. The upper beds as at Yate Rocks and Bury Hill are thin bedded grits and shales often ripple-marked. There appears to be no chert present in S_2 in the Wickwar-Chipping Sodbury area.

Dibunophyllum Zone. D.

The early advent of Millstone Grit conditions in this area limits the calcareous development to fifty-five feet only. The base of the Trias, here very massive and calcareous, is seen to overlie the D-beds in the railway cutting south of the Wickwar Tunnel. The calcareous D-beds are massive, highly fossiliferous limestone, including crinoidal and oolitic bands with a few shale partings. The limestone passes gradually into grits, and for a short period the calcareous and grit phases alternate with each other.

To the west of Qu. 5 at Wickwar are small exposures in a field behind the Meads Farm buildings. Grit bands and a massive red limestone in part oolitic, occur there.

Old quarries at Bury Hill expose reddish oolitic limestone with many fossils. Underlying these beds, although not well exposed there appear to be a very white pure limestone containing *Productus hemisphericus* (very similar to a band occuring at the base of D at Wick Rocks 7 miles further south), and below this white oolite. A disused quarry at Yate Rocks exposes oolite and crinoidal limestone separated by a band of red and green shale, and following the stream westwards Millstone Grit is found immediately after crossing the ford. The Ridge Quarry, a mile further south, is in coarse reddish oolite and gritty limestone, and again a little to the west Millstone Grit crops out through the soil.

To the right of the path leading from the west of Chipping Sodbury into the large town quarries, lower D_1 is exposed in a sloping face of rock, consisting of oolitic and rubbly limestone enclosing masses of pebbly grit. An exactly similar band is described by Prof. S. H. Reynolds[1] in D beds in the Sodbury cutting.

A new quarry north-west of the large town quarries exposes slightly higher beds including very white limestone, containing *Productus hemisphericus* followed by coarse white fossiliferous oolite.

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1 *Geol. Mag.*, 1923, p. 115.

IV. LIST OF FOSSILS.

	K1	K2	Z1	Z2		C	S1	S2	D1
Zaphrentis konincki E. & H.				*	*				
Zaphrentis konincki E. & H. var.				*					
Zaphrentis omaliusi E. & H.			*	*					
Caninia cylindrica Scouler						*			
Caninia cylindrica Scouler *mut. γ* Vaughan					*				
Caninia cylindrica Scouler *mut. δ* Vaughan							*		
Palæosmilia (" *Cyathophyllum* ") *murchisoni* E.&.H									
Carcinophyllum θ Vaughan								*	
Dibunophyllum θ Vaughan									*
Lithostrotion irregulare Phill.									*
Lithostrotion martini E. & H.							*	*	*
Diphyphylloid Lithostrotion								*	
Lithostrotion basaltiforme (Conybeare and Phill.) ...								*	
Michelinia megastoma Phill.						*			
Chætetes septosus (Flem.)									*
Syringopora distans Fischer									*
Syringopora geniculata Phill.									*
Syringopora θ Vaughan			*				*		
Rhipidomella michelini (L'Eveillé)			*						
Schizophoria resupinata (Mart.)			*						
Leptœna analoga Phill.		*		*					
Productus bassus Vaughan		*							
Productus cf. *semireticulatus* (Mart.)				*					
Productus (*Pustula*) *subpustulosus* Thomas				*					
Productus hemisphericus Sow = *P. cora* d'Orb.—Vaughan								*	
Productus giganteus (Mart.)								*	
Chonetes aff. *comoides* (Sow.)									*
Chonetes cf. *hardrensis* (Phill.)		*	*	*					
Chonetes papilionacea				*		*	*		
Orthotetes crenistria (Phill.) mut. *K*. Vaughan ...		*							
Orthatetes crenistria (Phill.) mut. *Z*. Vaughan ...			*	*					
Orthotetes crenistria (Phill.) mut. *C*. Vaughan ...						*			
Camarotœchia mitcheldeanensis Vaughan		*		*					
Cliothyris glabristria (Phill.)				*					
Cliothyris roissyi (L'Eveillé)				*					
Seminula ficoidea Vaughan							*	*	*
Reticularia cf. *lineata* Mart.						*			
Spirifer tornacensis de Kon. (*Sp*. aff. *clathratus* Vaughan)		*	*	*					
Spiriferina perplicata North		*							
Tylothyris laminosa M'Coy						*			
Syringothyris cuspidata Mart. mut. *cyrtorhyncha* North				*					
Cyrtina carbonaria M'Coy								*	
? *Modiola* sp.								*	
Bellerophon sp.							*	*	
Euomphalus sp.						*			
Loxonema sp.						*			
Crinoids	*	*	*	*	*	*	*	*	*
Polyzoa	*								
Fish Teeth	*			*					

V. DESCRIPTION OF EXPOSURES.

(1) WICKWAR.

(For position of quarries see p. 240).

Qu. 1. is in Old Red Sandstone which dips to the west at 35 degrees.

Qu. 2. exposes about 70 feet of Z_2 and 10 feet of Hor γ. Weathered specimens of *Zaphrentis* are common amongst the loose material at the foot of the quarry.

Qu. 3. is on the same strike as Qu. 2, but higher beds are exposed in the west of the quarry. A little above the conspicuous bedding plane at the entrance to the quarry, fish teeth have been found, and may be taken as indicating the existence of "fish beds" comparable to those at the same level in the Avon Section. Rare specimens of *Caninia cylindrica mut* γ are found about 10 feet below the top of the quarry. The remaining 10 feet are unfossiliferous, only crinoids having escaped dolomitisation. The division between Z and C has been drawn here.

Qu. 4, exposes C beds. The large bedding plane which forms one side of the quarry is in the "suboolite" bed, and is crowded with *Chonetes aff. papilionacea* and *Orthotetes crenistria.*

Qu. 5, in S contains a large amount of loose material in which fossils are well weathered out. *Cyrtina carbonaria* and *Diphyphylloid Lithostrotion* are very abundant.

The succession from the top of the quarry is :—

		ft.	ins.
23.	Massive limestone	7	0
22.	Massive limestone crowded with *Lithostrotion*	4	0
21.	Oolite	7	3
20.	Massive dark limestone	8	0
19.	Limestone crowded with *Seminula*	3	0
18.	Limestone crowded with *Lithostrotion*	1	6
17.	Dark massive limestone	9	7
16.	Thin bedded grit band	1	0
15.	Massive dark limestone with *Lithostrotion* (weathers yellow)	5	0
14.	*Algal* limestone	0	7
13.	Chinastone—patchy development in oolite	1	0
12.	Oolite	1	0
11.	Pisolite	1	1
10.	White oolite with *Lithostrotion*	27	5
9.	Limestone	9	7
8.	Limestone crowded with *Seminula, Productus Lithostrotion*	2	0
7.	Massive limestone	18	2
6.	Shale	0	7
5.	Limestone	10	0
4.	Shale	0	8
3.	Dark limestone	5	3
2.	Shale	0	10
1.	Dark massive limestone with thin shale partings	25	8
	Total ...	150	0

The Grit band (16) is taken as the base of S_2.

(2) Bury Hill.

(2 miles south of Wickwar to the west of the main road to Chipping Sodbury.)

The quarries which are now worked are chiefly in S_1 and afford a fine section of the grit and shale that are developed at the top of S_2, including a band of shale with lamellibranchs. Well-marked algal bands are present in the limestone. Crumpling and faulting in the top beds give evidence of some disturbance at this level which is seen also at the same level at Yate Rocks, and in the large Town quarry at Chipping Sodbury.

The following gives the succession from the top of the quarry :—

		ft.	ins.
60.	Grits	4	0
59.	Shales and grits	10	0
58.	Green and red grit	1	0
57.	Green and red shale	10	0
56.	Shale and thin limestone bands	2	6
55.	Algal limestone	4	0
54.	Gritty limestone, current bedded	1	9
53.	Shale and limestone	1	5
52.	Nodular concretionary limestone	7	0
51.	Red and green shale	2	0
50.	Shales and grits	5	0
49.	Grit	2	0
48.	Shale	2	0
47.	Calcite mudstone	5	0
46.	Chinastone	1	8
45.	Oolite with shales	4	6
44.	Shale with algal limestone bands	4	10
43.	Pisolite	2	0
42.	Shales and grits	5	0
41.	Green and red laminated grit	6	6
40.	Shale and limestone	1	0
39.	Limestone	4	8
38.	Red and black shale	2	6
37.	Limestone with shale partings	1	6
36.	Black and yellow shale	1	6
35.	Limestone	1	6
34.	Algal limestone and shale	2	0
33.	Shale	2	3
32.	Algal limestone	3	0
31.	"Cotham marble" (concretionary) beds	2	0
30.	Concretionary limestone	2	0
29.	Shale and limestone	1	6
28.	Algal limestone	3	6
27.	Limestone and shale	2	0
26.	Thin bedded algal limestone	5	0
25.	Light coloured algal shale with limestone bands	4	0
24.	Limestone	1	0
23.	Black and brown shale	2	0
22.	Limestone	4	6
21.	Shale	1	6
20.	Thin limestones and shales. Limestones include chinastones and oolites	6	0
19.	Calcareous and nodular shale band	1	0

		ft.	ins.
18.	Dark algal and oolitic limestone	2	6
17.	Massive oolite with breccia and *Productus* and *Seminula* bands	10	0
16.	Massive limestone, oolite and brecciated, and with shale partings	16	0
15.	Shale	1	6
14.	Limestone	8	6
13.	Shale	1	0
12.	Limestone	4	0
11.	Black shale	2	0
10.	Fine grained dark limestone	6	6
9.	Massive dark limestone—well developed algal nodules ...	11	6
8.	Black shale	0	10
7.	Massive limestone with Seminula	16	0
6.	Impersistent band of shale and limestone	1	6
5.	Massive limestone	3	8
4.	Black shale	0	4
	(Break of a few ft. not quarried)		
3.	Massive limestone	14	0
2.	Shale and thin limestone	1	0
1.	Massive limestone	9	0
	Total ...	253	0

Professor Reynolds contributes the following note on band 52: " This band forms one of the most remarkable developments of algal limestone known in the Bristol district. The algal material occurs in the form of spheroidal nodules generally about 2 inches long, very evenly distributed throughout the band. A section showed the structure to be concentric, and that the nodule chiefly consisted of successive layers of *Mitcheldeania* and *Spongiostroma.*

There are old quarries in D to the N.W. of these which yield well weathered out fossils, especially " *Cyathophyllum* " (*Palæosmilia*) *murchisoni.*

(3) YATE ROCKS (half mile S. of Burry Hill).

The section of S-beds exposed in the quarries at Yate Rocks is very similar to that of Bury Hill, but upper S_2-beds are not so clearly seen. The quarry at present working is in S-beds, and lies to the north of a stream which flows across the outcrop from east to west, and which is responsible for the removal of the Lias from the lower Avonian and Old Red Sandstone. A disused quarry lying on the south side of the stream is on the same strike as that in operation while two others expose slightly higher beds. The succession in the large working quarry on the north bank is as follows :—

		ft.	ins.
30.	Limestone	2	0
29.	Red and yellow shale	1	4
28.	Oolite	8	0
27.	Limestone with shale partings. I band markedly oolitic ...	2	0
26.	Oolite	12	6
25.	Algal limestone with shales	2	6
24.	Shale	0	6
23.	Concretionary limestone	0	10
22.	Black and red shale with algal nodules	1	4

		ft.	ins.
21.	Massive dark limestone	5	0
20.	Shale—black and red with crushed valves of *Productus* ...	0	3
19.	Massive dark limestone	6	6
18.	Red limestone with shale partings	3	0
17.	Red and green shale	1	10
16.	Massive limestone	4	0
15.	Thin limestone and red and yellow shale	1	0
14.	Massive limestone	12	10
13.	Pinkish grey limestone including one band crowded with *Productus* and *Seminula* decalcified near bedding planes	5	6
12.	Algal limestone (nodular) showing signs of brecciation at top	7	0
11.	Grey massive limestone	17	0
10.	Shale parting	0	2
9.	Massive dark limestone	33	0
8.	Limestone—black on a fresh surface, weathering white, with *Lithostrotion*, *Productus* and *Seminula*	13	0
7.	Fine grey oolite	16	0
6.	Fine grained grey limestone	5	0
5.	Thin bedded limestone	3	6
4.	Fine grey fossiliferous oolite	46	0
3	Fine grained limestone calcite veined	8	6
2.	Grey fine grained limestone	14	0
1.	Grey fine grained slightly gritty limestone forms beddieg plane at east end of quarry		
	Total ...	233	6

There is no exposure at Yate of the grits and shales at the top of S_2, nor of D_1, but immediately west of the ford, Millstone Grit occurs in the bed of the stream. A very white pure limestone crowded with *Productus hemisphericus* is exposed along the road-side about 150 yards south of the ford. This is very similar to a band occurring at Wick (7 miles to the south) at the base of D. Working eastwards from the large quarry exposures are met with of strata ranging from C to K. Thus *Caninia*-dolomite is seen in isolated outcrops in a field leading from Brinsham Farm down to the stream ; *Caninia*-oolite and *laminosa*-dolomite are exposed in old quarries to the east of the road from Wickwar to Chipping Sodbury, and still further eastwards loose blocks of fossiliferous Z and K material may be found on the banks of the stream.

(4) Chipping Sodbury.

No exposures of K have been found along the banks of the Frome. Z-beds are exposed on its north bank behind the main street of the town.

The quarry east of the Wickwar road exposes the following succession in C_1.

			ft.	ins.
4.	Limestone with crinoids, *Orthotetes* and *Chonetes* the "suboolite" bed		10	0
3.	Fine grained grey dolomite ...	*laminosa* Dolomite	8	0
2.	Dark calcite-veined algal limestone	... ...	$\frac{1}{2}$	0
1.	Dark, dolomitized crinoidal limestone	... ...	51	0
		Total ...	78	0

The most easterly of the quarries W. of the Wickwar road exposes S_1 and part of S_2 as follows:—

		ft.	ins.
16.	Oolite very fossiliferous	32	0
15.	Massive limestone	10	0
14.	Gritty limestone	3	6
13.	Black limestone (Chinastone type)	3	0
12.	Shale parting	0	3
11.	Compact limestone, algal and banded	39	0
10.	Limestone with pisolite	12	0
9.	Oolite	30	0
8.	Oolite, patchy distribution of grains, especially at top where it passes into Chinastone with corrugated surface	3	10
7.	Grey limestone with *Seminula*	3	0
6.	Shale parting	0	2
5.	Dark fine grained limestone	0	10
4.	Calcite mudstone. Top band "Cotham marble" with mammillated surface	12	0
3.	Calcite mudstone with shale	1	6
2.	"Concretionary" limestone	2	4
1.	Black shale	0	2
	Total ...	153	7

The main quarry slightly further west shows the following succession (upper S_2):—

		ft.	ins.
6.	Ripple marked grits, shales, and subsidiary limestone ...	60	6
5.	Mainly massive fossiliferous limestone, oolitic and algal in parts	24	6
4.	Algal limestone and shale with one gritty limestone band at the base	23	0
3.	Argillaceous and algal limestones and red and green shale	38	6
2.	Grey calcite—veined limestone with subsidiary shales ...	14	0
1.	Massive limestone, mainly oolite	80	0
	Total ...	240	6

The Stub Riding Quarry a third of a mile further north is mainly in lower S_2, whilst a new opening to the north-west of the main quarry exposes D_1.

VI. COMPARISON WITH OTHER AREAS AND CONCLUSION

1. As would be expected, the succession between Wickwar and Sodbury bears a strong resemblance to that of the Tytherington-Tortworth Ridge, but in the former area the calcareous facies extends into D_1, whereas in the latter arenaceous beds succeed S_2.

2. The Wickwar-Sodbury succession differs from that in the Avon Gorge in the following respects:—

(*a*) the absence of chert in Z and S.
(*b*) the more fossiliferous and less markedly oolitic character of of the *Caninia*-oolite.
(*c*) the thick grit and shale development at the top of S_2.
(*d*) the coming on of Millstone Grit conditions in D_1.
(*e*) the rare occurrence of *Caninia* in γ.
(*f*) the abundance of *Cyrtina carbonaria* in S_2.
(*g*) the presence of a distinct band at the top of S_2, yielding lamellibranchs.

For comparison the thickness of the zones in the Avon and Sodbury sections are given here, with the estimated thickness at Yate Rocks. The zones at the latter are not fully exposed, but boundaries have been placed as accurately as possible, and the thickness calculated from the map.

	Avon feet.	Sodbury feet.	Yate Rocks feet.
D	559 ...	84 ...	150
S	707 ...	574 ...	550
C	420 ...	422 ...	410
Z	376 ...	275 ...	280
K	463 ...	390 ...	350

In conclusion I wish to thank Prof. S. H. Reynolds and Dr. S. Smith for help and criticism, and Dr. F. S. Wallis for giving me the results of his examination of the Wickwar cutting.

The cost of publication of this paper has been partly defrayed by a grant from the University of Bristol Colston Society.

The Avonian Succession of Spring Gardens and Vallis Vale, Frome, Somerset.

By G. E. Bush, B.Sc.

CONTENTS.

I. INTRODUCTION AND PREVIOUS WORK.

THE inliers of Upper Palæozoic Rocks at Spring Gardens and Vallis Vale, Frome, are the most easterly exposures of the Old Red Sandstone and Carboniferous Limestone in the South of Britain. They lie at the eastern end of the Beacon Hill Pericline—the most southerly, and at the same time the most easterly of the four main periclinal uplifts which form the Mendip Hills.

The area is contained within sheet XIX of the one-inch Geological map, and sheet XXX, S.W. Somerset, six-inch Ordnance Survey map; the Geology of the district has been dealt with in the following works:—

de la Beche — Memoirs of the Geological Survey of Great Britain, Vol. I, 1846.

T. F. Sibly — "The Carboniferous Limestone (Avonian) of the Mendip Area," *Q.J.G.S.*, Vol. LXII (1906). Alluded to as "Mendip Paper."

S. H. Reynolds — Geological Excursion Handbook for the Bristol District, 2nd Ed., (1921), pp. 147—150.

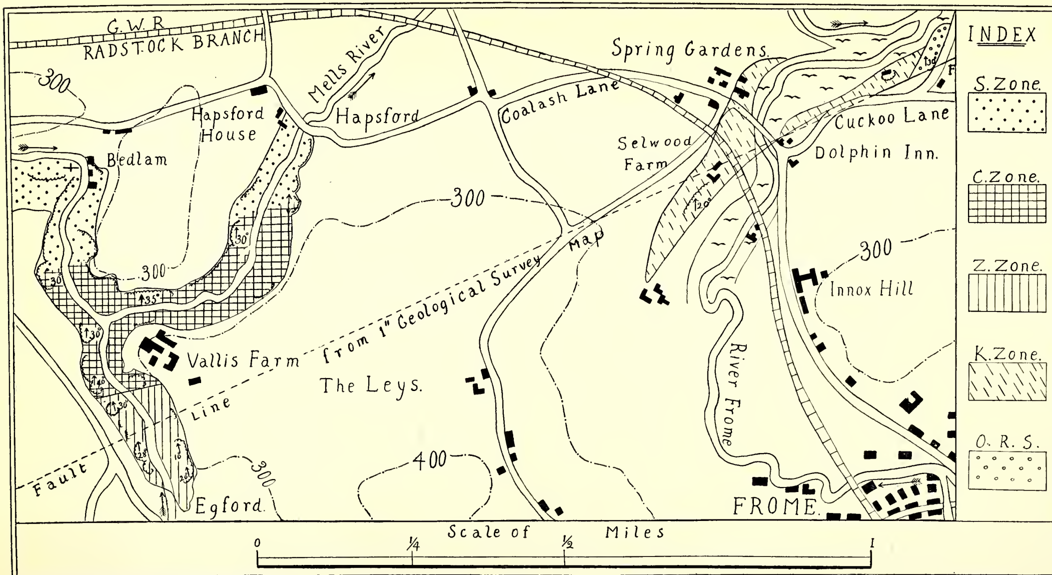
To the general account of the Carboniferous Rocks that these works have furnished, the present paper adds a more detailed description of the structure, lithology and palæontology.

The two inliers between them expose an almost, but not entirely, complete succession of Lower Carboniferous beds from the base of the *Cleistopora*-Zone (Km.) to the Lower Part of the *Seminula*-Zone (S_1).

II. GENERAL DESCRIPTION.

(1) Spring Gardens Inlier.

This small inlier of Old Red Sandstone and Carboniferous Limestone is situated about one mile due north of Frome, and extends from Whatcombe Farm north-eastwards to a little beyond the cottages at the foot of Cuckoo Lane. The strata are to a great extent concealed by alluvium, and only four exposures have been observed.



Map of the Spring Gardens and Vallis Vale Area.

(*a*) Road-side exposure, 400 yards east of the Dolphin Inn. About ten feet of Old Red Sandstone are here seen consisting of compact, highly micaceous, red sandstones, evenly bedded with thin shaly partings.

(*b*) Creed's Farm. An excellent exposure of beds very low down in the *Cleistopora*-Zone is seen behind the outbuildings of this farmstead. The beds strike almost due E–W but are much disturbed and display considerable thrusting and even inversion. Lithologically they closely resemble the Km beds as seen in the Avon Gorge,[1] and St. Monica's Home, Westbury.[2] The following succession was measured at the N.E. end of the farmyard :—

		ft.	ins.
10.	Shaly limestone	1	0
9.	Compact gritty limestone with shaly partings	4	0
8.	Compact gritty limestone, more shaly	0	9
7.	More massive, coarser grey limestone	1	6
6.	Shaly beds	4	0
5.	Thin bedded limestone and shales	6	0
4.	Calcareous shale with thin bands of limestone	6	6
3.	More massive compact limestone	12	0
2.	Shales with thin limestone	4	0
1.	Soft micaceous shales—to base of section	3	0
	Total ...	42	9

(*c*) Footpath leading to Selwood Farm from Coalash Lane, 150 yards N.E. of the Dolphin Inn. The limestone is exposed in the path close to the wicket gate. The highest bed here seen is a much decomposed, very crinoidal limestone, containing abundant bryozoa. Below this is a dark grey or bluish, compact, crinoidal limestone crowded with *Eumetria* sp. identical in character with specimens collected by Dr. Stanley Smith and Prof. S. H. Reynolds from K_1 beds at St. Monica's Home, Westbury ;

(*d*) Selwood Farm. A disused quarry at the S. end of the outbuildings afforded the following section of K_1 beds which were seen dipping N.W. at 20^o :—

		ft.	ins.
5.	Platy red limestone	2	6
4.	Platy fine-grained grey limestone	0	9
3.	Massive red crinoidal and bryozoal limestone	8	0
2.	Well-bedded grey limestone with bryozoa	5	0
1.	Alternate bands of red and grey limestone thin-bedded—to base of section	2	0
	Total ...	18	3

[1] A. Vaughan, *Proc. Bristol Nat. Soc.*, Ser. 4, Vol. 2 (1906), p. 98, and S. H. Reynolds, *Q.J.G.S.*, Vol. 57 (1921), p. 216.

[2] S. H. Reynolds and S. Smith, *Geol. Mag*,. Vol. LXII (1925), p. 467.

Lithology of K_1.

The chief interest lies in the bryozoal limestone (band 3 in the above section). On comparing thin sections with others from the Avon Gorge and various Mendip localities these differences are seen. The bryozoa are unusually abundant, forming, together with crinoid ossicles, the bulk of the rock. Further, in this rock it is the matrix which is picked out with iron, whilst the bryozoa are clear. Sections from the "Bryozoa Bed," of the Avon Gorge, and from elsewhere in the Mendips, show the matrix clear and the bryozoa iron-stained.

(2) Vallis Vale.

Vallis Vale is a steep-sided valley or combe, a mile and a half north-west of Frome, which has been excavated by the Egford Brook and Mells stream.

These streams have cut through the overlying, almost horizontal Mesozoic strata (Bathonian, Lias and Rhætic) and have exposed the strongly inclined Carboniferous beds beneath. The latter dip to the north, and the dip becomes increasingly steep as one ascends the series until at the north-west end of the area the beds are vertical. The strike at the south end of the valley is S. of W.—N. of E., but swings round slightly until at the northern end it becomes almost due E. and W. The tilted beds of Carboniferous Limestone have been planed down to a level surface, and this surface has been much bored by molluscs and other organisms.

The Lias rests on the Carboniferous at the southern end of the exposure, and the Rhætic at the northern end, but these are overstepped by the Bathonian which throughout the greater part of the exposure lies directly upon the Palæozoic platform.

The lowest beds of Carboniferous occur at the southern entrance to the combe, and in working upstream the succession is traversed in ascending order.

Subzone of Schizophoria resupinata (Z_2) 240 feet.

The beds of this subzone are exposed by three quarries, the first situated on the right bank, and the second and third on the left bank of the Egford brook. The base of the subzone is not exposed.

The upper limit of Z_2 is taken as marked by the incoming of *Caninia patula*.

Lithology of Z_2 Beds.

Bands of very dark encrinital limestone, comparable with the "Black Rock" of the Avon Gorge, but not strongly dolomitised, alternate with lighter red bands. The most remarkable feature of the exposure is the great development of bands of nodular chert.

In addition to the bands of nodular chert there is a large lenticular mass of strongly banded chert seen at the foot of the quarry-face in the first quarry. The maximum thickness of this mass is 10 feet. The surrounding limestone is also strongly siliceous. Mr. H. C. Sargent very kindly examined photographs and specimens of this chert for me and is of the opinion that the occurrence is of a similar kind to that described by him from North Flintshire.[1]

These stand out well in the weathered face of the quarry, showing whiter than the limestone, and contain in addition to crinoid ossicles, ostracods and spines of *Productus* and *Palechinus*.

A minor thrust traverses the beds just above this chert mass. There are also two prominent, almost vertical, joint cracks terminating against the upper surface of the mass. These are largely filled with ochreous iron, in varying stages of oxidation, and with large radiating masses of crystalline barytes. Charles Moore has described " infillings " of Lias from the same quarry.[2]

Horizon γ. 280 feet.

In this paper the term " Horizon γ " is used in the same sense as Dr. Sibly uses it in his " Mendip Paper." That is, it is regarded as being the top of the Zaphrentis Zone. It is characterised especially by the entrance and acme of *Caninia patula*, and by the abundance of *C. cylindrica*. The beds are poorly exposed in several small disused quarries on the left bank of the stream.

Lithology of Horizon γ.

The incoming of *C. patula* corresponds with the occurrence of rocks of Petit Granit structure. The matrix of this is black and almost completely dolomitised. In the second quarry on the left bank small quantities of galena occur in the fault breccia of another minor thrust. Towards the top of this quarry the rock has a peculiar banded structure suggesting the flow-structure of some rhyolites. The harder grey bands are silicified whilst the lighter yellowish bands are dolomitised. Penecontemporaneous brecciation with subsequent silicification and dolomitisation is suggested as a probable explanation.

Towards the top of Horizon γ dolomitisation is less complete and organic remains, such as ostracods, *Productus* spines, and crinoid fragments form the bulk of the rock.

---

[1] H. C. Sargent. *The North Flintshire Cherts, Geol. Mag.* 1921, p. 265; 1923, p. 168.

[2] C. Moore. *On abnormal conditions of Secondary Deposits, &c., Q.J.G.S.* Vol. XXIII (1867), pp. 488–91.

FAUNAL LIST. Z_2 and γ.

Psammodus rugosus, Agz.	
Zaphrentis delanouei, E. & H....	rare
Zaphrentis konincki, E. & H.	rare Z_2, common γ
Zaphrentis omaliusi, E. & H.	very common.
Caninia cornucopiæ, Mich.	common.
Caninia patula, Mich.	common γ.
Caninia patula var. densa, Saleé	do.
Caninia cylindrica, (Scouler)	do.
Syringopora θ, Vaughan	common.
Cyathaxonia sp.	rare.
Michelinia favosa (Goldf.)	in γ only.
Michelinia megastoma (Phill.)	do.
Cyathophyllum θ, Vaughan	rare γ.
Leptæna analoga (Phill.)	common.
Spirifer tornacensis de Kon. (= "S. aff. clathratus") Vaughan	do.
Spirifer tornacensis var. attenuatus Sow, ...	rare.
Syringothyris cuspidata mut. cyrtorhyncha North ...	common.
Rhipidomella michelini (L'Eveillé)	do.
Chonetes hardrensis (Phill.)	rare.
Schizophoria resupinata (Mort.)	common.
Cliothyris roissyi (L'Eveillé)	do.
Cliothyris glabristria (Phill.)	do.
Orthotetes crenistria mut Z., Vaughan	do.
Reticularia lineata (Mart.)	do.
Productus "aff cora" mut. Z., Vaughan	do.
Productus subpustulosus Thomas	very common.
Productus fimbriatus (Sow.)	rare.
Productus aculeatus (Mart.)	do.
Edmondia sp., ...	do.
Conocardium sp.	do.
Euomphalus sp....	do.

FAUNAL NOTES Z_2 AND γ.

Z_2 beds form a poor collecting ground, fossils are not numerous and are badly preserved, the corals especially are usually replaced by silica. *Caninia cylindrica* appears low in the sub-zone, but does not become common until the top of γ. *Spirifer tornacensis* is by far the most abundant of the brachiopods, and reaches its maximum towards the top of the sub-zone.

In Horizon γ corals are becoming commoner, *Michelinia favosa* and *M. megastoma* appearing for the first time. *Zaphrentis konincki* becomes very abundant towards the top as does also *Productus subpustulosus.*

SYRINGOTHYRIS ZONE. (C). 535 FEET.

The provisional base of C is here taken as denoted by the incoming of *Chonetes comoides* associated with large *Caninia cylindrica, Michelinia favosa, M. megastoma* and a small *Syringopora, S. cf. reticulata,* which is the form obtained low in C. at Burrington Combe. Unlike the Avon Gorge Section there is no sub-division into *laminosa*-dolomite, *Caninia*-oolite and *Caninia*-dolomite. It is convenient in this paper to use the terms Upper Syringothyris

Zone (C_2) and Lower Syringothyris Zone (C_1), each defined by its characteristic assemblage of fossils.

Lithology of the C Beds.

The C_1 beds consist mainly of very massive dark grey limestone, less crinoidal, but more dolomitised than that of Z_2 and γ. The dolomitisation is very irregularly developed. Ostracods and foraminifera are abundant and well preserved throughout C_1 and C_2.

The C_2 beds are similar massive limestone but lighter in colour than those of C_1. Narrow and inconstant bands of breccia are common. These may be due to penecontemporaneous or desication brecciation, and if so are an indication of the shallowing of the sea shown at this horizon throughout most of the South Western Province.

FAUNAL LIST. C_1 and C_2.

Caninia cylindrica (Scouler)	very common at base.
Amplexus coralloides Sow.	common.
Amplexus sp. nov.	do.
Zaphrentis konincki E. & H.	very common.
Michelinia megastoma Phill.	rare.
Michelinia favosa Goldf.	common.
Syringopora reticulata (Goldf.)	do.
Clisiophylloid corals	do.
Cyathophyllum θ, Vaughan	do.
Palæosmilia (Cyathophyllum)	rare.
Chonetes papilionacea (Phill.)	common.
Chonetes comoides (Sow.)	common at base.
Orthotetes crenistria mut C. Vaughan	very common.
Syringothyris cuspidata Mart.	common.
Schizophoria resupinata (Mart.)	do. (at base)
Martinia glaber Mart.	do.
Rhipidomella aff. michelini (L'Eveillé)	do. (at base)
Cliothyris glabristria (Phill.)	do.
Spirifer tornacensis de Kon.	do. (at base)
Tylothyris laminosa (Mc.Coy)	rare.
Reticularia lineata (Mart.)	common.
Productus subpustulosus Thomas	do.
Productus fimbriatus Sow.	do.
Productus hemisphericus, Sow. (including P. aff. cora Vaughan)	rare.
Productus costatus Sow.	do.
Bellerophon sp.	common at top.
Euomphalus sp....	common in bands.

Faunal Notes C.

Large typical *Caninia cylindrica* are very common near the base. Towards the top of C_2 *C. cylindrica* approaches the S. mutation.

Orthotetes crenistria attains a very large size, and is very common at the base of C_1, it becomes less common towards the top.

Chonetes comoides is very abundant near the base of the zone and attains a large size.

Zaphrentis konincki is extremely abundant towards the top of C_2, and attains a diameter of half an inch, it quickly dies out, and is not recorded from S_1.

A very large form of *Amplexus* is abundant at two levels, near the base of C_2, and again near the top.

The common occurrence of many *Clisiophylloid* corals, and occasionally of *Palæosmilia θ* foreshadows the oncoming of the Viséan fauna.

Seminula Zone (S.).

These beds are well seen in the last quarry at the Hapsford end (N) and in the quarries in the Mells branch of the Valley. Only the lower part of the zone is exposed.

Subzone of Productus semireticulatus (S_1). 324 feet.

In the first quarry on the left hand side of the Mells branch of the Vale the light-grey foraminiferal limestone of the uppermost C_2 beds gives place to distinct calcite-mudstones and china-stones. *Lithostrotion martini* occurs abundantly in these whilst it has not been found below them. The base of these mudstones thus forms a convenient line for the base of S_1.

SUCCESSION OF THE S_1 BEDS.

4.	Oolitic limestone with bands of chert nodules	20 feet.
3.	Oolitic limestone	224 ,,
2.	Limestone with shaly partings	50 ,,
1.	China-stones and calcite mudstones	30 ,,
		324 feet.

The china-stones when fractured smell strongly of petroleum.

The mudstones and china-stones (band (1) above) contain bands very rich in bryozoa, as in the Avon Gorge Section; they are immediately succeeded by normal limestones (2) much dolomitised in patches. The beds are separated by thin red shaly partings, and one of these is crowded with remains of *Phillipsia*. The oolitic limestone (3) was originally a fine white oolite, but subsequent dolomitisation has largely destroyed the oolitic structure, and only a few perfect ooliths, which show good radiating structure, have escaped. The uppermost 20 feet of limestone (4) is only slightly oolitic and contains numerous bands of chert nodules. These alternate with bands of limestone packed with *Lithostrotion martini*. Near the archway at Bedlam the beds are vertical, and even appear slightly overfolded.

FAUNAL LIST S_1.

Caninia bristolensis Vaughan	common (at base).
Syringopora distans (Fischer)	do.
Lithostrotion martini E. & H.	very common.
Palæosmilia sp.	common.
Clisiophylloid corals	do.
Koninckophyllum sp.	rare.
Spirifer trigonalis (Mart.)	common in one band
Orthotetes crenistria mut. C. Vaughan	very common.
Chonetes papilionacea (Phill.)	do.
Cliothyris cf. glabristria (Phill.)	common.
Athyris expansa Phill.	do.
Seminula ficoidea Vaughan	do.
Productus aff. cora d'Orb.	do.
Productus semireticulatus (Mart.)	do.
Productus elegans McCoy	rare.
Phillipsia scabra H. Woodw.	rare.
Phillipsia eichwaldi Fischer	common in one band.
Bellerophon sp.	common.
Euomphalus sp.	do.

FAUNAL NOTES S_1.

Lithostrotion has now become the dominant coral genus, and associated with it are many as yet undifferentiated Clisiophylloid forms.

Koninckophyllum. The specimens differ from the typical D form[1] in having well-developed, long minor septa, and a long well developed fossula recalling strongly that of *Cyathophyllum* θ Vaughan, from C.

It may be interesting to note that Vallis Vale is the type locality of *P. scabra*, H. Woodward.

III. CONCLUSIONS.

The detailed work done in this small area confirms the conclusions, and amplifies the work done by Principal T. F. Sibly in his Mendip Paper. In the vertical sections the development at Vallis is compared with those at Burrington Combe and the Avon Gorge. The thicknesses of the two latter are taken from the diagram in the "Burrington Paper."[2] The progressive increase in thickness of the Z_2 and γ beds referred to by Dr. Sibly, is brought out, at Vallis this may be due in part to minor thrusting. The most striking feature is the swelling out of the S_1 beds.

Comparing the total thickness of the Vallis sequence (from Z_2—S_1) with that of the corresponding beds at Burrington, and in the Avon Gorge the figures are: Vallis 1,377 feet, Burrington 1,330 feet, Avon Gorge 822 feet.

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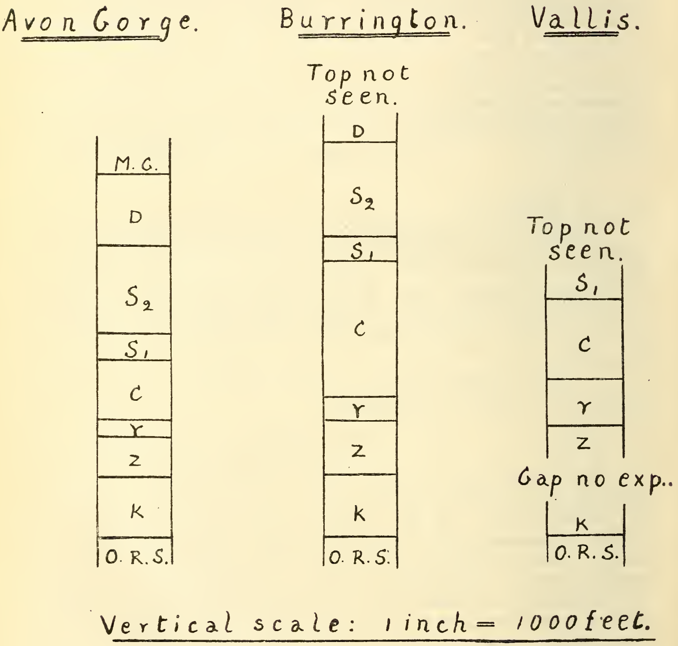
1 *Koninckophyllum magnificum*, Thom. & Nich.

2 S. H. Reynolds and A. Vaughan. *The Avonian of Burrington Combe. Q.J.G.S.*, Vol. LXVII, 1911


Avon Gorge.
Burrington.
Vallis.
Top not seen.
Top not seen.
M. G.
D
S2
S1
C
Y
Z
K
O. R. S.
D
S2
S1
C
Y
Z
K
O. R. S.
S1
C
Y
Z
Gap no exp..
K
O. R. S.
Vertical scale: 1 inch = 1000 feet.

The faunal peculiarities may be stated as follows :—

1. The common occurrence of Clisiophylloid corals of a simple type at the top of the Tournaisian and base of the Viséan.
2. The enormous abundance of a large species of *Amplexus* in the Syringothyris Zone.
3. The recording of *Cyathaxonia* sp. from Z_2.
4. The early occurrence of certain Productids—*Overtonia fimbriata*, and forms near *P. hemisphericus* (=*P. corrugato-hemisphericus*) in the Syringothyris Zone.

Lithologically the main difference between the Vallis sequence and that of the Avon Gorge is the absence in the former of conspicuous oolites and dolomites from the Syringothyris Zone. A further peculiarity of this area is the great development of massive, banded chert, and of bands of chert nodules in the Z_2 beds.

I am greatly indebted to Prof. S. H. Reynolds, M.A., Sc.D., and Dr. Stanley Smith, M.A., D.Sc., for constant help and advice, to Mr. F. B. A. Welch, B.Sc., for help in the field, and to Mr. T. A. Ryder, B.Sc., for help in naming specimens.

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	Amory, T. H.	29, Beaufort Road, Clifton
A	Audcent, H. L.	34, Belvoir Road, St. Andrew's, Bristol
	Badock, Stanley H.	Holmwood, Westbury-on-Trym
*	Baker, B. A., F.G.S.	37, Clyde Road, Redland
	Barke, H. F., F.I.C.	34, Park Row, Bristol
S	Barke, Mrs.	34, Park Row, Bristol
	Barrow, L., M.I.Mech.E., F.G.S.	Wolverley, King's Norton, Birmingham
*	Bartlett, Chas.	8, Woodhill, Portishead
*	Baxter, T. V. T., M.A., B.Sc.	95, Hampton Road, Redland, Bristol
	Beck, R.	18, Victoria Road, Clevedon
	Bell, Mrs. A. G.	25, St. Michael's Park, Bristol
*	Blood, B. N., M.D.	5, Brynland Avenue, Bishopston
†	Boley, A. E.	508, Stapleton Road, Bristol
*	Bolton, Miss E., M.Sc., F.L.S.	58, Coldharbour Road, Bristol
*	Bolton, H., D.Sc., F.R.S.E., F.G.S.	The Museum, Bristol
	Bowen, Miss M., B.Sc.	73, St. Alban's Road, Westbury Park, Bristol
S	Bowland, J.	12, Berkeley Road, Bishopston
A	Brebner, Mrs. G.	22, Victoria Road, Cotham, Bristol
S	Bush, J. E. S.	Bishops Knoll, Sneyd Park
	Carter, Miss F.	14, Charlotte St., Park St., Bristol
	Cay, Arthur	Lyndhurst, Leigh Woods, Bristol
A	Chamberlain, R. E.	56, Brecknock Road, Knowle, Bristol
	Chamberlain, W.	157, Whiteladies Road, Clifton
	Charbonnier, T.	10, West Shrubbery, Redland, Bristol
	Charbonnier, Mrs. T.	10, West Shrubbery, Redland, Bristol
	City Librarian	Central Library, Bristol
A	Clarke, A.	16, Woodstock Rd., Redland, Bristol
*	Cook, Sir Ernest, D.Sc.	40, Alma Road, Clifton
	Cottle, A. W.	Black Horse, Kingswood, Bristol
S	Coysh, A. W.	15, Belluton Road, Knowle
*	Darbishire, Prof. O. V., Ph.D.	The University, Bristol
†	Darell, D., F.G.S.	Hillfield House, near Dartmouth
	Davies, A. T., F.R.M.S.	Avon House, Keynsham, Bristol
	Davies, T. H.	Down House, Stoke Bishop, Bristol
	Deacon, Mrs.	45, Sydenham Hill, Bristol
	Drew, Miss H., M.A.	Colston Girls' School, Bristol
	Dunscombe, Miss	199, Redland Road, Bristol
S	Ellis, F.	59, Berkeley Road, Bishopston
	Evens, F. W.	8, Rokeby Avenue, Redland, Bristol
	Fitzjames, R. H.	17, St. Martin's, 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

	Francis, H. A.	10, Victoria Square, Clifton
S	Fry, T.	1, Niblett's Hill, St. George's, Bristol
	Gait, R. P.	51, Howard Road, Westbury Park
	Gibbons, H. J.	8, Nugent Hill, Cotham, Bristol
	Goodall, Rev. Canon R. W. ...	19, Elmdale Road, Tyndall's Park, Bristol
A	Goulding, Thomas	6, Nelson Street, Bristol
	Gummer, Horace	Herbert Lodge, Cotham Park, Bristol
S	Hallett, Miss J.	3, Logan Road, Bishopston
S	Hallett, Miss L....	3, Logan Road, Bishopston
S	Harding, G. Dermott	10, Royal York Crescent, Clifton
S	Harding, Miss Dermott	10, Royal York Crescent, Clifton
	Harding, Miss E. M....	Bower Ashton, near Bristol
	Hellyar, R. H.	18, Redland Grove, Bristol
A	Heslop, J. R. P.	34, Henleaze Gardens, Westbury-on-Trym
	Higham, A. P.	*Western Daily Press* Office, Bristol
	Hodgson, C. J.	5, Cotham Terrace, Bristol
	Horder, Miss M. G.	81, Redcliffe Street, Bristol
	Humphries, Lady	Eastfield Lodge, Westbury-on-Trym
	Ivens, H. P.	18, Alexandra Road, Clifton, Bristol
A	Ivens, W. B.	49, Ravenswood Road, Bristol
	Jeffcoat, Rev. R., M.A.	5, Berkeley Square, Clifton
	Jenkins, Mrs.	10, Napier Road, Redland, Bristol
	Jenkins, F. G.	31, Berkeley Square, Clifton
S	Jennings, D. A.	Queen Elizabeth Hospital, Bristol
	Jervis, W. W., M.Sc., F.G.S. ...	The University, Bristol
S	Jones, F. G., F.G.S.	8, Clifton Vale, Clifton
	Knight, H. H., M.A.	The Lodge, All Saints' Villas, Cheltenham
	Knowlson, Mrs.	9, Downfield Road, Clifton
S	Kromler, A.	45, Summerleaze, Fishponds
A	Lee, Miss E. M., M.Sc.	55, Logan Road, Bishopston
	Llewellin, W. M., C.E.	8, Cotham Lawn Road, Bristol
S	Lloyd, H. T.	The University, Bristol
S	Lucas, H. J.	14, Walcot Parade, Bath
S	MacDonald, T.	50, Hampton Park, Bristol
S	Madkins, W. E., B.A.	Fairfield Secondary School, Bristol
	Mappin, S. W.	100, Pembroke Road, Clifton, Bristol
S	Marshall, Miss D.	54, St. John's Road, Clifton
	Martineau, P. E.	Hillside, Cleveland Walk, Bath
S	May, J. L.	25, Abbotsford Road, Bristol
	Miller, M.	7, All Saints' Road, Clifton
*	Morgans, Thos., M.I.C.E. (dec'd.)	7, Elton Road, Tyndall's Park, Bristol
	Morgans, Mrs.	7, Elton Road, Tyndall's Park, Bristol
S	Morris, D.	15, Charlotte St., Park St., Bristol
	Nierenstein, M., Ph.D.	30, Cavendish Road, Bristol
	Norgrove, J. W.	22, Alma Road, Clifton
	Nuell, F. H.	63, Springfield Road, Bristol
S	Onn, H. A....	Westleigh, West Town, near Bristol

S	Parker, J.	12, Conway Road, Brislington
S	Peach, A. H.	5, Hanbury Road, Clifton
	Pearman, J. V.	6, Westbury Park, Bristol
	Pepperell, R.	Ormond House, Russell Grove, Westbury Park, Bristol
S	Pook, J. W.	Waterloo House, Clevedon
	Powell, J. J., M.D.	2, Gloucester Road, Bishopston
	Rafter, J., M.A.	6, West Shrubbery, Redland, Bristol
*	Reynolds, S. H., Sc.D., F.G.S.	13, All Saints' Road, Clifton
	Richardson, Frank	15, Percival Road, Clifton
	Robbins, G. A.	3, Lower College Street, Bristol
*	Roper, Miss I. M., F.L.S. ...	4, Woodfield Road, Redland, Bristol
*	Rudge, C. K., L.R.C.P. (dec'd.)	145, Whiteladies Road, Bristol
	Rudge, Miss E. L.	145, Whiteladies Road, Bristol
	Rutter, Miss E. M.	Cambridge House School, St. John's Road, Clifton
A	Salmond, P. W.	20, Tyndall's Park Road, Clifton
S	Salmond, Mrs.	20, Tyndall's Park Road, Clifton
	Sampson, Miss D.	30, St. John's Road, Clifton
	Samson, F....	4, Woodfield Road, Redland, Bristol
*	Sandwith, Mrs.	26, Canynge Square, Clifton
S	Selley, A.	116, Coronation Road, Bristol
S	Selley, F.	116, Coronation Road, Bristol
	Shaw, Miss T.	Walton-in-Gordano, Som.
A	Sinnott, Jas.	15, Beaufort Road, Clifton
S	Sisson, J. E.	Heath House, Gadshill Road, Eastville
	Skene, Macgregor, ...	The University, Bristol
	Slee, Miss W.	Hazeldene, Glastonbury Road, Wells
	Smith, Stanley, D.Sc., F.G.S.	The University, Bristol
	Smith, W. A., M.A., M.B. ...	70, Pembroke Road, Clifton
A	Smith, Rev. W....	17, Vyvyan Terrace, Clifton
A	Smith, Mrs. W.	17, Vyvyan Terrace, Clifton
	Stanton, D. W.	42, Alma Road, Clifton
	Stanton, Mrs.	42, Alma Road, Clifton
S	Storey, R. G.	8, Oxford Chambers, St. Stephen's St., Bristol
	Sully, H. T.	Woodrange, Westbury-on-Trym
	Taylor, R. E.	Fonthill Villa, Keynsham
	Thompson, H. S.	33, Southleigh Road, Clifton
S	Trelease, C.	37, Fernbank Road, Redland
S	Trelease, Mrs.	37, Fernbank Road, Redland
	Tuckett, C.	5, Beaufort Buildings, Clifton
	Tuckett, R. E.	5, Beaufort Buildings, Clifton
	Turner, H. W., B.A. (Oxon.), F.G.S.	The University, Bristol
*	Tutcher, J. W.	57, Berkeley Road, Bishopston, Bristol
S	Tyrrell, E. B., B.A.	17, Camden Terrace, Clifton Vale
S	Tyrrell, Mrs.	17, Camden Terrace, Clifton Vale
	Vaughan, Mrs.	42, Fernbank Road, Redland, Bristol
*	Wallis, F. S., Ph.D., F.G.S. ...	15, Ravenswood Road, Bristol
	Walton, T. C. H.	Compton Bishop, Som.
S	Weaver, Miss M.	95, Kingsdown Parade, Bristol
	White, E. Barton, F.E.S. ...	Mental Hospital, Fishponds, Bristol

*	White, Jas. W., F.L.S.	18, Woodland Road, Clifton, Bristol
	White, Mrs.	18, Woodland Road, Clifton, Bristol
*	Wickes, W. H.	16, Oakfield Grove, Clifton
	Wills, Sir George, Bt., LL.D. ...	Burwalls, Leigh Woods, Bristol
†	Wills, W. Melville	Bracken Hill, Leigh Woods, Bristol
*	Womersley, H., F.E.S.	Sunny Meads, West Town, nr. Bristol
*	Yabbicom, T. H., M.I.C.E. ...	23, Oakfield Road, Clifton

Honorary Members.

Prof. George S. Brady, M.D., LL.D., D.Sc., F.R.S., F.L.S.

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., Brasted Chart, near Sevenoaks, Kent.

W. G. Scott, 25, Duke Street, 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.

Sir W. A. Tilden, D.Sc., F.R.S., Professor of Chemistry in the Imperial College of Science, S. Kensington, S.W.7. (Deceased).

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

REPORT OF COUNCIL.

To December 31st, 1926.

DURING the past year the working members have continued with great success their activities in different branches, and in entomology have added records of several new species of British insects, as well as increased our knowledge of their life history and habits. The assistance that these members are willing to give to less expert students ought not to be passed over as it is by the great number of young people, who could obtain knowledge and recreation by coming in contact with them through membership of the Society.

The number of Sectional members who pay only a very low fee and do not belong to the parent Society, has remained about the same, in spite of the opportunities offered, but the membership of the Society as a whole has sunk still lower, because the general public shows no interest in our activities and will not join us for encouragement and mutual assistance.

During the year death has fallen with severity on our members and we have lost two of our oldest supporters : Dr. C. King Rudge, who had filled many offices since his election in 1870, and had taken the keenest interest in the Society's welfare up to the last ; and Mr. Thomas Morgans, who joined in 1879, and had served on Council at various periods for 17 years, and was ever ready with sound advice and financial help. Further, we have lost Mr. Charles Hunter, a zealous worker for the Society, and Dr. H. B. Guppy, the eminent naturalist and traveller ; and amongst our Honorary members Sir William Tilden, Professor of Chemistry in the Imperial College of Science, who had been in touch with us for the past 45 years.

The holding of an Open Night in March for the benefit of the public was but poorly supported, although it was honoured by Dr. E. J. Allen, F.R.S., Director of the great Marine Biological Laboratory at Plymouth, who gave a lecture on the latest research work in Fishery.

The Summer Excursion to Beacon Hill, on the Eastern flank of the Mendips, received more support than in past years, but deserved to have been still better attended, because of the enjoyment of our pursuits and the opportunities it afforded for good fellowship and exchange of ideas between members.

Amongst minor happenings of the year the Secretary represented the Society at the Jubilee Dinner of the North Staffordshire Field Club at Stoke-on-Trent, for the winding up of the celebrations of its year. Blaize Castle Woods have been acquired by the City as public property. This is gratifying, because members will have the opportunity within easy reach to study at all seasons of the year the varied wild life in its many sheltered nooks.

The Proceedings for 1925 were published early in the year, and distributed to the British and Foreign Societies with whom we exchange. The contents maintained a high standard of original work with some excellent illustrations. The Papers on the Geology of the Bristol district were continued, and in this connection much gratification was felt that Prof. S. H. Reynolds, who has so long been President of our Geological Section, held the position of President of the Section of Geology at the British Association Meeting at Oxford. It was taken as an honour paid by the scientists of the Kingdom to the work on Carboniferous Limestone and its zones carried out under his leadership by the school of Geologists labouring at Bristol with such wide spread effect.

Council agreed towards the close of the year to the affiliation of the Bristol Field Club as a Field Section under Law XXII. The arrangement will take effect with the New Year, and should be beneficial to all our members and recruits, because the work of this Section will be devoted entirely to out-of-door study of the different branches of Natural History in rambles round the outskirts of the City. It is hoped that these facilities for rambles will meet a desire often expressed, and will cause a rally of new members to support the Section and in many instances to join the Society and participate in the advantages of the Library and yearly Proceedings.

IDA M. ROPER,

Hon. Secretary.

THE HON. TREASURER in Account with THE BRISTOL NATURALISTS' SOCIETY.

Dr. GENERAL ACCOUNT FOR THE YEAR 1926. *Cr.*

	£	s.	d.
To Members' Subscriptions :—			
Ordinary ...	41	5	0
Associate ...	2	0	0
Under Law IV ...	0	5	0
,, Entrance Fees	1	0	0
,, Subscriptions in advance	1	5	0
,, Arrears collected	2	10	0
,, Donations to Publishing Fund	9	16	6
,, Sale of Publications, etc.	4	17	6
,, Profit on Excursion	0	6	0
,, Interest on Deposit	2	1	10
,, Balance Forward :—			
General Account	73	5	2
Bookbinding Fund	27	8	3
	£166	0	3

	£	s.	d.
By Subscriptions to Societies :—			
Ray	1	1	0
Commons and Footpaths	0	10	6
S. W. Naturalists' Union	0	13	0
Geological Magazine	0	15	0
Zoological Record	2	10	0
,, Cost of "Proceedings" for 1925	52	10	0
,, Printing, Postage and Stationery	9	17	0
,, Rent and Fire Insurance	1	16	0
,, Gratuities	1	5	0
,, Lecture Expenses	2	12	0
,, Bookbinding	10	15	6
,, Cash in hand ;—			
General Account...	65	2	6
Bookbinding Fund	16	12	9
	£166	0	3

December 31st, 1926.

Audited and found correct

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

LIBRARIANS' REPORT.

For the Year 1926.

WORK at the Library has been carried out steadily, so that the binding of loose parts is practically complete, and only the current volumes of exchange societies remain unbound. Donations towards this yearly expenditure are needed, but members can eongratulate themselves that an excellent Library of Natural History brought up-to-date is now available for their use, and it would be gratifying if the books were consulted by a very much larger number of members.

The Catalogue on the table gives the required information to find the volumes on the shelves, but the absence of a gift of a cabinet for the card index of subjects, or the provision of money to buy one, is a matter of regret, because the information in the books would be then more available, and might induce the younger members to read them and take up a special subject of study.

The Library is very centrally housed, and the building operations, which the Museum Committee is engaged in, do not interfere unduly with the facilities and comfort of readers, although the room at present may seem somewhat crowded. Members will gladly submit to some inconvenience to assist the general improvement of accommodation for the Natural History collections of the City.

Dr. Rudge was a frequent visitor to the Library for many years after he had ceased to be the Librarian, and by his death we have lost one who tried to pass on his enthusiasm for living organisms to those whom he found consulting the books.

His daughters have presented several standard works from his Natural History books, which are very acceptable, and our thanks are given to the donors.

The Sections have continued to give various monthly publications, including the last issue of the Palæontographical Society to carry on our series.

Additions to the Library in 1926.

Austen, E. E.	Handbook of the Tsetse-Flies, 1911.
Bentham and Hooker	British Flora, 2 Vols., 1892.
Bouvier, E. L.	The Psychic Life of Insects, 1922.
Goebel, K. von	Wilhelm Hofmeister, 1926 (By Purchase).
Gosse, P.H.	The Ocean, 1860.
Huxley, T. H.	Anatomy of Vertebrated Animals, 1871.
Do.	Anatomy of Invertebrated Animals, 1877.
Jeffreys, J. G.	British Conchology, 5-vols, 1862–9.
	Journal of Linnean Society (Zoology), 1890–1906.
	Journal of a Naturalist, 4th Edit., 1838.
Marshall, A. M.	Junior Course of Practical Zoology, 1892.
Prior, G. T.	Guide to Meteorites, 1926.
Rye, E. C.	British Beetles, 1866.
Shuckard, W. E.	British Bees, 1866.
Wilson, G. and Geikie, A.	Memoir of Edward Forbes, F.R.S., 1861.

IDA M. ROPER, *Hon. Librarian.*

T. CHARBONNIER, *Hon. Sub-Librarian.*

BOTANICAL SECTION.

1926.

THE Botanical Section has indeed justified its re-formation during this first year of its renewed existence.

We have been able to hold ten meetings—helpful meetings, thanks to some of the original members and encouraging meetings, thanks to the five new members. There have been several outstanding features of the year. In January Miss Roper showed doubling flowers of *Cardamine pratense* with petaloid stamens and in November types and varieties of Plants. Mrs. Bell in June brought a delightful collection of Stonecrops, *Sedum roseum, S. Forsterianum, S. album, S. dasyphyllum, S. acre, S. anglicum*, and in September three interesting Linarias and *Mirabilis Jalapa* (The Marvel of Peru). Miss Marshall in September brought flowers from Cornwall ; Mr. Stuart Thompson in December gave us an interesting quarter of an hour with Irish flowers.

Mr. Gibbons and Miss Bowen brought some forty Fungi for the open evening of the Society, and it is here when we work on Fungi that we miss Mr. Charles Wall, who died during the Easter holidays. To the first meetings of the year he came, always with a vasculum full of fresh plants, usually Fungi or garden shrubs in bloom. To many of us who love the living plants better than the herbarium specimens, it was a delight to have the opportunity of meeting such a botanist as Mr. Wall, and it is a sorrow to have to record his death.

M. BOWEN, *Hon. Secretary and Treasurer.*

ORNITHOLOGICAL SECTION.

1926.

THE activities of members of this section during the year have been principally confined to three main heads, Photography, Ringing, and Discussion of Exhibits at Winter Meetings.

With regard to the first, following out previous observations members have definitely marked down a new breeding place locally of the Redshank, and obtained photographs of the sitting bird. It is hoped that it may be possible in the coming season to obtain a more representative series. Members have also been able to obtain a photographic series of the Dipper, which breeds locally quite commonly, but is perhaps even more difficult to photograph than the Redshank. The localities usually occupied, the time of the year, the weather, the almost unbelievably quick and (to the photographer) the irritatingly irrational movements of the bird with its perpetual dipping or curtsying, in fact every conceivable difficulty, is most unwelcomely forced on the bewildered photographer. Going rather further afield, many beautiful and interesting pictures have been obtained in the Scilly Isles, but an account of the trials and tribulations of the three members who went is to be found elsewhere, and will be related to the Society as a whole at one of its monthly meetings.

With regard to Ringing, The objects and advantages of thus marking birds have been previously explained. Some of the birds ringed by the section include, Swallows, Wheatears, Red Backed Shrikes, Sparrow-hawks, Moorhens, Lapwings, Ringed Plover, Razorbill, Manx Shearwater, Shag, Cormorant and many of the Gulls. It is hoped that more members will undertake this very useful work.

The section has well maintained its reputation for the variety and scientific interest of its exhibits It has been suggested that a portfolio or record of photographs by members should be kept by the section. This should be facilitated by the fact that we have added to our numbers several actively interested Bird Photographers, and the record should be one of supreme interest and value to the Society as a whole.

COLDSTREAM TUCKETT, *Hon. Secretary and Treasurer.*

ENTOMOLOGICAL SECTION.

1926.

OWING to difficulty in securing accommodation, only four meetings were held during the year (that for April being merged with the Society's General Meeting). The ill-health of Dr. Rudge precluded advantage being taken of his offer of hospitality, but the situation was relieved by the generosity of Mr. J. W. Norgrove and Mr. A. H. Peach in placing rooms at the disposal of the Section. Arrangements have now been made to meet at the University, in the Botany Library, on the same days as the Botanical Section. To suit the convenience of members living at a distance, meetings commence at 6 p.m.

There has been no lack of exhibits. Especially interesting was Mr. R. Beck's illustration of the parasitisation of the micro-lepidopteron *Sylepta ruralis* by the ichneumon *Pimpla vestigator* and by the diptera *Exorista ruralis* and *Chætolyga sp.* Miss I. M. Roper outlined the life history of the locally rare aphid *Tetraneura ulmi*, exhibiting specimens of the insect and of its galls on elm leaves. In addition to scarce and striking species of local Lepidoptera, Mr. A. Kromler displayed a nice collection of " incidentals " of other orders including several fine longicorns (Coleoptera) and sawflies. Many other interesting species and varieties of Lepidoptera have been shown by Mr. C. Bartlett (Pres.) and Messrs. Norgrove and Peach.

At the merged April meeting Mr. Beck dealt with the Acarine disease of Bees (noticed on page 278), and at the December meeting Mr. H. Womersley summarised his researches on the Protura, briefly describing the new forms he had discovered locally.

No excursions were made during the year, but mutually arranged working expeditions were successfully carried through.

To enable the Section to continue the series of " The Entomologist " presented yearly by the late G. C. Griffiths, the subscription has been raised to 2s. 6d.

It was with deep regret that members learnt of the death of Dr. C. King Rudge in October. Dr. Rudge joined the Section in 1900, and, until hindered by ill-health, manifested a keen and active interest in its welfare. He was nominated as President in 1925, but declined election.

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

GEOLOGICAL SECTION.

1926.

THIS year the number of resignations and elections have balanced each other, so that our membership remains at 48.

We record with much regret the death of Mr. Thomas Morgans who has been a member of the Section for 25 years.

All the officers for 1925 were re-elected, *viz.*: President, Prof. S. H. Reynolds, M.A., Sc.D.; Vice-President, Mr. J. W. Tutcher; Secretary and Treasurer, Dr. F. S. Wallis; and Auditor, Mrs. E. Vaughan.

The finances show a credit balance of £2 16s. 1d. Six evening meetings were held during the year with an average attendance of 21. The President in continuation of the description of his recent world tour dealt with phases of the geology of South Africa and United States of America, and especially with questions of economic importance. In pursuance of our recent custom of inviting at least one "outside" lecturer to visit the Section during the year, Dr. J. A. Douglas, M.A., of Oxford, gave an interesting account of his geological work in the Andes. Mr. P. E. Martineau, our Bath member, struck an original note in his Paper on the Bristol Avon. It is hoped that at some future date Mr. Martineau will again favour the members with the results of his further researches into the early history of our Bristol Avon. Mr. F. B. A. Welch, B.Sc., gave an account of his recent work on the geological structure of the Central Mendips.

The Exhibition meeting attracted an unusual wealth of specimens, and the Summer excursions to Abbot's Leigh and Keynsham, held jointly with the Geological Section of the Bristol Field Club, were each attended by 14 members.

We would take this opportunity of placing on record our congratulations to Prof. S. H. Reynolds on his occupation of the Presidential chair of Section C at the British Association meeting at Oxford.

The Section still continues to place the Geological Magazine and Palæontographical Society's Monographs in the Society's Library, and a few members have continued their work on the card index of the *Q.J.G.S.*

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

Account of the Annual and General Meetings.

THE 63RD ANNUAL MEETING.

January 21st, 1926.

The election of officers was confirmed with Dr. W. A. Smith becoming a Vice-President. Prof. O. V. Darbishire was elected President for the third time, and delivered his second Presidential Address, entitled "Plants of the Sea" (printed in full on page 208).

THE 521ST GENERAL MEETING.

February 4th, 1926.

"Olaus Magnus, a 16th Century Naturalist,"
by Mr. P. E. Martineau.

Olaf Stora (Latinised Olaus Magnus), a Swedish Churchman, was born in 1490 and died in 1558. He spent the last thirty years of his life in Rome, being exiled at the Reformation. He took part in the Council of Trent in 1546, and towards the end of his life became titular Archbishop of Upsala. His great work, *Historia de Gentibus Septentrionalibus*, was published at Rome in folio, 1555. It was translated from Latin into various languages, and the 8th edition, an English one, was published in London in 1658. The book deals with Norway, Sweden, Lapland, Finland and Iceland, discussing, with very numerous illustrations, the language, ethnology, manners and customs and folk lore of each country. But its chief value is in the Natural History section where, among scraps of folk lore and traditional natural history, there are frequent glimpses of accurate observation and sound inference.

For instance, in a certain fiord iron rings are fastened high up the cliffs; to Olaf's knowledge they were set there by a certain king about the year 1,000 and in 500 years they had gone so high up the rocks as to be out of the reach of seamen. Therefore, says the Archbishop, the sea must have shrunk or the land must have risen, but if the sea had shrunk we should have heard of it from England, so the land must have risen, but he knows not how or why.

Again, in Iceland, he observed that the fire of burning mountains did not come from the top, but from half way up, and he has sound remarks on the geysers.

He tells us that ermines change in winter from brown to white and he wonders whether it is for the purpose of defence.

Whales he deals with at great length; he knew the sperm whale (a very rare visitor to Northern waters), and he tells of threshers killing a whale off the coast of England in 1532.

His folk lore stories are amusing. Elks are better for drawing sleighs than reindeer, because they can go 200 miles without food

The lynx does not hunt, but robs wild cats of their prey. Squirrels foretell the future, if you can catch them, and they cross streams on rafts of bark. The hedgehog attacks the bear with the object of making him shake down fruit from trees. Bears are useful animals to take to sea, they are an excellent defence against pirates. Seal skins bristle as the tide goes down.

On the polypus or cuttlefish he has much to say, and also on the Kraken or sea-serpent which is 200 feet long with a 20-ft. mane. One lived near Bergen. As a rule it eats small animals, but when it attacks a ship and eats men great wonders are to happen in the kingdom. Such an event happened in the year 1022 and King Christian was immediately deposed.

In giving an account of this 16th century naturalist, the lecturer had the help of many lantern slides from the original woodcuts.

Exhibit by Miss Roper of *Xylaria carpophila*, a "Candle-snuff" fungus, from the Leigh Woods.

THE 522ND GENERAL MEETING.

March 4th, 1926.

"Fishery Researches" by Dr. E. J. Allen, F.R.S., (*Director of the Plymouth Marine Biological Laboratory*).

The great sea-fisheries of the country, are of two kinds—trawl fisheries and drift-net fisheries. The trawl works along the floor of the sea and captures such fish as cod, haddock and plaice which live there. Drift-nets hang suspended from the surface of the sea and catch such fish as herrings, mackerel, and pilchards, which swim freely in the body of the water. Both fisheries are subject to great variations in their abundance of fish captured from year to year, and much research has been done to ascertain the causes of these fluctuations. The history of the fish has been studied from the development of the egg to the larval stage and then gradually through the life of the fish until it is adult and of a suitable size for capture. The food and habits both change during the life of the fish, and has been examined at each stage.

It has been found that certain years give good breeding figures, when a large number of young are present in the sea, while others are bad and only a small number of the fry survive.

This is probably due to the fact that in some years the food available for the fry is abundant, whereas in others it is scanty. When we seek for the causes of this fluctuation in the food supply, we find it is due to differences in the physical conditions of the water, such as temperature, and also to the varying amounts of sunlight available for plant growth.

Different features of the research work were illustrated by means of numerous lantern slides.

The lecture was open to the public and was well attended.

THE 523RD GENERAL MEETING.

April 8th, 1926.

"The Acarine Disease of the Honey Bee," by Mr. R. Beck.

Interest in bee-keeping has greatly increased in the last 25 years, which has led to much improvement in the hives, to facilitate easy removal of the honey, and to increase cleanliness. Further, many county Bee Associations are formed to make known experiences, and prevent lack of perseverance, whilst the County Bee teachers give many demonstrations.

The two diseases of Bees most dreaded are "foul brood" and the Acarine internal one. There is no remedy for the first except burning, but the second has yielded since 1905 to scientific enquiry, and the lecturer, said he had recently held 87 examinations for it, and was able now to decide in a few minutes if the disease was present in a hive. The cause of the trouble is a mite, so small that it needs 7 male or 5 females to cover a millimetre space. The mite gets entrance inside the Bee at a valve under the wing, in order to breed in the trachea or breathing tube of the Bee, which causes suffocation.

All these points and many more were made clear by excellent lantern slides, and incidently the lecturer advised the owners of apple orchards to arrange to have hives placed in them in the Spring to secure the utmost fertilization of the blossoms.

THE 524TH GENERAL MEETING.

May 6th, 1926.

I. "The Age of the Earth," by Mr. T. A. Ryder, B.Sc.

For nearly a century, astronomers, geologists and physicists have been attempting to estimate the age of the earth as an individual member of the solar system. The results obtained varied considerably and the methods used were open to much adverse criticism. It was not until the discovery of the radio-active elements, nearly thirty years ago, that any satisfactory method of estimating the age of the earth was available. The discovery that the element uranium is slowly disintegrating, and that among its end-products are helium and lead, afforded a means for a more accurate and reliable estimate. The rate of breakdown of uranium can be calculated and from that and the measured amounts of the element and its products in a rock, it is possible to arrive at the age of that rock. The lead from uranium varies, in certain respects, from the ordinary lead of commerce. From data of the above nature, and also from other considerations based on radio-active phenomena, it has been possible to assign to the earth an age of approximately 1,600 million years. The immensity of this figure can be better realised when one knows that man has been on the earth for less than half a million years, and that recorded history only dates back a mere 6,000 years or so.

II. "Our Knowledge of Animal Mind," by Mr. R. H. Hellyar.

The lecturer gave a short review of the manner in which we became acquainted with mind in the lower animals. His aim was to contradict a general and popular idea that it was impossible to judge an animal's mind, because our own mental outlook was so widely different. He first touched on the philosophical side, calling attention to the great problem of the principles of human knowledge, and went on to point out that all knowledge of mind was by observation and inference of behaviour. There were different levels of mankind ; some minds were much simpler than others. Yet they felt capable of judging their thoughts and feelings from behaviour. There was no short cut to a man's mind. Mental states in others, whether animals or men, were deduced from their physical expression.

This method of obtaining knowledge of mental states in others applies equally to animals as well as man. With the lower animals, however, there is a danger of putting our own ideas into their minds. This must be always guarded against, for it is a very natural action on our part.

Mr. Hellyar went on to explain the use of the famous Lloyd Morgan canon—"Never interpret a particular action in terms of a higher, more complex, motive, if a simpler explanation will serve equally well." The practical value of that canon in psychology was enormous, for it counteracted the anthropomorphic tendency in judgment of behaviour, the invariable tendency to humanise animals.

The paper concluded by emphasising the various ways in which animal psychology aided our understanding of the great problem of mind, the lecturer pointing out that the "richest future of natural history lies in the study of the mind."

THE SUMMER EXCURSION.

June 19th, 1926.

This was made to Beacon Hill in the East Mendips, by motor coach and private cars. The magnificent views over a large countryside during the drive, and at Beacon Hill were much admired, as well as the visit to the pond in its grove of rhododendrons in full bloom. After an enjoyable tea the geologists had the unusual experience of standing in the crater of a long extinct volcano surrounded as they were by igneous rocks and tuff, whilst the entomologists did well on the heath, and the botanists found many plants, which they were pleased to meet with in a new locality. Some of the more noteworthy were : *Ranunculus*

Godronii, Viola palustris, Geum rivale, Apium inundatum, several orchises, such as *Listera ovata, Orchis maculata, Habenaria viridis* and *H. chloroleuca, Polygonatum multiflorum, Carex disticha, C. pallesceus, C. binervis, Lastrea spinulosa* and *Botrychium Lunaria.*

The drive home through Temple Cloud, Stanton Drew, Chew Magna and Barrow was a fitting end to a very pleasant excursion.

THE 525TH GENERAL MEETING.

October 7th, 1926.

"Geology and Man," by Dr. F. S. Wallis, F.G.S.

Man was primarily an agent of Denudation, and it was in that connection that his work was mainly felt. The total amount of material excavated by Man in the British Isles since Roman times had been calculated to be in the neighbourhood of 40,000 million cubic yards. Taking the latest figures regarding the amount of material weathered away from the British Isles as about 2.7-in. in 2,000 years it could be proved that in a well populated area Man was about twice as effective as Nature in planing down the general surface of the ground.

The effects of subsidence—especially in the salt mining districts —were fully dealt with, and the various theories of subsidence explained.

London, as the largest city in the world, offers a good field for investigating the changes wrought by Man on nature. Before it was inhabited the district formed an extensive marsh, though now the river was confined within a deep channel, and the original contours of the land were difficult to trace.

Climate was another factor in the process of the natural denudation of rocks, and Man wielded an indirect action over geological work by removing forests and laying bare to the sun areas previously kept cool and damp under trees. A marked characteristic of Man's action was its intermittency, for while his geological activities were increasing in extent they were constantly changing in direction. Finally, natural denudation removed by preference the softer and more easily destroyed rocks, whereas Man selected rocks of economic importance, or those which stood in the way of his engineering schemes.

The lecture was illustrated by lantern slides.

Exhibits were shown by Miss Roper of three species of fungi: *Clavaria Kunzii, Craterellus cornucopioides* and *Cyathis striatus.*

THE 526TH GENERAL MEETING.

November 4th, 1926.

Exhibits of Natural History by the Members.

All the Sections were represented and the exhibition showed that steady, progressive work was being continued.

In Geology a model of the Isle of Wight, fossil corals, sponges, insects and reptiles from South Africa, were shown by Prof. S. H. Reynolds, local fossil sponges by Mr. J. W. Tutcher, and fossil shells from the Eocene at Barton Cliffs, Hants., by Mr. M. Miller.

In Entomology, Mr. H. Womersley showed some new species of Protura, the most primitive insects known ; Mr. J. V. Pearman some local Psocids, small orthopterous insects, three of which were additions to the British list ; and Mr. J. W. Norgrove a collection of Lepidoptera.

In Botany were exhibited the results of summer work, including a complete series of the genus *Bromus* by Mrs. Sandwith ; alien plants that have become naturalised by Miss Roper ; an instructive series of parasites, semi-parasites and saprophytes by Mr. H. S. Thompson ; Alpine flowers by Mrs. Bell ; paintings of Palestine flowers by Miss Reynolds ; Mycetozoa by Mr. F. W. Evens ; a fine collection of living fungi arranged by Miss Bowen and Mr. H. J. Gibbons, and succulent and growing plants by Prof. O. V. Darbishire.

In the Ornithological section were some excellent bird life studies by Mr. R. P. Gait and Mr. C. Tuckett, who also showed some photographs of bats hibernating and prepared bats' skins.

Coffee was served during the Meeting.

THE 527TH GENERAL MEETING.

December 2nd, 1926.

I. " Insect Pests and their Biological Control," by Mr. H. Womersley, F.E.S.

(*Printed in full on page* 297.)

II. " Seedlings," by Miss M. Bowen, B.Sc.

Seedlings of even the commonest plants are not always easy to recognise. The first two leaves or cotyledons are usually very simple and quite unlike the complicated foliage leaves which follow. In their simplicity, however, there are variations, and to follow up these there is much instruction. The cotyledons of the ordinary Holly, for example, have no sign of prickles In Mustard and the Corn Cockle one is bigger than the other ; whereas in the Dove's foot Cranesbill half of one is bigger than the other half. The cotyledons store food to start growth, as in Peas and Vetches, when they remain under ground, but usually they are too thin and small for such storage and come into the air to function as leaves and make food. On a larger scale the Avocardo Pear from the West Indies, to be bought of some Bristol greengrocers, stores food in advance, for the seed has two cotyledons as large as an egg. If kept in a little water, the two swollen " leaves " come apart, and the young roots and shoot grow into a handsome young seedling.

Excellent lantern slides illustrated the subject.

In Memoriam

CHARLES KING RUDGE,

M.R.C.S., L.R.C.P.

BY the death of the late Charles King Rudge, at the great age of eighty years, the Naturalists' Society has lost one of its most faithful and oldest members.

Member of an old Staffordshire family, Mr. Rudge was born at Haverfordwest, Pembrokeshire, in 1846. When a youth of twenty-one he began his medical studies at the Bristol Royal Infirmary and continued there until qualified to practice. As a student he gained the approbation of the famous Dr. Long Fox, and secured the Medical Suple Gold Medal and Prize. For a period of twelve years Mr. Rudge occupied the post of Surgeon at the Bristol Dispensary. His private practice commenced and continued in the Whiteladies Road for the long period of nearly fifty years. Few doctors were better known or more highly thought of, and his loss will be felt by many to whom he was not only a doctor, but a sympathising friend. Dr. Rudge was a man of many and diverse interests. A keen churchman, he was an active worker in the local section of the Medical Missionary branch, and in this and other sections of the same service he retained his interest to the last. The Church of England Mens' Society had no stauncher adherent, whilst on the practical side he warmly supported and worked for the Sailors and Seamens Mission. Whilst Natural History was his chief study during mature years, he was a member of the Bristol and Gloucestershire Archæological Society, and a student of Bristol's past history.

The study of Natural History was one of the greatest joys of his life, and here again he showed catholicity of interest, his studies ranging from the life histories and habits of British mammals and birds, the coastal fishes of the North Devon coast, and the marine fauna of the tide pools to entomology, his investigations in the latter being confined to the Diptera, Hymenoptera, and Hemiptera. For some time he devoted considerable attention to the trachea of birds, dissecting out a large number for the study of the syrinx or organ of voice production. The study of mimicry, and the protective devices of animals was a perennial joy to Dr. Rudge, his spirit of thoroughness causing him to keep in close touch with modern literature upon the subject.

Dr. Rudge had an intense desire for the growth and welfare of the Naturalists' Society. This found expression in many ways. Whilst he rendered excellent personal service in his efforts to gain new members, and notably so during his occupancy of the Presidential chair he was no less persistent in urging other members to do the same. He served the Society in several capacities, being Honorary Secretary jointly with two others frem 1896 to 1897; Honorary Librarian 1891–1904; Vice-President 1901–2–3; and President 1904–5–6. He was Secretary to the Microscopical section from 1887 to 1890.

The many calls of professional life and his numerous associations with public bodies left little margin for the publication of scientific papers, and three only, in addtion to three Presidential addresses were contributed by him to the Society's Proceedings. These were "British Shore Fishes and their Habits," 1888; "Mammals of the Bristol District," 1908; and "Food of Animals and Stratagems employed in obtaining it," 1913. As an exhibiting member he was one of the most constant, and few years occur from 1888 onwards in which he did not produce exhibits of special interest.

It is not easy to estimate fully the worth of such a man as Charles King Rudge. Reticent to a degree about his own achievements, he yet influenced many other student naturalists. Behind a somewhat abrupt manner, and a sharp method of interrogation (really due to inherent shyness) he did not always succeed in concealing his most kindly disposition and a very generous nature. Many sadly tried patients found him courteous and kind to a degree, religious and philanthropic missions always had a warm helper, and amongst us are those who testify to the scientific merits of one who sought the good of his fellows.

H.B.

Report of Delegate to the British Association.

AT the Oxford Meeting of the British Association I attended the Conference of Delegates of Corresponding Societies, and the address on the first day was given by the President, Sir John Russell on the subject of "Regional Survey."

He is Chairman of a very strong Committee at work on this subject, and he urged on the Delegates the importance and advantages of taking up surveys in an organized manner amongst the members of Natural History Societies. The study of the district within easy reach affords opportunity for them to have a pleasant recreation, and get together valuable information to be utilized later by professional workers to carry out schemes for making the best use of the resources and capabilities around them.

A regional Survey carried out by amateurs includes many aspects, both above and below ground, such as charting the drainage basins, the suitability of certain areas of land either for dwelling houses, recreation grounds, woodland or cultivation ; and the help of geology comes in by the study of strata, exposures, well-sinkings, or the presence of minerals.

When all these particulars can be marked on large scale maps, the amateur has provided the professional, whether town planning, manufacturer or others, seeking suitable localities for development, with helpful and accurate knowledge.

Sir John Russell gave many useful directions for guidance in carrying on such a survey, and amongst others advised the observer to record the rotation of crops on arable farms, whether three, four or five crop rotation was employed, rather than to name the actual crop grown in a given year.

On the second day of the Conference other matters of general interest were before the meeting. After discussion a recommendation was passed that local Societies should make systematic records of temporarily open geological sections, well-sinkings, and the like, and the Bristol Naturalists' Society was mentioned by name as an example already working on these lines. Also, that Government should lessen the restrictions concerning cinematograph films sent to England, when such were records of scientific observations and intended for purposes of education.

A Committee was re-appointed to co-operate with the Torquay Natural History Society to continue the investigation of Kent's Cavern.

IDA M. ROPER.

August, 1926.

PRESIDENTIAL ADDRESS, 1926.

"Form and Function."

By O. V. Darbishire.

At one time, many thousands of years ago, man probably did not lead a settled life, and stay in one locality during all the seasons. He went to a warmer part of the country in winter, and to a cooler part in the summer. At first too he did not till the soil and grow extensive crops of a few selected plants, as he would rarely visit the same spot even a second time. For this reason it was absolutely necessary for him to be quite familiar with all the wild plants he would come across in his wanderings. He would know his plants well by their external form. He would know where the plants which were of use to him grew. He had to recognise plants by their external and visible form, because in that way only could he find the roots and rootstocks which contained the food he was in search of, but which were hidden below the surface of the soil. Roots and other underground organs of the plant contain generally the excess of material built up by the plant during the last season. The life of himself and his family might depend on the food obtained in this way. Every member of the family would therefore have to learn to recognise plants by their form, and not only the useful ones but also those which were poisonous, in order to avoid eating a dangerous plant. In this way the outward form of plants was carefully studied and slight changes probably noted. Man was interested in the form of plants only because the form was the means of recognising important plants.

Gradually man came to lead a more settled life, and with this came the tilling of the soil, and the cultivation of the few most important plants. A knowledge of the wild plants became less important. But even then many plants and especially again their roots were collected in wood and field, not so much possibly on account of their food value as on account of their medicinal properties. The ancient Greeks had a special class of men, who were known as Rhizotomoi, who went out into the country and collected roots. That was their trade. These men of course studied the form of the plants they were interested in so as to be able to recognise them under all conditions, and at all seasons. They would thus always be able to collect any particular kind of root that was required. The form of the plant here again was only of interest because by it the collector could find the underground organs he was in search of

Among the cave-dwellers and with early man generally probably everybody had learnt something about plants and their recognition. But with the advance of civilisation and the accompanying division of labour, this knowledge of plants was acquired by the few only, as in the case of the Rhizotomoi just mentioned. The interest in the root had however become traditional and this tradition had its effect on the old Herbals, where every plant shown in an illustration is drawn with its root system complete. That is not done now any more. It must have been the traditional interest in the economic importance of the root and the necessity of recognising the form of foliage that gave us the first plant naturalist or botanist. He had got interested in the leaves of the plants near his home, and then became still more interested when he found some new form or variation. At first then form of foliage and nature of root were connected, but gradually the interest became centred more and more round the study of the varying form of the stem and leaf and flowers, as these organs could be seen. The root would gradually become neglected

Theophrastes recounts how the officers sent by Alexander the Great to India, were struck by the different appearance of the leaves of the trees they came across in India, when compared with the leaves of their native trees in Greece. They were in search of trees to obtain wood to build ships. They hunted for trees with the same foliage as that of the trees of their home. They found and carefully noted the difference in the foliage of the trees.

Although thus in most cases the study of the plant form had originally an economic motive, to find plants that provided food, or some drug, or wood, as in the case of Alexander's officers, people must in time have looked at plants and examined them irrespective of their economic, or medicinal or commercial value. In that way the form became a matter of study by the naturalist through all the ages, up to the time of Linnæus, and after him, up to the present day. Linnæus had the greatest knowledge of forms of animals and plants. Form meant a great deal to him. According to his view species owed their origin to special creation. Hybridisation was possible, but up to certain limits species were separately created. The species was thus an immutable unit. The mechanical description and separation of the plantform was therefore of the greatest importance in separating species. The species in the Linnean sense depends absolutely on accurate observation and description of form and structure. A slight variation from the type was of no value and no interest as it did not lead to anything. The careful work of Linnæus gave a great stimulus to the study of animal and plant forms and placed it on a very sound footing. Directly and indirectly Linnæus must have been responsible for the separation of a very large number of species.

During the earlier part of the 19th century the great knowledge of plantforms obtained from all over the world led to a closer study of the plants at home, and more especially of the lower plantforms. The improvement in the microscope too made possible a more detailed study of the many stages in the life histories of both higher and lower plants, which had hitherto been but inadequately determined. The life histories of moss and fern were worked out, and one result of this work was the growth of an almost new branch of Botany, namely Morphology. This was concerned mainly with a study of the mechanical organisation of the plant body. The morphologist divided the plant body into root and shoot. The shoot he again divided into stem and leaf. Leaf, stem and root are the morphological members of the plant body, quite irrespective of their functions.

Animal morphology was always on a different footing as it really dates back to Aristotle, though his pupil, Theophrastes, too discussed some questions of pure plant morphology. He discussed the question as to whether the supporting pillars of the Indian Banyan Tree were root organs or stem structures. They are as a matter of fact adventitious roots. But he thought that they might be stem structures.

Although, then, animal morphology is a much older science, one of the most important morphological technical terms was not introduced till 1843, when Owen, the great zoologist, invented the word homologous. An homologue is the same organ in different animals under every variety of form and irrespective of function. The term is used by botanists too.

Quite gradually during the 17th and 18th centuries the study of physiology had been growing up, mainly animal and human. Physiology and Morphology were then two quite distinct and separate branches of the study of animals. They are still largely so up to the present day. The zoologist of today is largely a morphologist studying comparative structure and development of homologous organs, or making out new homologies. Animal morphology and animal physiology still very largely go their own way, though during the last few years experimental zoology, genetics, and the study of special physiological processes in general but from a purely zoological point of view, are the subject of research even of the pure morphologist. It was Owen again who in 1843 invented the term analogous. An analogue is a part or organ in one animal which has the same function as another part or organ in a different animal. This term too is used by botanists.

Plant physiology really came into prominence very much later than animal physiology. Animal and human physiology was of greater importance, especially in connection with medicine and its bearing on the health of the human organism. Plant physiology had no such importance attaching to it. So plant morphology and plant physiology too went their own way, and general and special plant morphology are still very important branches of botany, to-day. The systematist is only a morphologist of a special kind interested in the classification of plants.

Animal structure is far more complex than plant structure. It is for this reason often very difficult to establish homologies between certain organs of certain animals. It is perhaps not so difficult on the whole in the case of plants, though the variety of form among nearly allied plants may be almost greater than in animals. This greater simplicity of plant structure has made it possible perhaps for the botanist of to-day to acquire a more extensive knowledge of physiology than the pure animal morphologist.

The morphologist considers form, the physiologist considers function. Should they work independently or should they co-operate in their studies ? Is there any definite relationship between form and function ? They must obviously stand in some relationship to one another.

The leaf is a definite morphological member of the plant body. It has a definite morphological dignity or status. But the form of this member, of the leaf, may vary. The foliage leaf of the oak has a flat green blade. The scaly leaf of the butchers' broom is a small membranous bract arising on the flat surface of a leaf-like stem. The stem has here taken on the form of the leaf and carries out the function ordinarily associated with a flat green leaf.

The green oak leaf and the scaly bract of the Ruscus are said to be homologous morphologically. The green oak leaf and the flattened green cladode of the butcher's broom are analogous in function, *i.e.* physiologically. The wings of the bird, the forefeet of the horse, and the arms of man are all homologous organs, yet they are not analogous organs. They are the same members but have different functions. The fins of the whale and the fish are analogous in function, but not homologous from a morphological point of view. Morphology is the study of the varying form of a limb or member of animal and plant body regardless of function. But as everyone must have observed, and as has just been pointed out some kind of relationship does exist between form and function.

The green leaf is an assimilating organ. We know that the green leaf shows a very wonderful adaptation to this function. The form of the leaf varies and its variety exhibits more in detail the special adaptation to this function necessitated by different localities. We can often from its form make out what the function of an organ is. But still this does not tell us exactly in what causal relation if any form stands to function. Does function influence or even create form, or vice versa. This is really the old question again which evolutionists are trying to solve. It is the question which interests every naturalist.

Lamarck maintained that the form adopted by animal or plant was a direct response of the organism to the influence of external conditions, and the desire of the organism to carry out some definite function by that organ. The change thus induced was purposeful. This view was strongly supported by Samuel Butler, who explained how it was that animals and plants could thus adapt the form of their limbs to their functions. The experiences of the ancestors acquired during life were passed on to the succeeding generations and unconsciously remembered by these, and made use of in unconsciously fashioning new, or improving old organs. The form of an organ was thus considered to be directly influenced, and even created by the function which the organism desired it to perform.

The ultra-Darwinian says that all changes in form are accidental, and never purposeful. Any particular organ can perform a certain function only because it has a particular form and structure which happens to enable it to carry it out. The form of an organ therefore determines its function. Natural selection however would in the end settle whether a form should persist or die out. Darwin believed that the continuous selection of small useful variations in the struggle for existence develops an efficient and well adapted organ able to carry out a definite function. De Vries would say that any change in form is due to a sudden also chance jump or mutation. But still the organ would determine the function rather than vice versa. Natural selection would in this case too pick out the more efficient organ for preservation.

So we are really at the old deadlock again. We may believe in organic evolution, but we do not yet know anything about its mechanism. How does a plant or an animal first acquire a useful organ. I have already said that the function which an organ has to perform may have a selective influence and may allow only the useful organ to survive. A plant with a form which carries out its function inefficiently will go under. But there is no evidence that function can directly create a new form of organ. What I have said so far, however, holds good only to a certain extent. Function may not create a new organ like the leaf, or the chlorophyll apparatus, as quite new qualities. But it may quite directly influence these qualities quantitively. It may influence the already existing leaf form and structure. The beech leaf growing on the south side of a tree has a structure differing from that of a leaf growing on the north side of the tree. The former has two layers of palissade cells as a greater protection against too strong light which would injure the green granules. The latter has only one layer. Function has not created a new leaf, but it has modified its form, but that modification cannot be inherited, and is thus not permanently acquired by the organism. We do not know how the main qualities of plant and animal organs arose, but we can get some idea of the quantitively modifying influence of function on form. This is easily observable in plants, but not quite so easily in the case of animals. One reason for this is that plants are generally fixed and stationary and are compelled to be accurately adapted to the conditions under which they live. Most animals can move from one place to another and thus select within limits the locality most suited to their structure. Function can therefore more readily modify a quality of the plant organ quantitively. The small extent of the airspaces in the land-grown specimen of *Hippuris* as compared with the very extensive airspaces in the water-grown plant affords a good example of this.

The naturalist, the botanist, can be a morphologist pure and simple, studying form and its variations with the greatest interest. Though not possessing any great knowledge of plant physiology he can yet add to the interest of his work by observing the conditions under which the various forms occur, and then connecting the change in form with the different way in which under certain conditions the functions have to be carried out. External conditions influence quantitively the form of an organ through its function, and in the end we can from experience conclude directly from the form what the prevailing external conditions are. This is the subject of Ecology and Biology. The same remark may be applied to the Zoologist.

We can say then that a very definite relationship exists between form and function. We need and cannot commit ourselves to say whether there is any deep causal relationship between the two. We can only say that especially in plants, function may to a certain extent modify the form of an organ.

A very interesting subject can be mentioned in this connection. The conditions under which animals and plants live on this earth are often very uniform over large areas which may be continuous or discontinuous. If the conditions acting on these forms of plants through the same function are almost identical we would expect that in the end the same kind of form would be selected in the case of all plants growing under these identical conditions. There are numerous examples of this development along convergent lines. Let us look at the leaf, stem and root of the green flowering plant. The roots grow in the soil, the upright stem and the flat leaves with their veins. Are they not extraordinarily similar in their general form, whatever family they may belong to. But they are growing roughly under similar conditions. The typical flowering plant may serve as our standard. We get the same kind of arrangement of stem and leaf in the moss, though the moss leaf is in no way connected or related morphologically to the leaf of the flowering plant. The organs are analogous but not homologous. We also get the same arrangement in many seaweeds. The fronds of the red *Delesseria sinuosa* are leaf-like, and have midrib and veins, resembling oak leaves. In the green alga, *Caulerpa prolifera*, we have roots, rhizome, and upright assimilating organs, resembling the organisation met with in the higher plant. But there is no connection by descent between these plants. Similar function goes with similar structure.

The common lichen *Peltigera prætextata*, made up of fungus and green algæ to form a compound organism, exhibits in certain small leaves, the isidia, an internal structure recalling that of the leaves of flowering plants, even to the development of pores, resembling the stomata of these leaves. This is a striking example of evolution along convergent lines. Function and form clearly go together in this case.

Yet another example may be quoted. The Cactaceæ of Central America resemble to an extraordinary extent certain Euphorbiaceæ of Central Africa. The conditions under which in both cases the plants grow are those of a hot and dry desert. The succulent and little branched stem, and the absence of any flat leaves in the mature plant characterise the representatives of both families. On closer examination we can detect differences. These differences are due to the cast iron traditions of the particular families, to which the species belong. The external form, and even the internal structure may undergo certain changes and become better adapted to their surrounding conditions, but not beyond certain limits. A member of the Cactaceæ can always be distinguished from a member of the Euphorbiaceæ if not by the internal structure of its vegetative organs at least by that of its flowers. These are naturally least affected by the prevailing local conditions. Plant family traditions are very strong, and will apparently not allow a quantitive modification of their qualities beyond certain points. When that point has been reached, should adaptation be insufficient, the death of the species or even race may follow. Thus we see here again in what relation function stands to form, and that the former does not control the latter completely.

The object of these disjointed remarks has been to give you food for thought. The study of form pure and simple is intensely interesting, and it is a study without end. It may be made a little more interesting when taken in conjunction with even a slight knowledge of the functions of the organs we come across in such an endless variety, both in the animal and plant world.

A Bird Trip to the Scilly Isles.

By R. P. Gait.

THE following Article is an account of a trip to the Scilly Isles during the Summer of 1926, undertaken by the President and Secretary of the Ornithological Section of the Society, together with the writer in search of photographs of sea birds.

After a somewhat eventful journey due to the unsettled conditions following the general strike, we eventually arrived by means of train, car and steamer at St. Mary's Island, which was to be our headquarters. Most newcomers to the Scillies are struck by the number of islands, for although only five of the large ones are inhabited there are dozens of others ranging from those of three-quarters of a mile in length to mere rocks almost submerged at high tide.

As the uninhabited variety were to be our hunting grounds our first excursion was in search of a boat, and we were very lucky in securing the services of an experienced boatman, for changing currents, sudden gales, reefs, bars and submerged rocks of every description render anything in the amateur boating line in the Scilly waters nothing less than sheer madness, to say nothing of the skill required to effect a safe landing on those rocky shores, more often than not in a running sea of some considerable force.

Annet is the most well-known of the bird islands, and has perhaps the greatest variety and number of nesting sea fowl. Imagine a low rocky uninhabited island about three quarters of a mile in length by a few hundred yards in breadth, exposed to the full fury of the Atlantic storms, and terminating in the " Haycocks," a line of cruel isolated piles of rocks over which the sea breaks in great spouts of foam. Annet in June can best be described as one huge rock garden. Great patches of sea pinks grow clump against clump, all over the island, matching in Nature's own perfect tone with the grey lichen-covered rocks ; in fact so profusely do they cover the ground that in parts no other colour is discernible, and the island shows as a pink mass from six miles to seaward. Stonecrop and spurrey add their colours to the picture, the whole being set in a sea of the most wonderful shades of blue, purple and green.

On rowing towards the jumble of rocks which constitute the shore of Annet, searching for a likely landing place, we disturbed several large flocks of puffins which were resting on the water. They flew shorewards with rapidly vibrating wings, many of them disappearing into their breeding holes, with which the island is simply honeycombed.

Photo by OYSTERCATCHER, ON EGGS *[C. Tuckett*

On our scrambling up the beach a great cloud of Gulls,—herring, great and lesser black backed—arose from the breeding colonies making a prodigious clangour, whilst oystercatchers added to the din by flying in circles around our heads, giving vent to their feelings in a continuous piercing note.

Laden with photographic outfits, walking in the deep cushiony sea pinks was a tiring business, and a careless step on an innocent looking patch of sandy soil landed one knee deep in a puffin's or shearwater's burrow, with a fair chance of a bad sprain if nothing worse. Amongst the boulders of the beach on our left, herring and lesser black backed gulls were nesting in their hundreds. Many a laughable sight was to be seen in these colonies ; grotesque love making attitudes, fights between rivals, egg raids, and the swift retribution dealt out to the robbers by the rightful owner of the property.

Curiously enough the herring gulls kept to the beaches, but there were several large colonies of lesser black backs, with a sprinkling of great black backs, inland amongst the sea pinks.

An examination of the eggs showed an extraordinary range of variation in colour and markings varying from a rich chocolate spotted and streaked with black to an almost plain light green with scarcely a mark. So much did the eggs of herring and lesser black backed gulls resemble each other in size and markings that the only method by which they could be distinguished was to watch the owner settle down upon them.

Amongst these gulls several small great black backs and large lesser black backs were frequently observed, so that the only determining feature became the colour of the legs and feet, which are pink in the case of the former and yellow in the case of the latter bird.

Oystercatchers' eggs were found all round the edge of Annet, on the patches of shingle, under the granite rocks, and out amongst the sea pinks, and a series of studies were obtained of this bird by means of panchromatic plates (with or without screen), which successfully brought out the orange coloured eye rim and the gradations of the long bills.

Judging by the behaviour of these oystercatchers, and a number of imperfect clutches of eggs, they have to keep a close watch on the gulls, as these inveterate egg stealers never neglect an opportunity of a meal at some other bird's expense. It was interesting to watch from a hiding tent the oystercatchers negotiating limpets. They would slip the tip of their long bills under the edges of the shells and lever them off with the greatest ease, picking out the contents at their leisure.

In a few suitable places some clutches of ringed plovers' eggs were found, but the sandy shores of St. Mary's, Tresco and Tean were much more favoured by these birds than Annet.

The most important bird inhabitants of Annet are the stormy petrel and the manx shearwater. The usual place for the stormy petrel to lay its eggs is on bed rock where the boulders of the beach meet the turf.

To find them one has to either listen for their curious purring note, or try to detect the musky odour which they emit. Having located a bird a considerable amount of hard work is required to shift the stones to a depth of perhaps four feet or more,before this delightful little bird can be found sitting on her single white egg in her dark retreat.

To find a manx shearwater is an easier process, one has only to follow up a likely looking burrow amongst the hundreds available, until one receives a painful nip in the hand, which means that the bird is at home. Very awkward are these manx shearwaters on the ground, being unable to stand upright, and having to shuffle along in a clumsy manner till they reach an eminence from which to take off, but once in the air the reverse is very evident, as they glide over the waves with an easy graceful flight reminding one somewhat of enormous swifts.

Both stormy petrels and shearwaters are largely nocturnal during the incubation season, only coming out at night when their weird cries in the darkness sound like lost souls visiting the scenes of their misdeeds on earth.

The great black backed gulls kill a large number of shearwaters and puffins, and bundles of bones and feathers with every particle of flesh torn off them littered the whole island. For this reason war has been waged on these bloodthirsty members of the bird community for some seasons past, and the previous year a big bag of these birds and shags was made by an organized party of guns. The effect of the slaughter was disastrous from our point of view, as both species proved to be very hard to photograph, whereas in previous years they had presented no difficulty.

We were lucky enough to be able to spend one day on Mincarlo, a steep pile of rock on which it is rarely possible to land owing to its exposed position and precipitous sides. No vegetation grew on Mincarlo, excepting a few patches of giant mallow, but it was a fine island for puffins, razorbills and shags, which nested amongst the rocks in large numbers, together with a few guillemots, including at least one of the bridled variety.

The photographic problem presented by the razorbill is to obtain a negative that shows the eye, which is so inconspicuously hidden in the fine black feathers of the head, that no amount of

Photo by] COMMON TERN, SITTING [*R. P. Gait* over exposure seems to be of any use, and one has to hope to reproduce the reflection of light in the pupil when the head is turned at certain angles to the sun.

Meledgen, far down to the west, however, was the best island for shags and cormorants. Meledgen requires an absolutely calm day for landing, being merely a collection of huge water worn boulders, amongst which the only level place that we could find was a piece of wreckage thrown high up on the crest of the rocks.

Here the shags and cormorants had built their nests in great numbers, the shags underneath the rocks and the cormorants out in the open, but owing to the reason mentioned before, they were very shy of facing the camera. Personally it will be a long time before I shall forget Meledgen ! A broiling hot sun brought out the characteristic evil stench of these nests in an appalling degree, and being confined to the close quarters of a hiding tent made matters considerably worse, so that never did the " chuff, chuff " of our boatman's motor engine sound more welcome than when he arrived to take us away that afternoon.

Two small islands not far from St. Mary's are chosen by those delightful birds the common tern as their special breeding territories, but why they should occupy them in preference to the many others of a similar character available is known only to the birds themselves The fact remains that these places are used year after year and everything is done by the bird authorities in Scilly to encourage them to continue to do so.

There is something very engaging about terns, they are so graceful and dainty in their flight, their general appearance is so delicate, the black cap, grey upper and white under parts, and the red bill and legs, all blend into something which is very pleasing.

Observations of common terns in their breeding colonies gives one the impression that they must be of a very nervous or erratic disposition, as the whole colony will frequently take to flight for apparently no reason whatever, and after a considerable amount of wheeling and chattering settle down to their eggs for another spell, only to be up again on the flight of a single bird from her eggs.

As far as Scilly is concerned this erratic behaviour applies to their egg laying as well, and no one can be at all precise in predicting where the eggs can be found ; an island on which not a single egg can be seen will be simply covered with eggs perhaps a few days or it may be a month later.

Whilst watching a common tern fishing one day off St. Mary's, it was suddenly attacked by a peregrine falcon, but the tern easily eluded the swoop of the larger bird, and the falcon eventually gave up the chase in disgust.

When unable to leave St. Mary's because of the rough seas, we turned our attention to the wheatears, rock pipits, and stonechats, which abound on the island. Rock pipits are very fond of building their nests in the ancient fortifications on Garrison Head, and we found four nests in the cracks between the granite blocks, one nest containing a very fine cuckoo's egg. This particular site, although it was just possible for a cuckoo to enter with a squeeze, closely approached one of those positions which often occur, where the ornithologists who believe that a cuckoo never deposits her egg with her bill, would find it hard to justify their theory.

In addition to the above mentioned land birds, wrens, common buntings, skylarks, linnets, sedge warblers, blackbirds and thrushes were common on St. Mary's, but on the other hand a well-known bird man who was summoned to a neighbouring island some years ago to see a rare bird, found that he had made a special journey to see a common starling.

During our visit we ringed a number of birds under the Witherby scheme, details of which will be found in the Report of the Ornithological Section.

In conclusion few places can be found to equal Scilly for sea bird photography, both for variety of species, and for ease of working in comparision with the dangerous cliff work, which has to be accomplished in other parts of Great Britain, whilst the delightful sea views, the novelty of the islands, their interesting flora and kindly inhabitants weave a spell round the visitor, which sooner or later fetches him back for another bird trip to the Scilly Isles.

Insect Pests and their Biological Control.

By H. Womersley, F.E.S.

At the present time the study of Entomology has become far more than the collecting of butterflies, moths, and other insects. The scientific investigation of their life histories and their economic effect on agriculture has in recent years become a matter of increasing importance. In this, the correct identification of an insect, especially in the lesser known groups, plays an important part and it is here that the systematist and collector takes his place ; but of even more value is the biological study of insects, and the biological entomologist, in his thirst for knowledge must find out the why and wherefore of an insect's existence, what it lives on, and its effect on other forms of life.

From this economic point of view insects roughly divide themselves into three groups, according to their harmful, neutral or beneficial characters. In this article only the insects will be somewhat briefly discussed, which are of direct benefit to agriculture.

Such useful insects are to be found in most Orders, especially the more recent ones as the Coleoptera (Beetles), Hymenoptera (Ichneumon flies), Diptera (true Flies) and the Neuroptera (Lace-wing flies), etc. Amongst the Beetles the most important and probably the most familiar to our members are the Lady-birds (Coccinellidæ). These many-spotted little fellows are most voracious and feed gluttonously both in the larval and imago stage on many of the pests of the agriculturalist and gardener, such as on blight (Aphides or green-fly) and scale insects (Coccidæ). The eggs of the lady-bird are yellow, turning brown as they are ready to hatch, and are laid in small clusters on plants infested with aphides. The grub is an ugly blackish creature with six legs and a large black head. Immediately on hatching it commences to feed on the nearest green-flies, and hardly pauses in its work of destruction. In fact its appetite is so enormous that one has been observed to devour as many as 30 to 40 aphides without a break. As the immediate supply of food is finished it rambles further afield in search of more. After several changes of skin, it becomes a pupa or chrysalis much resembling a pear shaped blob of dirt, attached to any convenient leaf or stem. At first the pupa is somewhat variegated, but as the change to the adult proceeds it darkens considerably. On emergence the Lady-bird itself also hunts for suitable food and then after pairing the eggs are laid and the cycle begins again.

Several broods may occur during a suitable season, which depends largely on the supply of food. The last brood passes the winter in the mature stage hibernating in all sorts of nooks and crannies, under bark, etc., often in very large numbers. Attempts have recently been made to get them to hibernate in these large numbers in captivity, so that they may be used effectually to control such pests as have been mentioned. As yet this has not been very successful.

Amongst the true flies quite a number play an important part in preserving the balance of Nature in the insect world, keeping down to a proper level injurious species. Those of you who have gone in for rearing moths from their larva have no doubt experienced much disappointment when instead of the moths expected, you have found your breeding cages inhabited by flies much resembling the ordinary house fly. At the same time you would have found the small reddish puparia at the bottom. These flies which have been parasites on your moth larvæ are a species of Tachinid flies, and as a rule are very bristly. There is a large number of species, and it is only the expert systematist who can competently distinguish them. Most kinds, are parasitic on caterpillars, and do an immense amount of good in keeping some of these caterpillars in their proper proportions. The eggs are laid in or on the body of the host, and on hatching, the grub or maggot of the fly eats its way into the caterpillar, only to leave it when it is itself ready to pupate.

In another class of Diptera of considerable service to mankind in keeping down pests are the Syrphid or Hoverer flies, those brightly coloured yellow banded ones, so much resembling wasps, that one sees hovering over the flowers in our gardens on a hot day. The eggs of some of these flies are laid, as in the case of the Lady-bird, amongst the patches of green-fly, and it is on the latter that the grub, a somewhat squattish legless slug-like creature of various shades of green to brown, lives. These aphides it devours with almost as much avidity as does the grub of the Lady-bird. The Hoverer pupa too. somewhat resembles that of the beetle first mentioned, but the fly itself does not feed, and is content to let the control of these pests rest with its larva.

In the Order Hymenoptera, to which belong the wasps and bees, are many insects of economic value. Here again the lepidopterist will have discovered various species of Ichneumons in his breeding cages instead of the moths he expected. In general, members of this order resemble the wasps although more slender, and of variable size, ranging from the minute Fairy-flies, only a millimetre or so in length, to the large wood wasp *Sirex gigas* and its allies. Many species in the female sex are provided with a very elaborate ovipositor, which often is so large as to give the creature a very formidable appearance. This organ is so constructed to enable the ichneumon to reach its prey, sometimes hidden under a good thickness of timber, through which it must penetrate before the egg can be laid in the host grub. Such an ichneumon is Rhyssa, parasitic on the caterpillar or grub of the wood wasp already mentioned. The eggs of Ichneumons are laid in or on the body of the host larva, or in some cases the egg. In the case of the grub feeding species, the parasite eats its way into the body of the host, and until full fed remains inside, quite invisible, feeding all the time on the body of the host. While thus feeding, until fully fed and ready to assume the pupal stage, it avoids touching any of the vital organs, when it may or may not, pupate within the body of the host.

Most of you will have seen the caterpillar of the large white butterfly, and may have noticed on some convenient wall or paling such a caterpillar fully fed, but that has failed to pupate. Attached to it will be a cluster of small silken cocoons. These are the cocoons of a little ichneumon, a species of Braconid, the grubs of which have been busy inside the caterpillar of the butterfly. Many other species of Braconids are useful.

On Kingsweston Down a small somewhat yellowish species may be seen doing its best to keep down the yellow and black banded caterpillar of the Cinnabar moth. I have myself observed as many as four of these ichneumon laying their eggs in one caterpillar. The surprising thing about some of these fellows is that so many of the parasitic grubs should find sufficient sustenance in the body of one caterpillar.

Other species of parasitic Hymenoptera belong to the Chalcids and the Ichneumons proper. Many Chalcids and Braconids play a large part in keeping in check the aphides and also species of Psocids. If you observe carefully you may see in the autumn brownish aphides attached to the leaves of nettles and such like. On further examination these will be found to be nothing more than hard dry skin, and in most cases will have a small round hole in them. They have been parasitized by a small ichneumon, which has emerged from the hole. Some species of Psocids may be found that have been affected in a like manner.

In the Neuroptera, the Lacewing flies or Golden Eyes are of economic importance. They are very delicate green or brown lacey winged insects, with a pair of beautiful golden eyes. They are by no means rare, and you have probably seen them at some time or other. When at rest their wings are folded roof-like over the body. The eggs of some species are very interesting, being laid in clusters, each egg attached to the leaf or twig by a short stalk. The grub somewhat resembles that of the Lady-bird in general appearance, and likewise has a most insatiable appetite for greenfly. They are somewhat variable in colour with a distinctly pointed head.

From these instances it will be readily seen how important is the balance of Nature in the insect world, and how, should the natural enemies of a harmful species disappear, the pest itself might become a serious and costly problem.

Abroad, the biological control of insect pests has received a much wider application than has been possible or necessary in this country. Probably nowhere else has it been so successful, however, as in the Islands of Hawai. This has largely been the work of Dr. R. C. L. Perkins, and other eminent professional entomologists. I shall only briefly survey the work of these men by taking a few of the cases they have had to tackle.

First of all was one of the Froghoppers, known in Hawai as the Sugar-cane leaf hopper, *Perkinsiella saccharicida*. Like most of the pests investigated in these islands this insect was an introduction, and owing to the amiable climate, and the fact that none of its natural enemies were introduced with it, it flourished exceedingly. So much so that although first noticed about 1897, by 1902 the sugar production on one plantation fell from 19,000 tons to 7,000 tons in about three years. As a result, strong efforts were made to combat it, and after various haphazard attempts to introduce parasites, which might or might not attack that particular species of hopper, Perkins and a colleague in 1904 visited Australia to study the insect in its natural environment, and if possible obtain living material of its natural enemies.

Several species were obtained and introduced, but only one became successfully established. This was a species of Chalcid (*Paranagrus optabilis* Perk.) from Queensland, which laid its eggs in the eggs of the leaf hopper. Another species of somewhat similar habits was brought at the same time from Fiji. After some eighteen months from the introduction of these parasites the damage caused by the leaf hopper fell to about half and the next year about 75 per cent. of the plantations were under control. Such success as this however was not considered sufficient, and search was made for further enemies. After many trials a species of Capsid bug (*Cyrtorrhinus mundulus* Bred.) was obtained from Fiji and Queensland. This insect lives by sucking the eggs of the leaf hopper, and its introduction following that of the Chalcids was so successful that now it is exceedingly difficult to find specimens of the Sugar-cane leaf hopper.

Another pest successfully controlled was a beetle, the sugar cane borer *Rhabocnemis obscura* Boisd., which first made its presence felt about 1865. Search for its native haunts and enemies was made in many parts of the Orient and finally Muir found it in large numbers in Lazat, breeding in Penang and Sago palms. Further it was found to be attacked by a Tachinid fly (*Ceromasia* *sphenophori* Vil.). Having made these discoveries the question arose how to transport living specimens of this fly to Honolulu. This was a very difficult proposition and after many attempts it was found necessary, owing to the short life cycle of the fly, to divide the journey into stages, and at each place to erect suitable breeding cages. In these cages cane, infested with the beetle grubs that had been parasitized by the fly, could be kept and the fly bred. Finally in 1910 the flies were successfully brought to Honolulu. It was then only necessary to establish them in the Islands. Some were liberated directly while the others were retained for building up an increased stock. It was found as few as 100 to 250 puparia would serve to colonize an entire plantation, and even after only nine months flies were found from a half to one and a half miles away, having by that time passed through five or six generations. By 1913 they were thoroughly established with considerable benefit to the sugar crop. One plantation alone recorded a drop in the number of beetles collected of from 27,000-ozs. to 1,568-ozs. It is now only occasionally when climatic conditions favour it that the beetle gains the ascendency.

Another pest of the sugar canes is the Anomala beetle (*Anomala orientalis*) which has been successfully controlled by a wasp (*Scolia maniliæ*) from the Philippines, while the Avocardo mealy-bug was mastered by a Chalcid from Mexico.

The indigenous leaf-rollers *Oniodes accepta* and *O. blackburni* were controlled by a Braconid and a Chalcid from Japan. The Mediterranean fruit fly *Ceratitis capitata* and the Australian fern weevil *Syagrus fulvitarsis* are well on the way to complete control, and aphides and their like have been subjugated by various species of lady-birds.

Apart from being used to control pests belonging to their own kingdom we can also look to Hawai for successful efforts at controlling the spread of noxious plants by means of insects. About 70 years ago a plant which has since spread to such a degree as to become a nuisauce was introduced into the Islands by the famous botanist Hildebrand for ornamental purposes. This was the Lantana of Mexico *L. camara.* Efforts to introduce the insect enemies of this plant have resulted, not in its eradication as in some of the insect pests previously mentioned, but in preventing its increase, especially on ground already cleared. Eight different species of insects have been pressed into service for this purpose :

1. A Tortricid moth which enters the flower stalk and consumes it.

2. A fly, Agromyza, which lives as a grub on the berries.

3. A Tingid bug destroys the leaves to such an extent as to cause the plant to fail to blossom.

4. Two species of blue butterflies of the genus Thecla, many members of which in this country are bud feeders, do their bit.

Several other plants are being controlled in ways such as have been described, and here I would just mention that attempts are now being made in Australia to control the blackberry pests by means of the Peach-blossom moth. Visits have been also recently paid to Britain and Europe in search of parasites of the Earwig, which is doing considerable damage to the blossom of Australian and New Zealand fruit trees.

In conclusion let me emphasize the fact that the introduced parasites must themselves be closely watched, for we know so little about them, that under the changed and more agreeable conditions they may not remain true to their host, and may subsequently become pests themselves.

The Hornworts and their occurrence in Britain.

By Cecil Sandwith.

THE Ceratophylla or Hornworts are totally submerged aquatic flowering weeds of curious habit. The flowers are monoecious, the ♂ and ♀ axillary, and borne at separate nodes. They are minute, the ♂ bearing numerous stamens, the ♀ a single ovule. These water plants are widely distributed throughout the world, and may be found in millponds, fenland ditches and meres. Prof. Glück* of Heidelburg has made an intensive study of the leaves of these plants from an anatomical and biological point of view. The Ceratophylla have no roots, but are provided with rhizoid branches, which morphologically represent sprouts, and biologically act as roots to anchor the plant in the mud, and to nourish it. The rhizoid leaves are much smaller and finer than the ordinary water leaves, and are sometimes undivided. They are lighter in colour than the water leaves, and collapse when taken out of the water. The linear segments of the rhizoid leaves bear 3–4 tiny prickles, composed of only one cell, while the terminal segments of the ordinary water leaves are formed differently, having tissue and ending in a sharp tooth, or prickle. These leaves remain stiff when taken from the water, and are of a darker colour.

The phylogenetic position of the Ceratophyllaceæ has for many years provided an embarrassing problem to British systematic botanists. The family has been variously placed in different Floras thus : between Euphorbiaceæ and Callitrichaceæ—between Empetraceæ and Callitrichaceæ—Salicaceæ and Coniferæ—Callitrichaceæ and Urticaceæ—Empetraceæ and Coniferæ—Empetraceæ and Hydrocharitaceæ ; this last being the position given in the new edition of the London Catalogue. Ceratophyllum was originally placed next to Haloragaceæ, and this arrangement was followed by de Candolle, who placed it between that family and Lythraceæ ; and its position near to Lythraceæ, though apparently indefensible, is still maintained by Coste in his Flore de France, and by Gremli for Switzerland. Most of our modern British handbooks of botany continue to follow the Bentham and Hooker system of the arrangement of families, and thus, because the plant has no petals, place it in the Apetalæ. Then, because it is not like any of the other apetalous families, they place it at the end of the Apetalæ. Thus, in the last edition of the London Catalogue, Ceratophyllum appears at the end of the Apetalæ, and just before the Monocotyledons, and no longer between the Apetalæ and the Gymnosperms, since

*Glück, H. Biologische und morphologische Untersuchungen über Wasser- und Sumpfgewächse. 2, Teil, Jena, 1906, pp. 191–203.

the editors of this edition of the Catalogue have realized the absurdity of keeping the Gymnosperms amongst the Angiosperms. The Apetalæ, as was recognised by Bentham and Hooker themselves, constitute the most hopelessly artificial group, and in many instances an individual of the apetalous families is now known to have a closer phylogenetic affinity with a petal-bearing family, than with the apetalous family which follows or precedes it.

The most reasonable and likely position, but perhaps one quite unexpected by British botanists, is that given to Ceratophyllum by Engler and Prantl in the Pflanzenfamilien, popularly known as the Engler System, which has been followed by Prof. Moss in the Cambridge British Flora, and still more recently by Mr. Hutchinson in his new and highly suggestive book, *The Families of Flowering Plants* (1926). In both these works the family is placed in the Ranales, nearest for the purpose of British botanists to Nymphæaceæ, and separated from it by the tropical family Cabombaceæ, which is intermediate in character, possessing leaves somewhat like those of Ceratophyllum, but also bearing long peduncles, and quite conspicuous petalous flowers like very minute waterlilies. As the Ranales have now been shown fairly conclusively to represent the earliest type of flowering plants, and in spite of the Engler System, to deserve the position which Bentham and Hooker gave them, Ceratophyllum may well be one of the very earliest genera of aquatic angiosperms; and this supposition is further justified by the evidence of its world-wide distribution, and the fact that it varies very little. It may possibly have evolved from Nymphæaceæ through Cabombaceæ by losing the petals, and developing a single carpel, though still maintaining the numerous stamens which are characteristic.

The strongest evidence, however, in support of this position is derived from the structure of the embryo. Nor were the investigations which led to this view so modern as might be thought. It was propounded by A. Brongniart* (1826), and adapted by Asa Gray in an excellent paper on the subject read in 1837.† He writes that the fruit and seed of the genus Ceratophyllum were first correctly figured and described by Gaertner in 1778, " a fact worthy of note, as erroneous views about the structure of the seed have been introduced into every subsequent systematic work that has fallen under my notice, in which an account of that organ has been attempted. The only error in the description of Gaertner is that of considering the proper cotyledons as a separate organ . . . . but his work was prepared at a period when the nature of the embryo was imperfectly understood." The paper goes on

*Memoire sur la génération et le développement de l'embryon dans les végétaux phanérogames.

†Published in Ann. Lyc. nat. hist. New York, iv, 41–50 (1848).

to deal with the " erroneous views " before mentioned and remarks that it would be unnecessary to go into the matter, as Gaertner has given a correct description of the seed, were it not for the extraordinary fact of its inadvertant adoption by de Candolle, Lindley and others, and the writer expresses surprise that Chamisso has revised the genus and indicated several new species without taking any notice whatever of the structure of the seed. True affinities were overlooked, because the real structure of Ceratophyllum was misunderstood. Later in the same paper he writes " It is desirable that classification and nomenclature of ovules should be extended to seeds and generally employed in systematic description." Asa Gray quotes Brongniart's *Memoire* freely as providing the only remarks extant which throw any light upon the true affinities of Ceratophyllum, and he deplores the fact that they have also the misfortune of having been wholly overlooked by succeeding systematic writers. Brongniart, compares at some length the differences and points of resemblance between the genera Ceratophyllum and Nelumbium, and also the chief points of difference and affinity between the Ceratophyllaceæ and Cabombaceæ in the structure of ovule and seeds.

Seeing that our British systematic botanists of the past could not agree as to the position of Ceratophyllum in their respective Floras, it is not surprising that their descriptions should vary likewise. It is interesting to refer to such works as Sowerby in *English Botany* (1868), Bentham's *British Flora* (1892), Babington's *Manual of Botany*, Hooker's *Students' Flora* (1884), Sir Wm. Jackson Hooker's *Flora* (1855), and the more recent Cambridge *British Flora*. All of these differ, more or less, either in actual description, or on the point as to whether all forms occurring in Britain should be included under the aggregate *C. aquaticum* H.C. Watson, or separated into two distinct species, *C. demersum* L. and *C. submersum* L. Here again, surely, unnecessary difficulties have arisen.

In 1753, Linnæus, in the Species Plantarum, clearly described two species, founded on Hortus Cliffortianus 446 (1737) ;

(1) Ceratophyllum foliis dichotomo-bigeminis fructibus trispinosis. Hort. cliff 446.

(2) C. submersum foliis dichotomo-trigeminis fructibus muticis. Hydroceratophyllum folio lævi octo cornibus armato, Vaill. act. 1719. Affinis nimium præcedenti, ut fere varietas.

Vaillant in 1719 divided the two species very simply and clearly :

(1) Hydroceratophyllum folio aspero, quatuor cornibus armato.

(2) Hydroceratophyllum folio lævi, octo cornibus armato.

He expresses surprise that Ray and Tournefort have taken " our armed Hydro for Millefolium aquaticum. The second species d'Hydre cornu is neither described nor named as far as I know by any author. One can easily distinguish it from the first species by the leaves which are soft, smooth and generally *une fois plus découpées*, and by the capsules which have not the long spines that one notices in the other species."

I have recently examined all the fresh specimens I could procure of both species of Ceratophyllum, and have also been through the dried material at the National Herbaria, South Kensington and Kew, and the Father Reader collection at Bristol University, and also by the kindness of Dr. G. Claridge Druce, Mr. C. E. Salmon, and Messrs. J. W. White and H. J. Gibbons of Bristol, I have had the opportunity of examining the specimens of Ceratophyllum from their herbaria ; and I find without exception that this character of the leaf division, so clearly described by Vaillant more than 200 years ago, still holds good for dividing the two species, and correlates with the character of the length of the terminal spine or style.

Although *C. submersum* never produces the two lateral spines or protuberances on the dorsal and ventral edges towards the base of the fruit, which are characteristic of forms of *C. demersum*, this character, which has been so much stressed in the past in our British Manuals, must be treated with caution, since these lateral spines or protuberances develop as the fruit becomes mature, and are often almost invisible when it is young ; in fact I have gathered specimens of *C. demersum* in Norfolk, in which on the same plant, some of the younger fruits have developed no basal spines, while the older ones have the long spines of typical *C. demersum* L. (*oxyacanthum* Cham.). Care must also be taken to observe whether the lateral spines and terminal style have not been broken off or eaten, should these appear shorter than is required for *C. demersum*. Another character that has been used in the past for distinguishing the two species is the presence or absence of tubercles on the surface of the fruit. This again is untrustworthy as a constant character. Though the fruit of *C. submersum* is usually roughly tuberculate in a way that is never apparent in that of *C. demersum*, yet I have seen fruits of the former in several localities near Bristol with an apparently smooth surface. Finally, while *C. submersum* appears to prefer brackish waters near the sea, it would be quite untrue to say, as has been suggested, that it does not occur in any inland counties, as I have seen specimens obviously referable to this species from both Worcestershire and Leicestershire.

By using the characters of the leaves, and the relative length of the terminal spine or style, in conjunction with the other, perhaps more familiar, characters when used with the caution suggested above, our two British species seem to be clearly and easily distinguishable. Our real difficulties arise when we come to consider the question of varieties.

In 1829 Chamisso* arranged the genus and described six species, of which only the following need be dealt with in a study of the British representatives ;

(1) under *C. demersum* L :†
oxyacanthum = type.

Chamisso definitely identifies his *oxyacanthum* with the plant described by Linnæus as *demersum*. *Oxyacanthum*, therefore is nothing else but *demersum* L., and the name can only stand if *demersum* is taken merely as an aggregate of various varieties a, b, c, etc., as was done by K. Schumann in the Flora Brasiliensis. It cannot possibly be treated as a " var. b " of *demersum* L., as has been done in recent lists.

(2) under *C. submersum* L :
apiculatum.
muticum = type.

He definitely identifies his *muticum* with the plant described by Linnæus as *submersum*.

Chamisso admits that *muticum* is different from *apiculatum*, having more divided leaves, etc. He definitely figures *apiculatum*, and also describes it as having two lateral knobs near the base of the fruit (where *oxyacanthum* produces spines). In the full-face figure he draws the style just as long as the fruit, in profile a little shorter. Chamisso admits that his *apiculatum* is described from Californian specimens, as he could not get any from Europe. He adds that it does occur in Europe, but very rarely.

From all this evidence it is clear that Chamisso ought to have put his *apiculatum* under *C. demersum*, and this has been done recently by Prof. C. Schröter of Zurich‡ and others. The *apiculatum* of Chamisso, however, is certainly not the *apiculatum* which was figured and described under *C. demersum* by Prof. Moss in the Cambridge British Flora. The plant figured by Moss has the short style, knob-less tubercled fruit, and much-divided leaves of *C. submersum* !

The evidence for the supposed existence of *apiculatum* Cham. in Britain rests largely upon gatherings which have been passed through the Exchange Clubs, and discussed in their Reports.

* Linnæa, iv., 503–5 (1829).

† In " The Families of Flowering Plants," Mr. Hutchinson has unfortunately chosen the fruit of the Amazonian var. *cristatum* K. Schum., as representative of *C. demersum* L., in the figure which he has devoted to the family.

‡ Lebensgeschichte der Blütenpflanzen Mitteleuropas, Lieferung 22, Band II, Stuttgart 1917.

Amongst the specimens kindly lent to me by Dr. G. C. Druce there is an interesting sheet of *C. demersum* from a ditch in Huntingdonshire sent by Mr. Alfred Fryer with the following note: "This is the form I recorded as *C. apiculatum* Cham. in J. of Botany, vol. 25, 282. The specimens on which I founded that record had no spines at the base, but two minute tubercles in their place. Afterwards, on gathering a large series of examples, I found on the same branch fruits (1) with no spines at the base, (2) with two tubercles, (3) with one spine, (4) with two spines, (5) with a winged spine. As all these varieties in the fruit occurred in apparently full-grown examples, and as the absence of spines seemed in no wise to depend on the maturity of the fruit, I am induced to believe that our fenland plant is better placed under Mr. Watson's aggregate *C. aquaticum*. Possibly all Chamisso's "species" or "sub-species" have no substantial existence in nature, but may be, like our fenland varieties, states of one plant. Prof. Babington names our fenland plant *C. demersum*, a name which may fairly be given to its usual state; but, looking at habit and foliage alone, we certainly have a plant that is well described and figured in E.B. ed. III. pl., 1267 as *C. submersum*. Also in some seasons and situations, the fruit has neither spines nor tubercles. The style too is variable in length."

I have seen a specimen in Dr. Druce's collection of this debatable plant of Mr. Fryer's, and I consider it without any doubt to be *C. demersum*. The leaves are those of that species and the single fruit which has been preserved had the long style, but it has obviously been broken off near the middle. I cannot agree with Mr. Fryer's conclusion about the two species of Ceratophyllum. I think that he was finding plants of *C. demersum* in which the fruits showed all the normal gradations of development, even on the same specimen. On his own evidence this plant cannot possibly be identified as *C. apiculatum* Cham. As to the figure of *C. submersum* in *English Botany*, mentioned by Mr. Fryer, the foliage there figured is clearly that of *C. demersum*; it is evident that Syme, like other British botanists, had failed to discover the importance of the leaf character for distinguishing the two species.

In Herb. C. E. Salmon there are two sheets of *C. submersum* from a pond at Castle Morton, Worcestershire, which have caused much discussion, and are of importance as they throw light upon Prof. Moss's conception of Chamisso's *apiculatum*. They are named *C. submersum* by the finders, A. J. Crosfield and R. F. Towndrow, and have been passed by such critical authorities as Mr. Arthur Bennett and the Rev. E. S. Marshall. However, there is a note below in which Prof. Moss says: "This plant is in my opinion *C. demersum* var. *apiculatum* = *C. apiculatum* Cham. I have never gathered *C. submersum* in any inland county, and have only seen British specimens from Southern England, Somerset to Norfolk.

The var. *apiculatum* is intermediate between *C. demersum* and *C. submersum,* and it is somewhat arbitrary to refer it to one of the species rather than the other, but I prefer to put it to *C. demersum,* simply because this plan enables one to determine the two species in absence of ripe fruit. I agree that in fruit characters the variety is not far from *C. submersum,* and I should not complain if the two species were reduced to one. C. E. Moss."

All these arguments appear singularly weak and unsatisfactory, and reveal a misunderstanding of Chamisso's description and figure. The Worcestershire plant seems to me to be pure and simple *C. submersum,* as does the plant figured as *apiculatum* in the Cambridge British Flora. Both show the leaf and fruit characters which are typical of *C. submersum* whereas Chamisso's *apiculatum,* as I have explained above, should have the style at least as long as the fruit, and two lateral protuberances near the base, characters which place it under *C. demersum.* I have not yet seen in British exsiccata any specimens that could be referred to Chamisso's *apiculatum.*

To summarise, there are in Britain two well defined species of Ceratophyllum :

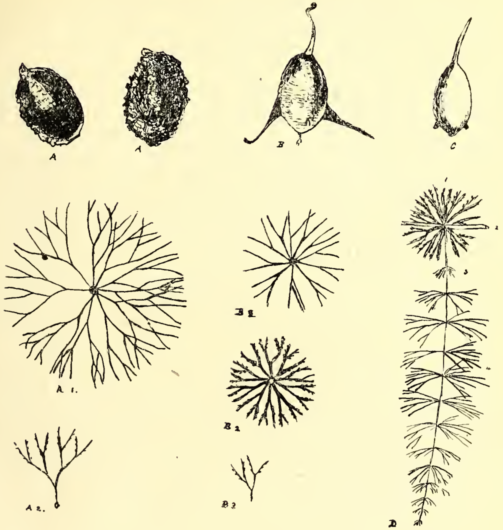
(1) *C. demersum* L. = *oxyacanthum* Cham. Leaves dark green, stiff, *once or twice dichotomously forked,* with 2–4 linear segments, which are serrulate, or denticulate-spinous ; fruit smooth or sometimes pitted, at maturity producing near the base two lateral spines, and at the summit a spine which, with the style, at least equals and usually far surpasses the length of the fruit.

(2) *C. submersum* L. = *muticum* Cham. Leaves a clear green, longer than those of *C. demersum, thrice dichotomously forked,* thus usually with eight very finely serrulate capillary segments ; occasionally one of these fails to develop at the final lateral forkings. The fruit is hard and often covered with raised tubercles, which are scarcely visible when the fruit is young ; there are no lateral spines near the base, and the style is much shorter than the fruit. The whole plant is softer and more collapsible than *C. demersum.*

The existence in Britain of *apiculatum* Cham., which should be treated as a variety of *C. demersum,* is at present doubtful, and I have seen no dried material that can be referred to it. I have, however, a form of *C. demersum* under observation near Meare, N. Somerset, which has the long style when immature, and no lateral spines, only rudimentary protuberances, in some fruits apparently absent. The style appears to shorten as the fruit matures, or the slender tip is deciduous ; while the protuberances near the base, if present at all, do not appear to lengthen. It would be futile to make any definite statement about this plant without further investigation into the constancy of these characters at different stages of development and under different conditions ; but there is at least a possibility that it is some such plant as this which will approximate most closely to Chamisso's description and figure of *apiculatum*.

An interesting feature of the Worcestershire *C. submersum* discussed above is the curiously flat thickened leaves, arranged in a palmate fashion, from which the fine capillary segments spring like whips, giving the plant an unusual appearance. The linear segments also are more asperous than is usual, and the colour a deeper green, though not the reddish-brown tint of *C. demersum*. Plants brought from West Gloucestershire by Mr. E. Nelmes of Kew, as well as two sheets in the Father Reader Collection, and a recent gathering of my own at Worle in North Somerset, present these same slight facial differences, which do not in any way detract from the strong characters that divide *C. submersum* from *C. demersum*. *C. submersum* appears to fruit more freely than the so-called " common " species. Prof. Glück, writing of *C. demersum*, observes that, if the plant depended solely upon its fruit for reproduction, it would soon become extinct, as from his experience fruit is only produced under peculiarly favourable conditions, the plant reproducing itself in a vegetative manner by means of shoots.

In the Bristol district the distribution of *C. submersum* is fairly clear, at any rate in N. Somerset, where it occurs in brackish rhines and ponds near the coast at Congresbury, Kewstoke, Woodspring and Worle. Mr. Nelmes has also found it at Hill, near Falfield, W. Glos. The Rev. E. S. Marshall's records of *C. submersum* at Worle, as well as Mr. H. S. Thompson's recent rediscovery of the same species at Congresbury, are of great interest, as they confirm the old records of Dillenius made 200 years ago, which were " the first British records for the species " (White's Bristol Flora). At the present time it is *C. demersum* which needs further study in the district both as to its distribution, and also the degree of variation in the characters of the mature fruit. Both species of Ceratophyllum produced an abundance of fruit in 1926. The flowers are water-pollinated, and it is purely theoretical to suppose that this year of unusual rainfall may have produced the necessary conditions favourable to the plants.



EXPLANATION OF PLATE.

A. A. Fruits of *C. submersum* L. From Congresbury, September, 1926. Photograph by C. Tuckett and C. J. James.

A. 1. Leaf whorl of *C. submersum* L. From Congresbury.

A. 2. Leaf of *C. submersum* L., trifurcate showing eight segments. Nat. size.

B. *C. demersum* L. = *oxyacanthum* Cham. From Hickling, Norfolk, August, 1926. Fruit showing the long style and basal spines. Photograph by C. Tuckett and C. J. James.

B. 1. Leaf whorl of *C. demersum* L., rhizoids. From Meare, December, 1926. Nat. size.

B. 2. Ordinary leaf whorl of *C. demersum* L. Leaves ending in 2, 3 and 4 segments. (After Glück).

B. 3. Leaf of *C. demersum* L., bifurcate showing four segments.

C. *C. demersum* L., var. *apiculatum* (Cham.) K. Schum. From California. (After Garcke.)

D. *C. demersum* L. 1. Ordinary winter leaves. 2. axil. 3. primary leaves. 4. Horizontal to the axil and extending downwards = rhizoid, with well developed rhizoid whorls having fine leaves. (After Glück).

Bristol Botany in 1926.

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

THE pollard willows that stand along the banks of our rivers and lowland ditches are often of great age—mere hollow shells—and then their trunks, though still producing crowns of leafy shoots, are filled more or less with a mass of moist humus and decaying heartwood from which the roots of flood-borne or bird-sown flowering plants can derive nutriment sufficient for their growth. Even in their prime these pollards invariably carry on their bowl-shaped tops quantities of accumulated humus that support numerous plants as epiphytes.

In 1893 Messrs, Willis and Burkhill of Caius College published *Observations on the Flora of the Pollard Willows near Cambridge.** About 4,000 trees had been examined either on the banks of the Cam and Ouse, or in adjacent fens and meadows. The plants recorded from their bowls numbered nearly as many. They belonged to 61 genera included in 28 Natural Orders. There were listed eleven genera of Grasses ; six each of Rosaceæ and Compositæ and four of Umbelliferæ. In that district there could be no possibility of these plants having been introduced by floods. A careful analysis shewed that the seeds of more than half had been probably deposited by winds, while most of the remainder were due to the visits of birds and their nest-building. Plants with smooth, heavy seeds were entirely absent. With two exceptions none were found in trees more than 200 yards from others of the same species upon the ground ; the conclusion being that a seed is rarely carried a long distance by its distributive mechanism. One of the woody shrubs—an Elder—was found to have pushed its roots right down through the trunk of the willow into the soil below, and that may have happened in other cases.

Some time later Mr. Burkhill suggested to me that a similar investigation in the Bristol district would not be without interest. Nothing was done however until last year, when Mr. H. S. Thompson who was fly-fishing in the Chew Valley suffered his thoughts to stray from the trout in the river to the trees that overshadowed it. Here, as in Cambridgeshire, pollard willows invited attention to the adventitious vegetation thriving in their bowls. Mr. Thompson examined these along a stretch of several miles, and the results are now quoted from his report to *Nature*, published in November, 1925. More than a hundred species of Phanerogams were recognised, nine tenths of them occurring between Keynsham

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* Proceedings Camb. Philosophical Society.

and Compton Dando, and all being natives of the Chew Valley. On April 30th twenty-three flowering plants were counted upon a single tree leaning low over the stream. Dog-rose, Blackthorn, Hawthorn, Ash, Elder and an Elm were among the shrubs that had become established.

Adventive Gooseberry bushes had already been commented on in *Fl. Brist.* The fine Woolly-headed Thistle and the Great Mullein were conspicuous. Leguminosæ were curiously absent; Mr. Thompson did not observe a single clover, vetch or *Lotus.* But the seeds of this family are heavy and sink in water.

Whenever rainfall is exceptional near its source on Mendip the Chew is subject to rapid flooding, the rise being sometimes as much as ten feet above the normal level. Many of the plants noted, therefore—perhaps the majority—could have been brought down and stranded on the trees by floods; but a large proportion certainly owe their position to seeds conveyed by wind and birds.

Foremost among botanical events of the year is the issue of a new edition (the eleventh) of the *London Catalogue of British Plants,* a work regarded as an authoritative guide for arrangement and nomenclature by students and collectors of the native flora. In the seventeen years that have elapsed since the publication of the tenth edition critical botany has made much progress; some questions of nomenclature have found settlement on generally accepted principles, and the views of experts on genera to which they have devoted special study have been obtained. The inclination of modern systematists is towards the recognition of a multiplicity of varieties and hybrids. As a result of this particularity the new list is lengthened by several hundred additions —*Rosa, Rubus* and *Hieracium* furnishing the bulk. It should be instructive to take one of the smaller Nat. Orders—Orchidaceæ for example—and see how the flora of Bristol is affected by alterations in the *Catalogue. Orchis hircina* Scop. now stands alone as *Himantoglossum hircinum* Sprgl. agreeably with Continental usage. Similarly *O. pyramidalis* L. becomes *Anacamptis* Rich. as was long ago proposed. *O. latifolia* L. has been split up; the larger portion going to *O. prætermissa* Druce and a smaller to *O. purpurella* Stephenson, both as new species. A doubtful remnant of the Linnean aggregate is still preserved. *O. maculata* L. disappears: the small plant of heathy ground (*ericetorum* Linton) is now *O. elodes* Gris., and our common "Spotted Palmate" becomes *O. Fuchsii* Druce. *Habenaria* is no longer a genus: the Butterfly orchids are now *Platanthera,* and the Frog Orchis is *Cœloglossum.* The genus *Gymnadenia* is revived with a long string of *conopsea* hybrids and a second species—*odoratissima*—which presumably has been recognized in this country. The generic name *Epipactis* is resumed in place of *Helleborine* although Dr. Druce insists that the latter has priority. It has a new species (*E. leptochila* Godfery) to which the plants named *E. media* in *Fl. Brist.* must be referred for reasons recently stated by Col. Godfery in the *Journal of Botany*. *E. atroviridis* is discarded as being merely a form of *latifolia* ; and we can welcome the return of *E. palustris* in lieu of the usurping "*longifolia*." Such marked changes as these give some idea of the amount of work that must be done and the difficulties encountered in the compilation of a new *Catalogue*.

Ranunculus ophioglossifolius Vill. One of the rarest British flowering plants that occurs sparingly and uncertainly in very few localities. The record of its discovery in our district as published in *Journ. Bot.* for August, p. 221, is given below. But the finders modestly omit to state that their success was the reward of a systematic search for the plant in all likely situations during several years. "On June 26th we came across this very rare British species in a new locality in West Gloucestershire, within the limits of Mr. J. W. White's Bristol area. The place may be adequately described as a typical piece of common-land, situated between Yate and Wotton-under-Edge. It thus lies some ten to fifteen miles N.E. of Bristol, and about twenty-five miles S.W. of the East Gloucestershire locality . . . . It is always possible that *R. ophioglossifolius* may be passed over as *R. Flammula*, but besides the better-known scientific characters, the distinctly greenish (not golden) yellow of the smaller flowers, resembling more the colour of *R. sceleratus*, should easily distinguish it . . . . C. I. and N. Y. Sandwith."

R. parviflorus L. Still on Brean Down, S., where it was first noted in 1883. A large patch exists on the S.E. side of the promontory ; *W. D. Miller*.

Helleborus fœtidus L. Extended quarrying at Churchill Batch is destroying the plants occurring thereabout.

Nymphæa alba L. The present thriving colony in a railway pond towards Edithmead, Burnham, as noted in *Fl. Brist.*, was planted by a neighbouring farmer about 1860 ; *W. D. Miller*.

Papaver hybridum L. Garden weed, Sand Bay, Kewstoke, S. ; *H. J. Gibbons*.

Barbarea arcuata Fr. By the Chew near Chew Magna, S. ; *H. S. Thompson*.

Lepidium latifolium L. As was foreseen to be inevitable (*Fl. Brist.* p. 163), the roadside bank at Berrow where this fine Crucifer flourished for generations has been demolished by the builder.

Viola variata Jord. var. *sulphurea* Drabble. Arable field, Old Down, Tockington, G. Not recorded for the county in Drabble's *British Pansies*, 1909 ; *Miss Roper.*

V. lepida Jord. "A perennial with underground parts of stem." (*E. Drabble*). Arable field, Burrington, S. *Id.*

Medicago minima Desr. var. *recta* Burnat. Quarried ground at Twerton, S., 1915 to 1920 ; *Miss Roper* and *T. H. Green.*

Rosa agrestis Savi var. *belnensis* Ozan. On the Cadbury ridge towards Clevedon, S. ; *Miss Roper.* Had been previously observed at Uphill ; *Marshall* and at Sand Point ; *N. Sandwith.*

Apium inundatum Rchb. Roadside pond, Beacon Hill, Mendip ; *Miss Roper.*

Epilobium hirsutum × *parviflorum.* Clapton Wick, near Clevedon, S. ; *Miss Roper.*

Lonicera Caprifolium L. Churchyard wall at Charlcombe, Bath ; *Major R. Orme.*

Valerianella Auricula DC. (*V. rimosa* Bast.). Avonside, Bath, 1918 ; *T. H. Green.*

Antennaria dioica Gærtn. The usual tiny patch peculiar to the species in our area, in a large field near the head of Goblin Combe, S. ; *Miss H. M. Dixon.* A single plant discovered near Cheddar in 1922 by Mr. Hamlin is said to have increased fivefold.

Anthemis arvensis L. Harptree, near Bath ; *W. D. Miller.*
A. nobilis L. Syston Common, G., introduced ; *H. J. Gibbons.*

Senecio sylvaticus L. var. *auriculatus* Meyer = *S. lividus* Sm. Peat moor, Catcott Burtle, S.

Centaurea nemoralis Jord. Churchill Lane, Sandford Hill, S. ; *J. F. Jeffrey.*

Symphytum peregrinum Ledeb. Abundant for many yards along a track leading from the Hallen Road towards Lawrence Weston, G.

Cuscuta europæa L. There has been a remarkable diminution of this parasite in the Avon valley. I hear from Mr. Miller that as the result of many hours' search above and below Bath he could find only one small patch.

Datura Stramonium L. Has been known for several years on a rubbish heap by Catcott Drove, S. ; *W. D. Miller.* And it is particularly interesting to find that several plants still appear on the shore at St. Thomas' Head, Woodspring, a continuity of nearly forty years.

Linaria spuria Mill. Fuller's Earth works, Combe Hay, S. in peloria condition ; *Major R. Orme.*

Limosella aquatica L. May be lost to the Bristol district, and to the county. The swamp on Syston Common where it grew has been filled up and obliterated.

Mentha nemorosa × *viridis* = *M. Nouletiana* Timbal—Lagr. In 1906 the late Rev. E. S. Marshall gathered near Berrow, S., a Mint that he labelled "*M. longifolia* var. *nemorosa*." This, however, has the slender interrupted spikes and deeply incised toothing of *M. viridis* together with the velvety pubescence of *M. nemorosa*, and I venture to think is really the hybrid. The plant probably survives as Miss Roper saw it in the locality many years later. Recently Mr. H. J. Gibbons brought a corresponding hybrid from a cottage garden north of Clevedon.

Leonurus Cardiaca and *Ballota ruderalis* still grow near Portishead Dock, S. ; *Mrs. Sandwith.*

Pinguicula vulgaris L. "Has been very carefully looked for year after year in its two localities on the moors, but only four or five plants in all have been seen. Owing to peat-cutting and drainage I fear the species is doomed." *W. D. Miller.*

Chenopodium glaucum L. var. *microphyllum* Murr. Has appeared on more than one local rubbish-tip ; *Miss Roper.* The species is a native British plant.

Polygonum mite Schrank. In some quantity north of the Shapwick railway, with *P. Hydropiper* and *Rumex maritimus* ; *W. D. Miller.*

P. Bellardi All. Casual by the Docks at Avonmouth, G. *Mrs. Sandwith.* A bushy plant of erect habit with pitted seeds and flowers smaller than those of *P. arenarium.* Agrees well with French specimens from the Lot and Garonne. I have it also from St. Philip's Marsh (1904) and from Bradford, Yorks. (1919).

Corylus Avellana L. Mr. Miller remarks that to his knowledge there is not a Hazel outside gardens within five miles of Burnham-on-Sea.

Daphne Mezereum L. Eaker Hill Wood, Chewton Mendip, has been again carefully searched for this rarity. Although the original bush has disappeared two others have been located.

Salix aurita L. Moor between Ken and Clevedon ; *C. and N. Sandwith.*

Ceratophyllum submersum L. Abundant in an ancient pond or spring-head near Congresbury, S., fruiting quite well ; *H. S. Thompson.* Dillenius saw it near Congresbury in 1726. In a ditch at Hill, G. ; *E. Nelmes.*

Ornithogalum nutans L. In a low meadow by Box Brook, near Bath, badly trampled by grazing horses ; *Miss F. R. Longman.* *O. umbellatum* is reported to still exist on the sand-hills near Burnham where it was found in 1888 by Mr. D. Fry; but seems to have gone from the Uphill locality.

Lemna trisulca and *L. minor* were both flowering freely on June 19th in a rhine near Shapwick Station, S.; *W. D. Miller.*

Alisma lanceolatum With. Rhine in Sand Bay, Kewstoke, S.; *H. J. Gibbons.*

Eleocharis acicularis R. and S. Still flowers in shallow waters of the canal at Bath; *Major R. Orme.*

Carex contigua × *vulpina.* A rare hybrid, apparently new to the county. Near Whitchurch, S.; *H. S. Thompson.*

Poa annua L. var. *reptans* Hausskn. A perennial variety, throwing out many stolons. Tyntesfield Park, Wraxall, S.; *Miss Roper.*

ALIENS.

The year's list of foreign (and mostly evanescent) casuals from our docks and fowl-runs is longer than usual; the result mainly of observations by Mrs. Sandwith, Noel Sandwith, Major Orme and H. J. Gibbons. *Cicer arietinum* L. *Artemisia gnaphalodes* Nutt. *Carthamus lanatus* L. *Tagetes micrantha* L. *Amarantus deflexus* L. *A. Blitum* L. *A. patulus* Bert. *A. silvestris* Dsf. *A. spinosus* L. *Salsola Tragus* L. *Alternanthera ficoides* L. *Polycnemum arvense L.* *Rumex Patientia* L. *Panicum colonum* L. *Setaria verticillata* L. *Eleusine indica* L. *Bromus inermis* Leyss. *Eragrostis minor* Host.

The Effect on the Avon Section of the Construction of Portway.

By S. H. Reynolds, M.A., Sc.D.

THE construction of Portway has considerably modified the Avon Section improving parts and rendering them more accessible, but reducing the accessibility of other parts. It is fortunate that comparatively few of the chief exposures have been destroyed. In view of the great importance of the Avon Section and the numerous detailed references to particular exposures contained in papers by Vaughan and others it has been thought that a somewhat full account of the modifications in the section may be of service.

I am greatly indebted to Dr. F. S. Wallis who kept a careful watch on the section throughout the whole period of the construction of Portway, and to Dr. S. Smith, for help in measuring the chief exposures.

The following three papers will be referred to in the sequel under (1), (2), (3).

(1) A. Vaughan, " Palæontological Sequence in the Carboniferous Limestone of the Bristol Area," *Q. Journ. Geol. Soc.*, LXI, (1905), pp. 181–307.

(2) A. Vaughan, " The Carboniferous Limestone Series (Avonian) of the Avon Gorge," *Proc. Bristol Nat. Soc.*, 4th series, I, (1906 issued for 1905), pp. 74–168.

(3) S. H. Reynolds, " The Lithological Succession of the Avonian at Clifton," *Q. Journ. Geol. Soc.*, LXXVII, (1921), pp. 213–243.

Cleistopora (K) Beds.

The Km section[1] is improved. That in the Upper Avonmouth line is unaffected, that in the lower, formerly only to be approached by trespassing on the railway line is now fully accessible. The Bryozoa-Bed has been cut back with the result that the pseudobreccia band[2] and the Palate[3] Bed are both now well exposed. The riverside exposure of the Bryozoa-Bed has been covered up.

The condition of the main part of K1 and lower K2 remains unchanged, the beds are still very badly exposed. The widening of the road has however, provided a fine section of Upper K2 and β 62 yards long. As this section in view of its shaly character is

1 (2) p. 103. 2 (3) p. 218. 3 (2) p. 98 and (3) p. 219.

bound to be quickly overgrown it was measured with the following result :—

		ft.	ins.
1.	At the base, shale with several considerable bands of highly fossiliferous limestone	12	0
2.	Limestone	1	0
3.	Shale with subordinate limestone bands	3	0
4.	Limestone with shaly partings	4	0
5.	Shaly fissile limestone	3	0
6.	Shale	1	8
7.	Limestone	2	6
8.	Shale with thin limestone bands	7	0
9.	Limestone	0	6
10.	Shale	0	9
11.	Bryozoal limestone with shaly parting	0	8
12.	Shale	1	10
13.	Limestone with shaly parting	0	10
14.	Shale with nine little limestone bands some of them discontinuous	8	0
15.	Limestone	0	7
16.	Shale with limestone bands	1	3
17.	Limestone	0	7
18.	Shale with thin limestone bands	3	0
19.	Limestone	0	4
20.	Shale	1	3
21.	Limestone	0	6
22.	Shale	4	6
23.	Fossiliferous limestone predominantly argillaceous but in part nodular	12	0
24.	Fairly thick-bedded limestone mainly crystalline and highly fossiliferous, seen by the roadside below Sea Walls ...	12	0

Zaphrentis Beds (Z).

The mass of rock which formerly projected between Press's Quarry and the Black Rock Quarry has been cut back, and is more accessible than used to be the case. The small overthrust fault which traverses it is rather better seen. Although much material especially Bryozoa bed, has been dumped in the Black Rock Quarry the exposures are unaffected, except at the southern end, where part of the exposure of horizon γ is hidden. Certain fossiliferous bedding planes at the northern end are also covered up.

The riverside exposures of horizon γ and Z2 remain as they were.

Syringothyris (C) Beds.

The Gully Quarry has been in the main filled up, but at present the dump has not reached the base of the cliff. Even if it does so, the excellence of the section is not likely to be much affected. The pool of water which used to collect in the Gully Quarry in the early part of each year has gone, and so has the opening of the powerful spring which fed it. The riverside exposure of Caninia Oolite remains unaffected.

The removal of the railway has rendered the fine section of the top of the Caninia oolite and of the Caninia dolomite to the south of the Gully quarry, formerly only to be reached by trespassing on the line, freely accessible. The mass of rock showing a fine exposure of the "Suboolite" bed,[4] which formerly existed between the railway and road has completely disappeared. The road has been cut down to a lower level than that at which the railway formerly stood, and the exposures have been thereby improved. Evidence of slight disturbance at the top of the Caninia dolomite is now better seen than formerly.

Seminula (S) Beds.

There has been some change at the extreme northern end of the Great Quarry adjoining the cutting, but the *Diphyphyllum* band[5] marking the base of S., and the bands with algal nodules a few feet higher in the sequence may still be seen.

While the appearance of the Great Quarry is much changed by the disappearance of the rifle butts, and the introduction of tennis courts, and the level of the whole floor has been raised somewhat I do not think that any interesting exposures have disappeared. Features like the "front slope"[6] and "back slope"[6] of Vaughan remain, though in a somewhat reduced form. The fine riverside exposure, especially of the "Concretionary Beds" near the southern-end remains unaffected.

Dibunophyllum (D) Beds.

There has been more change in the D-beds than in any other part of the sequence, but the section as seen at the present time is rather better exposed than the original one.

The removal of the railway and the associated cutting back of the rocks have on the whole improved the D1 section. The pseudobreccias are particularly well seen, and while in the old section owing to the rapid weathering of this type of limestone, its features when in the fresh condition could rarely be observed, the present section shows the features of the fresh rock admirably.

Point Villa[7] which formerly stood near the mouth of the tunnel has been removed, as have the platform north of the tunnel, and the little approach cutting.[8] The highly fossiliferous section of D1 formerly to be seen by the riverside to the north of Point Villa has disappeared, the rocks being cut right back to the level of the railway cutting.

The riverside exposures of the D beds north of Point Villa have been partly destroyed.

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4 (3) p. 223. 5 (3) Pl. XIII. 6 (2) p. 113 and (3) Pl. XIII. 7 (2) p. 89. 8 (3) p 234

The changes alluded to above have altered the exposures of the Dibunophyllum Beds so much that it has been thought desirable to remeasure this part of the succession. Commencing with the lowest beds exposed just south of the Zigzag path we have the following succession :—

		ft.	ins.
1.	Reddish limestone, top bed with *Productus* and *Lithostrotion*	4	6
2.	Shaly parting	0	2
3.	Thick-bedded limestone, lower beds considerably calcite-veined, upper ill-exposed owing to weathering	45	0
4.	Thick shale band	1	0

We now come to a part of the section where the rocks are well-exposed owing to the cutting back of the road.

5.	Grey limestone a good deal calcite-veined, lower surface (seen up the bank) mammillated, fossils not conspicuous	22	0
6.	Pseudobreccia band	0	8
7.	Grey limestone with reddish stains and abundant *Productus hemisphericus*, upper part of the band shows irregular passage into pseudobreccia	4	6
8.	Shaly parting	0	2
9.	Grey limestone, lower surface mammillated. Includes two bands of pseudobreccia the lower of which shows the features of this rock when unweathered. Corals are conspicuous just above this band	19	0
10.	Limestone, large rubbly and associated with a good deal of shale. The strata are poorly exposed and the upper beds which show some slickensiding are partly walled up	22	0
11.	Limestone, rubbly in the main and with a mammillated base	8	0
12.	Limestone, when exposed chiefly coarse oolite but largely walled up	12	0
13.	Limestone, chiefly coarse red and grey oolite	12	0
14.	Shale ... ... (seen)	2	6

From this point for a distance of about 70 yards, *i.e.*, to near the end of the abandoned tunnel there are occasional exposures of oolitic limestone. Then we have :—

15.	Red grit	5	0
16.	Oolitic limestone, the lower part enclosing numerous quartz grains and small pebbles	2	6
17.	Shale and thin-bedded grit	4	0
18.	Massive grit	8	0
19.	Oolitic and crinoidal limestone	1	9
20.	Shale irregularly mingled with coarse oolitic limestone and containing quartz pebbles up to an inch in length ...	1	3
21.	Grit	0	10
22.	Irregular calcareous grit with quartz pebbles passing up into sandy limestone	3	0

Bands 15–18 are also seen in the remains of the cutting at the mouth of the tunnel.

Band 22 is probably the equivalent of the band of grit with quartz pebbles which prior to the making of Portway was exposed just south of Point Villa, and is taken as the lowest member of D2 in the vertical section given in (3) p. 242. The band as now exposed is, however, considerably more calcareous than that seen prior to the cutting back of the rocks, which in this part of the section has taken place to a distance of some fifteen yards.

		ft.	ins.
23.	Shale in the main, but now concealed by grass and walling, about	10	0
24.	Massive red grit partly concealed by walling	8	0
25.	Rubbly limestone and pseudobreccia	3	0
26.	Limestone, ill-exposed	4	6
27.	Rubbly limestone and pseudobreccia	2	6
28.	Limestone generally oolitic much stained and shattered ...	9	0
29.	Pseudobreccia	0	6
30.	Limestone generally oolitic	3	6
31.	Pseudobreccia	0	6
32.	Limestone, generally oolitic	3	0
33.	Pseudobreccia with abundant *Lithostrotion irregulare* ...	0	6

Band 33 is cut off by a mass of walling on the south of which it appears to be represented by little more than a clay parting.

		ft.	ins.
34.	Oolitic limestone	4	0
35.	Rubbly oolitic limestone, upper beds more shaly	3	0
36.	Massive oolite	4	0
37.	Pseudobreccia	4 to 6 feet	
38.	Oolitic limestone, with pisolitic (?algal) bodies near base ...	3	6
39.	Banded limestone, oolitic in places	6	0
40.	Limestone, rather coarsely crystalline and oolitic ...	0	9
41.	Compact grey limestone well bedded (truncated by a small thrust)	2	0
42.	Limestone, upper part nodular and highly fossiliferous, lower part has character of pseudobreccia	2	0
43.	Massive grit passing down into oolitic gritty limestone, top nine inches sandy pseudobreccia	7	0

The remainder of the section as far as the bottom of Bridge Valley Road is now completely concealed by a big wall some 130 yards long. Prior to the construction of this Dr. F. S. Wallis measured the following strata :—

		ft.	ins.
44.	Grey massive limestone, fossiliferous...	10	0
45.	Coarse red oolite	4	0
46.	Red grit or quartzite	6	0
47.	Shaly parting	0	6
48.	Red grits with finely laminated shaly partings	11	0
49.	Alternately red and green finely laminated shale showing slight disturbance	24	0
50.	Hard red grit or quartzite	6	0
51.	Alternately red and green shale showing slight disturbance	18	0
52.	Black carbonaceous shale containing ill-preserved plant remains	1	0
53.	Alternately red and green shale	4	0
54.	Thin-bedded quartzite and shale much disturbed and extending to the great fault	47	0

It is probable that a thickness of strata amounting to perhaps 50 feet remains unrecorded between bands 43 and 44.

The cutting back of the projecting mass of Observatory Hill at the bottom of Bridge Valley Road has produced a fine section of the disturbed and shattered rocks just below the big overthrust, and although they are hidden in parts by strengthening masses of masonry, the disturbed strata are better seen than they were before the construction of Portway.

The removal of Clifton Bridge Station exposes the section to the south of the tunnel, but unfortunately access to it has been shut off by an unclimbable fence.

New Sections of Avonian Rocks in the Neighbourhood of Bristol.

By A. W. Coysh, B.Sc.

CONTENTS.

1. INTRODUCTION.

THIS communication records three new and hitherto undescribed exposures of Avonian rocks. An excellent section of K_1 beds was seen in the excavations for the foundations of Downside Residential College, near Westbury-on-Trym, and since the area between Clifton and Clevedon was mapped by Prof. S. H. Reynolds,[1] two new quarries have been opened at Abbot's Leigh and Beggar's Bush Lane.

2. DESCRIPTION OF THE EXPOSURES.

(*a*) Abbot's Leigh.

A quarry, situated about 400 yards north-east of Abbot's Leigh Church, shows the Bryozoa bed and the lower part of K_1. A trial excavation a little north of the quarry exposed the Old Red Sandstone. The succession is as follows :—

		ft.	ins.
6.	Thin bedded fossiliferous limestone with shaly partings ...	6	0
5.	Massive limestone, finely oolitic	10	0
4.	Massive coarse oolite, often false-bedded	6	0
3.	Crinoidal and oolitic limestone	0	10
2.	Bryozoa bed, red crinoidal, limestone becoming oolitic near the top	6	0
1.	Shale with nodular argillaceous limestone (Km.) (seen)	2	0

The chief interest in the section is the development of shallow water oolitic limestone *above* the Bryozoa bed. Similar beds occur *below* the Bryozoa bed at Burrington and Failand, but are not seen in the Avon Section.[2] They are also seen below the Bryozoa bed at Skrinkle Haven, Pembrokeshire.[3]

Oolites are therefore common at this horizon, though they are only developed locally, conditions being favourable for the deposition of lenticular beds in very shallow water.

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1 Proc Bristol Nat. Soc., 4 S., Vol. 4., Pt. 3. (1918).
2 S. H. Reynolds. *Q.J.G.S.* Vol. LXXVII, (1921), p. 218.
3 " Geology of the South Wales Coalfield " Pt. XIII. The Country around Pembroke and Tenby. Mem. Geol. Surv. 1921, p. 97.

(*b*) DOWNSIDE.

The following fine section of the middle and upper parts of K_1 was seen in the excavations at Downside :—

		ft.	ins.
27.	Rubbly and thin-bedded argillaceous limestone with shale partings ... ... (seen)	4	2
26.	Thin-bedded limestones, weathering yellow	4	9
25.	Compact limestone, with shale bands	3	8
24.	Crystalline fossiliferous limestone	2	3
23.	Shale	0	2
22.	Dolomitized crinoidal and bryozoal limestone with shaly bands. *P. bassus*, " *Eumetria* " sp.	5	0
21.	Shale	1	0
20.	Limestone, gritty, slightly dolomitized, with *Productus bassus*	1	2
19.	Shale	0	9
18.	Compact limestone crowded with " *Eumetria* " sp.	0	3
17.	Crinoidal limestone with shale partings	2	9
16.	Shale	0	6
15.	Fossiliferous limestone with shale partings, mainly *Chonetes* cf. *hardrensis*	3	6
14.	Massive limestone	2	0
13.	Shale	2	0
12.	Shale with limestone bands	1	6
11.	Alternate limestone and shale	9	10
10.	Limestone with *Chonetes stoddarti*	0	9
9.	Shale	1	4
8.	Limestone	0	10
7.	Shale	1	0
6.	Limestone	0	10
5.	Crystalline limestone, crinoidal, weathering red, with bryozoans, ostracods, and small gasteropods (cf. Bryozoa-bed)	0	7
4.	Limestone with thin shale partings	6	6
3.	Shale	1	0
2.	Compact limestone	1	6
1.	Green shale with thin limestone band	2	0

The strata, which dip south, are cut by several small strike faults. The succession is similar to that at St. Monica's, Westbury-on-Trym,[4] bed 5 of the above section being correlated with bed 5 in the paper quoted. Thin sections of this limestone are indistinguishable from slices of the true Bryozoa bed from Abbot's Leigh. The remains of bryozoans and crinoids are impregnated with hæmatite. This forms a good example of the danger of attempting even local correlation by means of lithological types, for although the true Bryozoa bed may be at a constant stratigraphical horizon, it is obvious that similar conditions prevailed locally for short periods during K_1 and K_2 times, for at Portishead a similar limestone occurs in the upper part of K_2.[5]

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4 S. H. Reynolds and S. Smith. *Geol. Mag.*, Vol. LXII (1925), pp. 468–69.
5 *Q.J G S*, Vol LXI (1905), p 230

Bed 18 is crowded with "*Eumetria*" sp., in an excellent state of preservation. Unfortunately no internal characters of the shell have been recognised, and it is therefore impossible to assign a definite name to this species, which appears to be identical with that found at St. Monica's.[6]

(*c*) BEGGAR'S BUSH LANE.

A quarry in C_1 occurs in a small wood on the Melville Wills Estate. It is situated behind a farm, about three-quarters of a mile south-west of the main Portishead road, 300 yards from the right of Beggar's Bush Lane. The beds seen are of oolitic and foraminiferal limestone, 34 feet thick, below which are 4 feet of partially decalcified limestone, crowded with *Chonetes papilionacea.* The rocks are slightly dolomitised in places. They are very much weathered, and have crumbled on the surface to a calcareous friable condition. A large species of *Bellerophon* occurs abundantly.

3. FAUNAL LIST.

(*a*) ABBOT'S LEIGH. K_1.

Orthotetes crenistria (Phill.) mut. K. Vau.	very common
Camarotoechia mitcheldeanensis Vaughan	do.
Cliothyris royssii (l'Eveillé)	do.
Leptaena analoga (Phill.)	do.
Spirifer tornacensis de Koninck and vars.	common
Psephodus laevissimus Agassiz[7]	one specimen
Rhabdomeson sp.	rare
Fenestella sp.	rare.
Crinoids	very common

(*b*) DOWNSIDE. K_1.

Productus (*Avonia*) *bassus* Vaughan	common in bands
Productus sp. nov. = *P.* cf. *martini* Sow., Vaughan	rare
Chonetes cf. *hardrensis* (Phill.)	common
Chonetes failandensis S. Smith	rare
Chonetes stoddarti Vaughan	common in bands
Orthotetes crenistria (Phill.) mut. K. Vau.	very common
Camarotoechia mitcheldeanensis Vaughan	do.
Cliothyris roysii (l'Eveillé)	common
Leptæna analoga (Phill.)	do.
Spirifer tornacensis de Koninck and vars.	very common
Rhipidomella michelini (l'Eveillé)	do.
"*Eumetria*" sp.	common in one band
Reticularia lineata (Martin)	rare
Syringothyris principalis North	rare
Euomphalus pentangulatus Sow.	rare
Dielasma cf. *hastata*	rare
Spirorbis...	rare
Loxonema sp.	rare
Rhabdomeson sp.	common
Fenestella sp.	rare
Ostracods	common
Crinoids	very common

6 *Ibid,* p 472.
7 Collected by Mr. H. F. Barke from Abbot's Leigh.

(*c*) BEGGAR'S BUSH LANE. C1.

Michelinia cf. *favosa* (Goldfuss)	rare
Productus (*Pustula*) *pustulosa* (Phill.)	rare
Productus (*Pustula subpustulosa* Thomas	rare
Productus sp. nov. = *P.* cf. *martini* Sow., Vaughan (small narrow form)	rare
Chonetes papilionacea (Phill.)	very common
Chonetes aff. *comoides* (Sow.)	very common
Orthotetes crenistria (Phill.) mut. C. Vau.	common
Tylothyris laminosa (McCoy) emend North. ...	rare
Euomphalus cf. *pentangulatus* Sow.	rare
Bellerophon sp. large form	common
Naticopsis sp.	rare
Murchisonia sp.	rare

4. CONCLUSION.

I wish to express my sincere thanks to Prof. S. H. Reynolds and Dr. S. Smith for their kind assistance, to Messrs. Oatley and Lawrence, the architects, for permission to examine the Downside Exposures, and to the owners of the quarries for similar facilities.

Exposures of Rhætic and Lower Lias in South Bristol.

By A. W. Coysh, B.Sc.

CONTENTS.

1. INTRODUCTION.

RECENT temporary building operations have rendered it possible to examine certain Rhætic and Liassic strata at Knowle and Bedminster Down.

The object of this paper is to record these observations, no mention being made of permanent exposures.

2. RHÆTIC ROCKS.

In 1891, E. Wilson, F.G.S., described the Rhætic Rocks of Pylle Hill (Totterdown).[1] A cutting for a road on the southern side of Knowle Hill recently exposed corresponding beds. The Upper Rhætic was not completely seen, but the strata which succeed the Keuper Marls are as follows :—[2]

		ft.	ins.	
Upper Rhætic	(*i*) Limestone, argillaceous, light coloured, closely jointed and ripple-marked	1	0	*Chlamys valoniensis* (Defrance) *Saurichthys acuminatus* Ag. *Gyrolepis alberti* Ag.
Lower Rhætic	(*h*) Shale, dark blue	0	6	*Chlamys valoniensis* (Defrance) *Pteria contorta* (Portlock) *Protocardia phillipiana* (Dunker) *Schizodus ewaldi* Born. *Acrodus minimus* Ag. *Gyrolepis alberti* Ag.
	(*g*) Limestone, compact, dark blue. Irregular and sometimes laminated, weathering green	0	5	
	(*fedcb*) Black shales with three pyritic bands	7	0	
	(*aa*) Black shales with sandy band at the base	1	4	*Gyrolepis alberti* Ag. Coprolites
Keuper	Tea Green Marls.			

1 *Q.J.G.S.* Vol. XLVII (1891), pp. 545–549.

2 The small letters correlate the horizons with those given by Wilson in the Pylle Hill Section.

The above succession is practically identical with that of Pylle Hill.[3]

Near the Knowle Tramway Terminus, a few feet of Upper Rhætic beds were exposed. They consist of Cotham Marble underlain by blue shales with ostracods. (*Darwinula* spp.) The Cotham Marble shows the typical mammillated upper surface described by B. Thompson.[4] It is immediately overlain by White Lias.

3. LIASSIC ROCKS.

(*i*) Zonal Succession.

Only Hettangian strata have been observed, the following zones and horizons having been recorded :—

Oppel's Zones.	Horizons.
ANGULATUS	ANGULATA. LIASICUS. MEGASTOMA.
PLANORBIS	JOHNSTONI. PLANORBIS. LIASSICA. TATEI.
LANGPORTENSIS.	

These will be briefly referred to below.

(*a*) LANGPORTENSIS. (White Lias.)

The section exposed at Knowle was as follows at the top :

		ft.	ins.
7.	Sun Bed	1	4
6.	Clay	0	2
5.	Fossiliferous rubbly limestone	1	0
4.	Clay	0	10
3.	Compact blue-grey limestone	0	7
2.	Clay	0	4
1.	COTHAM MARBLE		
		4	3

(*b*) TATEI.

Cream and blue argillaceous limestones, with shaly partings. The limestones in thin section show patches of clear crystalline calcite[5] resembling *Calcisphæra*.

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3 See section. *Q.J.G.S.*, Vol. XLVII (1891), facing p. 546
4 *Ibid*, Vol. L (1894), pp. 393 and 409.
5 See *Sorby. Quart. Journ. Geol. Soc.*, Vol. XXXV (1879), p. 84.

(*c*) LIASSICA.

Poorly exposed. Limestone, weathering to a brown marly surface, covered with *Ostrea liassica* Strick.

(*d*) PLANORBIS (horizon).

Blue and cream coloured limestones with clay partings, characterised by *Psiloceras planorbis* (Sow.) and *Psiloceras* cf. *plicatum* (Quenst.).

(*e*) JOHNSTONI.

This horizon has not been seen in situ, but a block from a trench at Bedminster Down with *Caloceras intermedium* (Portlock) establishes its presence.

(*f*) MEGASTOMA.

The presence of this horizon is postulated on the occurrence of fragments of *Wæhneroceras* sp., an ammonite characteristic of these beds. At one time a non-sequence between *johnstoni* and *liasicus* deposits was assumed,[6] but in 1922, Mr. J. W. Tutcher recorded the possible presence of the "*megastoma zone.*"[7]

The evidence at Bedminster Down gives further support to his view, but the deposit is probably very thin.

(*g*) LIASICUS.

A specimen of *Alsatites* aff. *liasicus* (D'Orb.) was found at Bedminster Down in rubbly limestones, thin sections of which show abundant ostracods and foraminifera, *Textularia* being common among the latter.

This horizon has recently been recorded at Radstock.[8]

(*h*) ANGULATUS (horizon).

These beds consist of thick clays overlain by blue limestones containing *Schlotheimia* cf. *angulata* (Schloth.).

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6 *Ibid*, Vol. LXXIII (1918), pp. 279–281.

7 *Proc. Bristol Nat. Soc.*, Vol. 5 (1923 for 1922), p. 276.

8 *Quart. Journ. Geol. Soc.*, Vol. LXXXI (1925), Table facing page 598.

(*ii*) Faunal Notes.

FAUNAL LIST. (excluding ammonites).	langportensis	planorbis	angulata
Astarte consobrina Chapuis and Dewalque			*
Cardinia cf. *ovalis* (Stutchbury)			*
Gervillia sp.		*	
Gresslya galathea Ag.			*
Lima gigantea (Sow.)		*	*
L. hettangiensis Terquem.			*
L. cf. *punctata* (Sow.)		*	
L. succincta (Schloth.)			*
L. valoniensis (Defrance) Dumortier	*	*	
Macrodon cf. *hettangiensis* (Terquem)	*		
Ostrea irregularis Münst.			*
O. liassica Strickland		*	
Opis sp. nov.	*		
Pecten calvus Goldfuss			*
Perna cf. *infralassica* Quenst.			*
Pholadomya glabra Ag.			*
Pleuromya tatei Richardson and Tutcher		*	
P. tatei var. *langportensis* Richardson and Tutcher	*		
Protocardia phillipiana (Dunk.)		*	
Pseudomonotis decussata (Münst.)	*	*	
Unicardium arenacea (Terquem)		*	
Volsella (*Modiola*) *hillanoides* (Chapuis and Dewalque)			*
V. lævis (Sow.)		*	
V. langportensis Richardson and Tutcher	*		
V. liasina (Terquem)			*
V. minima (Sow.)	*		
V. wickesi Rich. and Tutcher		*	
Ornithella sarthacensis (A. d'Orbigny)			*
Nautilus sp.		*	
Isocrinus angulatus (Oppel)			*
echinoid spines			*
turbinate gasterepods (small casts)	*		

4. CONCLUSIONS.

(1) The Rhætic succession on the southern side of Knowle Hill is essentially similar to that at Pylle Hill.

(2) The *liasicus* and *megastoma* horizons hitherto unrecorded from the immediate neighbourhood of Bristol have been recognized.

(3) The sequence of the Hettangian is more complete than in the Radstock area, but the White Lias is much thinner, being less than 5-ft. as compared with 18-ft. at Clandown.

I wish to express my sincere thanks to Mr. J. W. Tutcher for his help in the identification of the fossils and for much kindly advice and criticism.

THE
W B HARRIS
PRINTING
COMPANY
BRISTOL

FOURTH SERIES, VOL. VI., Part V., 1927.

PRICE FOUR SHILLINGS.

ANNUAL REPORT

AND

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

" *Rerum cognoscere causas.*"—VIRGIL.

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MCMXXVIII.

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MCMXXVIII.

TABLE OF CONTENTS.

FOURTH SERIES, VOL. VI., PART V., 1927.

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REPORT OF COUNCIL.

To December 31*st,* 1927.

DURING the year more activity and interest in Natural History has been displayed by the members, and much good work carried out in the Sections. The different Reports show that new records have again been made in the district, and amongst the Insects some are new to Britain, and even to Science.

Members, however, have not brought to the General Meetings as many Exhibits as are desirable, although objects of interest must come under their personal notice or are in their possession. Explanation and discussion about them can be carried on in advance of the Meetings, and some of the active workers are willing to make a point of being present. In order to make a success of these facilities it is hoped members will co-operate and bring some Exhibit to each Meeting.

The work of the newly formed Field Section, which lies in rambles, and out-of-door studies, has proved of considerable value to help forward the objects of the Society, as a number of fresh people have taken part in that portion of our activities, and it is hoped they will continue to enjoy the benefits obtainable and add to them, in the interest of Science, the many advantages offered by full membership.

Seventeen new members have joined this year, and only one resigned, but unfortunately four have been lost by death. Col. T. H. Yabbicom was our oldest member, who joined in 1864, two years after the foundation of the Society, and had regularly kept in touch with its activities ever since. He became at once the first Secretary of the Botanical Section, and held the office for ten years. Mr. H. A. Francis, a worker on the Hymenoptera, was formerly an active member of the Entomological Section, besides being for a time Reporting Secretary and on Council. Rev. W. Smith was a steady supporter of the Society's Meetings, and Miss Helen Drew, the distinguished Headmistress of the Colston Girls' School, used her influence on our behalf chiefly for the study of Geology.

The customary Open Night was held in March, but only a moderate number of the general public were sufficiently interested in our welfare to take this opportunity to hear Prof. F. E. Weiss, F.R.S., of Manchester University, give a scientific account of the Vegetation of the Mediterranean Region.

The Field Section carried out the arrangements for the Summer Excursion to Vallis Vale near Frome, and the support given by members caused a gratifying attendance.

The mingling of all the Sections proved so successful that it is decided to carry on the good work by holding a Dinner during the Winter session.

The *Proceedings* for 1926 were published early in the year and distributed to the British and Foreign Societies with whom we exchange. The contents fully maintained the high standard, and some excellent illustrations of bird-life were included.

Great satisfaction was expressed that three members of our Society were included when the University conferred degrees, *honoris causâ*, on a small group of local people, who had assisted in the furtherance of education. Mr. Stanley H. Badock received the degree of LL.D. in recognition of his abilities and help to raise the University to its high standard ; Mr. J. W. Tutcher, a recognized authority on Jurassic Rocks, and Mr. J. W. White, the eminent British Field botanist, received the degree of M.Sc. for their Natural History work carried on as amateurs for so many years.

Amongst other happenings of the year was a visit by the President and the Hon. Secretary to Cardiff to take part in the three days celebrations of the Diamond Jubilee of the Cardiff Naturalists' Society, with whom we have always had happy relationship. Many distinguished representatives of kindred Societies were present, and the excellent arrangements led to an enjoyable and stimulating gathering.

On our part we have extended an invitation to the South Western Naturalists' Union to hold its 1928 Annual Congress in Bristol, and we feel we can rely on members to join in giving it a cordial welcome.

IDA M. ROPER,

Hon. Secretary.

THE HON. TREASURER in Account with THE BRISTOL NATURALISTS' SOCIETY.

Dr. GENERAL ACCOUNT FOR THE YEAR 1927. *Cr.*

	£	s.	d.		£	s.	d.
To Members' Subscriptions :—				By Subscriptions to Societies :—			
Ordinary	45	10	0	Ray	1	1	0
Associate	1	10	0	S.W. Naturalists' Union	0	12	0
Under Law IV	0	5	0	Zoological Record	2	10	0
,, Entrance Fees	2	15	0	,, Cost of *Proceedings* for 1926	43	7	0
,, Subscriptions in advance	2	0	0	,, Printing, Postage and Stationery	6	9	9
,, Arrears collected	1	5	0	,, Rent and Fire Insurance	3	1	0
,, Donations to Publishing Fund	5	0	0	,, Lantern...	2	5	0
,, Field Section, Capitation Fee	4	18	0	,, Gratuities	1	0	0
,, Sale of Publications	3	6	11	,, Lecture Expenses	1	2	9
,, Interest on Deposit	1	15	1	,, Bookbinding	4	8	3
,, Balance Forward :—				,, Cash in hand :—			
General Account	65	2	6	General Account	71	19	0
Bookbinding Fund	16	12	9	Bookbinding Fund	12	4	6
	£150	0	3		£150	0	3

December 31st, 1927.

Audited and found correct.

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

LIBRARIANS' REPORT.

For the Year 1927.

WORK in the Library has been maintained with due attention to the arrangement of the volumes on the shelves to keep the subjects in the most available form. The binding of the current volumes has been carried out, but no member has made any contribution to this yearly outlay, which is so essential. Thanks, however, are given to three members who have kindly continued to present to the Library the yearly issues of certain Natural History publications to keep our series up-to-date.

Several gratifying incidents have occurred in connection with the valuable sets of books which we possess. Chief of these is shown by the gift, which we announce with much satisfaction, of the first five volumes, and the seventh, of the "Journal of Botany," dating from 1862. These early numbers are almost unobtainable, and possession of them adds one more important set of reference books to the credit of the Library, as it makes complete our series of a botanical Journal carrying influence in all parts of the World. The donation is from Mr. R. V. Sherring, F.L.S., whose connection with the Society is of long standing, and who thus maintains a life-long belief in the advantages of being able to verify facts from trustworthy volumes on one's own shelves. He has further shown his interest by presenting the scarce first twelve volumes of Curtis' "Botanical Magazine," a publication which Naturalists still hold in high esteem, its issues extending from 1792 to the present day.

Applications have come from the Musée Royal de Belgique, and from the San Diego Society, California, that our Society would favour them with a set of our *Proceedings* for inclusion in their Libraries, and would add their Institutions to our Exchange List. Council had much pleasure in agreeing to this, and in return the Museum of Belgium has forwarded to us 36 volumes of "Mémoires," which are so highly thought of amongst scientists.

Further, a set of our *Proceedings*, which contain the records of "Bristol Fungi," compiled by the late Mr. Cedric Bucknall, has been added by request to the Library of the Imperial Bureau of Mycology, London.

By direction of the Board of Education the Science Museum, South Kensington, has registered our Society upon its books, whereby members can obtain on loan from the National Library of Science volumes of monographs and current publications issued by Universities, and scientific Societies of the World. This concession is already proving of great assistance to the researches of members engaged on specialized subjects ; and in addition a set of our *Proceedings* now forms part of the National Reference Library.

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 Palæontographical Society.

In spite of the progress to make our Library of genuine use to Naturalists it must be admitted that the members as a whole do not show the interest expected, or take advantage of the opportunities provided for study and recreation.

IDA M. ROPER, *Hon. Librarian.*

T. CHARBONNIER, *Hon. Sub-Librarian.*

ENTOMOLOGICAL SECTION.

1927.

ALTHOUGH 1927 was, perhaps, the worst of a succession of bad years for field work, and, in consequence, few noteworthy captures have been recorded, there has been a gratifying revival of activity and interest in entomology.

Resignations since 1925 had reduced the membership to 16; gains and losses during the year give a net increase of 5, and the section now consists of 18 ordinary and 3 honorary members.

In May, by invitation of the President (Mr. C. Bartlett), a meeting was held at Portishead, at which 10 members attended and were hospitably entertained by Mr. and Mrs. Bartlett. Two other excursions, to Leigh Woods and Haw Wood, Henbury, coming in the holiday season were less well supported.

At the indoor meetings there has been an average attendance of 8, and nearly all members have contributed to the many interesting exhibits shown. Papers have been read by Dr. E. Barton White, F.E.S., on "The Life Histories of *Polia xanthomista* Hubn. and *P. lichenea* Hubn."—in which the development and habits of the two species were outlined and their early stages illustrated by coloured drawings, and by Mr. C. Bartlett on "Varieties of *Abraxas grossulariata* L."—epitomising the investigations made into the various colour forms of this moth, some striking varieties of which were exhibited. An interesting account was given by Mr. H. Audcent of an entomological holiday at Saclas (France), where a great quantity of material was gathered, some of which is being worked through by Mr. Audcent and other members of the section. At the December meeting a debate on "Mimicry" was opened by Mr. H. Tetley, B.Sc., when members compared their impressions gathered from observations on British insects, specimens exemplifying mimicry being exhibited. So much interest was evinced that the debate is being continued in the new year.

The section is contemplating the compilation of records of the local insect fauna, and a sub-committee has been appointed to formulate working arrangements. This valuable work is handicapped by lack of funds, and it is hoped that accessions to the membership will make it possible to undertake the recording as well as ease the financial burden of continuing, on the present small subscription, to maintain the series of the entomological periodicals in the Society's library.

From the Entomological Section of the Somerset Archælogical and Natural History Society (with whom this Section is in friendly correspondence) have been gratefully received copies of their Reports for the years 1920–26, containing the Somerset records of various orders of insects. J. V. PEARMAN,

Hon. Secretary and Treasurer.

BOTANICAL SECTION.

1927.

STATISTICS show an increase in membership by six, and financially a small credit balance. Eleven evening meetings have been held during the past year, at which nearly 300 exhibits of Plants have been shown to carry on the study of the local Flora, and to discuss their peculiarities and general life history.

Of particular interest there has been : *Lolium temulentum* var. *arvense* ; *Anthoxanthum aristatum* (new to the district) by Mr. H. J. Gibbons ; Sweet Chestnut catkins, wholly pistillate by Miss I. M. Roper ; *Paulownia imperialis* from Clifton, where it has not flowered for six years, by Mr. H. S. Thompson ; *Isatis tinctoria*, *Anthemis nobilis*, and *Centaurea scabiosa* (white form) by Mrs. E. M. Bell.

The Section has settled down to active usefulness, and the enthusiasm which urged the re-formation of the Section two years ago has been maintained, but it is wished still more members would join to avail themselves of it.

MABEL BOWEN, *Hon. Secretary and Treasurer.*

ORNITHOLOGICAL SECTION.

1927.

IT is always a pleasure to write the Annual Report, because the enthusiasm manifested from the beginning shows no sign of flagging. This is noteworthy since the abnormal wetness of the year has seriously inconvenienced the activities of the field workers. Parties of members, however, have made numerous excursions for observations on the domestic life of birds, nesting habits, etc. It is a matter for congratulation that the little band of workers, who are following a definite programme of bird-life study and photography have not allowed their labours to be interrupted by climatic hardships, and have been rewarded for their zeal by securing fresh records and gaining valuable information.

As before, during the Winter months, well attended meetings have been held at the houses of various members, for whose hospitality the Section is grateful. At these meetings numerous topics have come up and discussion has been well helped by interesting exhibits.

A fifty per cent. increase in membership augurs well for the Section's future.

The writer regrets that this is the last occasion on which he will pen these notes, but the regret at relinquishing the Secretaryship, necessitated by heavy inroads on his leisure, is lessened by the fact that he leaves it in the capable hands of Mr. H. Tetley, B.Sc., and by his complete confidence in the Section's continued progress through 1928.

COLDSTREAM TUCKETT, *Hon. Secretary and Treasurer.*

FIELD SECTION.

1927.

On January 12th, 1927, the Bristol Field Club became affiliated to the Bristol Naturalists' Society, and started to operate as a Field Section of that Society. This report therefore, covers the first year of affiliation, and shows that the new arrangements have worked smoothly. The Summer excursions were very successful and an average attendance of 36 proves the continued interest of the members. The attendance of members at the Winter meetings of the Parent Society has also been most encouraging, though it is hoped that in the future arrangements can be made so that the subjects discussed may be of even more direct value to field workers.

Four excursions were held during the Summer months. In May, Mr. H. Vicars Webb led a party through the grounds of Oldbury Court, Fishponds. By kind permission of Mr. Harry Vassall members were privileged to walk through the private portions of this estate, and many opportunities were afforded of examining the spring life of both plants and birds.

On June 18th, the Section combined with the parent Society in an excursion to Vallis Vale. Mr. H. F. Barke acted as leader, and over 60 members and friends were present.

The July excursion was led by Mr. H. Womersley through the Bourton and Cheston Combes, over Backwell Down, which proved *terra incognita* to many members. Characteristic Carboniferous Limestone fossils, a varied insect life and plants in the vicinity of Wurple Pool were collected.

In September, under the leadership of Mr. G. H. Beacham, Cadbury Camp was visited. The cross country route from Portbury *viâ* Clapton-in-Gordano gave the geologists opportunity to find several small exposures containing abundant weathered Zaphrentids.

During the Spring and early Summer Mr. H. Vicars Webb conducted six Bird-life Excursions, the district visited being Stapleton, Oldbury Court Estate, St. Anne's Wood, Flax Bourton, Abbot's Leigh and Portbury Woods. The rambles gave favourable opportunities for distinguishing the songs of migrant and resident songsters, and several nests of an interesting character were found for the parties.

Four Botanical Excursions were arranged by Mr. H. C. Sutton in April, May, July and September, the districts visited being Stapleton Glen and Frenchay, Blaise Castle Woods, Charlton Common and Leigh Woods respectively.

These excursions served a useful purpose, for under efficient leadership small groups of members were enabled to carry out detailed study, and it is hoped that a similar series will be arranged during the coming Summer.

Congratulations are due to our President, Mr. J. W. Tutcher, who has been awarded the degree of M.Sc., *honoris causâ*, by the University of Bristol. Mr. Tutcher's geological and photographic work is of international reputation and the distinction is richly deserved.

The membership of the Section now stands at 93, 6 new members having been elected during the year.

M. DORIS HILEY, *Hon. Secretary.*

GEOLOGICAL SECTION.

1927.

AMONG the activities of this Section foremost place must be given to the monthly meetings. Six have been held during the past year, and the continued interest of members is shown by an average attendance of 29.

The Exhibition Meeting was specially instructive and interesting in that it brought to light the " finds " of several of our members during their Summer holidays. Prof. S. H. Reynolds has recently gathered together a mass of information concerning breccias. Collected literature on this subject is meagre, and few members realize the existence of such a variety of types. It was the class of lecture well suited to the needs of our members. Mr. J. W. Tutcher, M.Sc., gave an account of his recently published work (in collaboration with Dr. A. E. Trueman) on the Liassic rocks of the Radstock district. It was pointed out that the peculiar character of these deposits may be explained by their close proximity to the Mendip axis, and also that the variations in thickness are due to intra-Liassic folding and penecontemporaneous erosion.

Prof. H. L. Hawkins' Paper on " Crises in Evolution " appears in another portion of these *Proceedings*. The Section hopes to continue this practice of inviting an extra-Bristolian to lecture each session. They help to keep the Section in touch with the trend of thought in other centres of geological research.

Dr. F. S. Wallis in speaking on the Old Red Sandstone of the Bristol district showed that in this area the main scenic feature in those remote times was a large delta, through which emptied the waters of a river which originated in a mountain system to the north-west, somewhere in the region now designated Anglesey.

On another occasion Dr. S. Smith explained the various structures in a coral, basing his remarks on the better known sea anemone. He also dealt with coral islands, and introduced a new note into the threadbare controversies by explaining the presence of calcareous algæ and bacteria.

Arising from the affiliation of the Bristol Field Club with the Bristol Naturalists' Society as a Field Section, a class for discussion of geological topics has been formed. This is held on the same evening as the monthly meetings, and many members have taken advantage of the informal atmosphere in this class, and the opportunity it affords for examination of specimens.

Two excursions were held during the Summer months. Wick was visited under the leadership of Dr. S. Smith, who explained the interrelationship of scenic features and solid geology ; whilst Mr A. Selley led a party to Failand for the purpose of collecting in the Bellerophon beds. Many members also attended the excursions arranged by the Field Section.

In July the University of Bristol awarded the degree of M.Sc., *honoris causâ*, to our vice-president Mr. J. W. Tutcher. Hearty congratulations to him !

During the past year the task of preparing an authors' index to all the Papers in the 60 volumes of the *Q.J.G.S.* in the Society's Library has been completed. This has involved the writing of about 3,500 cards ; a useful work, which some members have found very interesting.

We record with deep regret the death of two members : Miss H. Drew, M.A., and Mr. C. Trelease.

The Geological Magazine and Monographs of the Palæontographical Society for 1927 have as usual been presented to the Library.

The membership at the close of the year stands at 46, with a balance in hand.

F. S. WALLIS,

Hon. Secretary and Treasurer.

Account of the Annual and General Meetings.

THE 64th ANNUAL MEETING.

January 20th, 1927.

Mr. James Rafter, M.A., was elected President, and Prof. S. H. Reynolds, M.A., Sc.D., a Vice-President, with minor alterations in Council. The retiring President, Prof. O. V. Darbishire, Ph.D., F.L.S., gave his Annual Address for his third year of office, 1926, entitled "Form and Function of Plants." (See page 285).

THE 528th GENERAL MEETING.

February 3rd, 1927.

"Studies in Bird Life," by Mr. R. P. Gait.

The lecturer gave an account of the season's photographic work in the field carried out by three members of the Ornithological Section.

Reviewing the whole breeding season, he found that they had attempted some difficult subjects, which had taxed all their previous experience, but some interesting data had been collected. A considerable portion of the early spring had been devoted to the dipper, a bird of the rushing moorland and mountain streams, which was not too common in North Somerset. Almost the whole of the River Chew was surveyed in their attempts to find a nest of this interesting water bird. Finally one was discovered, but in a position which bristled with photographic difficulties; and after exposing 23 plates during six separate occasions, only one passable result was obtained.

The next subject was the red shank, a wader, which was common along the mud flats of the Bristol Channel, and even the River Avon. A nest of this species was found in what is apparently a new breeding haunt in North Somerset. The bird is exceedingly shy, and only one photograph was secured of the female as she returned to her eggs. A week later the eggs were hatched, and, as is common with most waders, the young chicks had almost immediately wandered away from the vicinity of the nest.

An interesting set of pictures were taken of a hedge sparrow feeding a young cuckoo, ending with this feathered parasite perching, fully-fledged, on the bough of a tree. This was followed by an interesting account of the nesting habit of the kestrel, whose nest, containing the downy young hawks, was found in the hole of an oak tree, about a few feet up—an unusually low position.

Curiously enough, about 10 feet above the kestrel's nesting-hole there was a thriving and noisy family of great spotted woodpeckers, but they evidently, when hatched, formed an item in the menu of the young kestrels, as the nest later contained numbers of black and white feathers.

A trip to the Scilly Isles in search of sea birds provided an excellent series of negatives of that striking wader, the oyster-catcher, of razor-bills, puffins, great black-backed gulls, shags, cormorants and rock pipits.

THE 529TH GENERAL MEETING.

March 3rd, 1927.

"The Flora of the Mediterranean," by Prof. F. E. Weiss, F.R.S.

(*Victoria University, Manchester.*)

Visits to Spain, Corsica, Italy and Greece had given an opportunity of seeing something of the vegetation of the Mediterranean flora. General agreement was obtained in what they might call the facies or general aspect of the Mediterranean flora, which was that of a vegetation determined by a winter rainfall of not too great an amount and a hot and dry summer. This was responsible for the formation of the macquis, so typical of the Mediterranean region. But even the macquis varied in its nature and richness considerably, and its constituents were somewhat different in the eastern and western portion. This was no doubt due to the greater amount of rainfall. On the Eastern or Mediterranean shores of the Iberian peninsula the climate was, of course, much drier and colder in winter, not having the benefit of the Gulf Stream, but cold winds from the Sierra Nevada and the Pyrennes. In some parts, however, as on the slopes of Mont Serrat, near Barcelona, the typical scrub-like macquis was met with.

A better example of unspoilt macquis could be seen in Corsica. There they had the lower reaches of the hills around the shore covered with rock-roses (cistus), white and pink in colour, forming handsome bushes some 3-ft. in height. On their coasts it was not uncommon to find an interesting brightly coloured parasitic plant growing, which was allied to a group of tropical parasites. Other shrubs found in the macquis were the Mastic Tree, not more than 6 feet or 8 feet in height ; the Arbutus or strawberry tree, 10 feet to 12 feet in height ; and the Tree Heath, usually only 5 feet to 6 feet in height, while in Teneriffe and Portugal it might be 20 feet to 30 feet high, forming a proper tree. Two evergreen oaks, the Cork and the Turkey Oaks were also constituents of the macquis, but were usually only small trees. The myrtle, too, might be regarded as typically a plant of this formation. Among the herbaceous plants one encountered a number of Labiates, including the lavender and rosemary, and indeed the macquis was often remarkable for the sweetness of its scent. As they went further east in the Mediterranean the climate became drier. The macquis gave way so as to consist of spiny shrubs, many of them being spiny forms of plants which in this country were spineless. The Labiates had thick and felty leaves, and many of them were scented. As they travelled east the number of plants related to those of Asia naturally increased, for in Tertiary times Greece was united to Asia Minor, and the islands of the Ægean were the tops of the mountains of that connecting land. Geological evidence showed that in Tertiary times there was even a closer correspondence between the floras of the east and west.

THE 530TH GENERAL MEETING.

April 7th, 1927.

Discussion. "What is a Species?"

The question was discussed from the botanical, geological, and zoological points of view.

Dr. McGregor Skene, for the botanical section, said the delineation of the individuality which made up the plant and animal kingdoms into groups was a necessity for any scientific treatment, and it was this which made the conception of a unit type of group or species essential. The species was the invention of Linnæus, who, however, failed to define it. The variety, also recognised by Linnæus, was a unit more susceptible of definition, for we could to-day relate it to a constant hereditary composition. The study of varieties must be the aim of the systematic and other branches of biological science. But the species retained its importance as a convenient unit, and it was possible that it, too, might have objective reality.

Dr. Stanley Smith for the geologists, thought that the idea of regarding a species as a consanguineous group of organisms in the same stage of evolution was convenient from certain points of view. The palæontologist and the worker on modern life are agreed, but the former is limited to the study of the hard parts only whilst the latter can test the essential parts and follow out experimentally the life histories. Palæontological research strongly points to the simultaneous change of a group rather than the inheritance of the acquired characters of an individual. Hence the recognition of a species was an entirely different matter to the definition of the term to cover such dissimilar organisms. The species becomes a convenient label to connote a particular form, and the differences between two species may after all be due to conditions of living. As an example, some molluscs from a stream were kept in an aquarium in hard tap water, and, in the absence of common stream weeds, were fed on lettuce. The result was that their shells became thicker than was the case with those growing in the stream. The application of the term may prove too restricted in some cases and too wide in others.

Mr. J. V. Pearman, F.E.S., considered the question from the Zoological aspect. It might be supposed that the best test of the admitted objective existence of species could be applied through physiological behaviour. In some degree this is so. The usually accepted criteria are those of sterility and fertility as between the supposed species or as affecting their offspring, sterility implying specific distinctness. Cases were mentioned showing that the results of experiments along these lines were erratic and inconclusive. On the other hand differentiation of species by morphological characters was equally unsatisfactory, but the defects of this method (often the only one available) were due largely to the arbitrary selection of only a few characters for comparison. It was suggested that if ALL the homologous observable features of organisms were compared, and discrimination of species based on positive and constant differences, the sum of the whole of the morphological details of an individual would define its specific position with a sufficiently close approximation to the actual facts of its evolutionary descent, which is the ultimate object of our systems of classification.

An interesting discussion followed, in which many members took part, but the meeting left the problem in its existing state.

THE SUMMER EXCURSION.

June 18th, 1927.

This was made to Vallis Vale, near Frome, when about 60 members took the opportunity of visiting the Eastern Mendips. The arrangements were carried out by the Field Section, and the increased attendance showed the appreciation of members for this annual form of enjoyment in close touch with Nature. The journey by motor coaches was through beautiful country by way of Vobster Valley outwards, and Limpley Stoke along the course of the wooded Avon, on the return.

Vallis Vale was entered at Great Elm under the leadership of Mr. H. F. Barke, and after tea the President welcomed the members and their friends, and thanked the organizers.

The visit to the Vale was a great success, as it is rich in all kinds of natural objects and afforded each science a treat. The geologists inspected many of the open quarries, and saw a splendid series of the unconformable junctions between the secondary rocks and the carboniferous limestone, collecting characteristic fossils in plenty. The botanists were rewarded by the sight of numerous species of plants, for which the district is well-known. The entomologists were kept busy in their studies of many kinds of life during their wanderings amid the bushy ground ; whilst the ornithologists were specially interested in their observations on bird life as they followed the stream through the valley.

THE 531st GENERAL MEETING.

October 6th, 1927.

"Form and Variation in Nature," by Mr. A. P. Higham.

Variety enters largely into Nature's scheme. In all directions cell activity followed a principle by which plant and animal forms were built up, but there was an ancillary principle under which infinite variety was assured. That variety was found in the internal constitution as well as in outward form, but so regularly that the constitution of every species and variety of species was maintained constant and distinct. It was not enough to say that the foot of a fly differed from the foot of a spider; the law of differentiation was found to a far wider extent. For instance, every variety of spider had its peculiar shape of feet, etc., and a similar remark might be passed with regard to each section of nature.

The lecture was illustrated by numerous photo-micrographic slides, prepared by himself, of transverse sections of plants, of fungi, and a series of insects' feet and other organs.

THE 532nd GENERAL MEETING.

November 10th, 1927.

Exhibits of Natural History by the Members.

Specimens of photographs, drawings, and microscopic slides showed that steady, progressive work had been done by all sections during the year. In the botanical section, Miss I. M. Roper exhibited a series of the ranunculaceæ family and photographs of spiral torsion; Dr. Macgregor Skene specimens of blanching of plants and bacteria; the University gardener, a good collection of cacti and tropical plants; Mr. F. W. Evens, mycetozoa; and Mr. T. V. T. Baxter, microscopic slides of structure of plants. Mr. A. Selley exhibited a bunch of wild flowers picked that day at Clapton-in-Gordano, and Mrs. Sandwith a basket of strawberries, fruit and flowers.

For zoology, Mr. H. Tetley, showed the skeleton of the crucifix fish from British Guiana. The geological exhibits were fossil reptiles from South Africa and Texas; rocks and photographs from Isle of Eigg, and Agassiz's great work on fossil fish, by Prof. S. H. Reynolds; and cretaceous and jurassic Trigoniæ by Mr. J. W. Tutcher. Entomology was represented by Mr. J. V. Pearman, who showed local psocids and their eggs; Mr. M. Miller, cocoons from High Alps, Switzerland; Mr. W. C. Taunton, exotic coleoptera; Mr. H. Womersley, diptera, mycetophillidæ or fungus gnats, daddy longlegs and apterygota; and Mr. R. Beck, drawings of 229 varieties of two-spot ladybirds and 36 varieties of ladybirds taken in 1927.

Coffee was served during the meeting.

THE 533RD GENERAL MEETING.

December 1st, 1927.

"Flightless Birds," by Mr. H. Tetley, B.Sc.

The flightless condition in birds may be put down to one of three causes. Firstly, the wing power atrophied owing to disuse on lands where there were no predaceous animals. This happened chiefly on oceanic islands, and the Dodo of Mauritius is an example. Secondly, the birds developed running power at the expense of their wing power, as in the ostrich. And thirdly, they became highly specialised for aquatic life, and the wings were transformed into efficient paddles, as in the penguins.

All these birds have the normal bones of a bird's wing, and there seems to be little doubt that they are derived from birds that could fly originally, but have since become specialised. At the present day they are practically confined to the Southern Hemisphere, the only exception being the ostrich, which is found in Arabia, and two other birds, which occur in islands through which the Equator passes, and the great auk which has been exterminated by man within the last 100 years, and was to be found in the North Atlantic.

The ostrich and its allies have been evolved separately on the continents where they are found. They differ so much in structure, that it does not seem possible to derive one from the other. The ostrich has gone furthest in specialisation and can be compared with the horse. In both there has been a reduction in the digits of the feet in correlation with increase in running power. Though now practically a southern form, it seems likely that the ostrich was originally a northern form, fossil remains having been found in India and Samoa.

Penguins are entirely southern forms, and include the Emperor Penguin, the largest existing example, which is remarkable for laying and incubating its egg during the Antarctic winter at temperatures below 70 deg. Fahrenheit.

Exhibits by Mr. M. Miller of the fruit of *Pyrus Japonica* from a Wotton-under-Edge garden; by Miss Roper of a Mildew *Oidium Euonymi* on the leaves of the garden Euonymus recorded in Britain in 1900, and now found in Gloucestershire for the first time.

Report of Delegate to the British Association.

THE Meeting of the British Association for 1927 was held at Leeds, and the President of the Conference of Corresponding Societies was Sir Francis G. Ogilvie, LL.D., the Chairman of the Geological Survey Board.

His address was mainly devoted to Regional Surveys, and he strongly urged local Societies to carry out a Vegetation Survey of their own districts.

This is the second year in succession that the Presidential Address has been devoted to the subject of Regional Survey, which leads to the conclusion that much importance is attached to it, to enable public Authorities in due time to make use of the accumulated knowledge of all parts of the country. Sir Francis advocated that every active member of a Society undertaking field work should provide himself with a map of the 6-inch Ordnance Survey, and mark upon it his own observations on the vegetation.

He also wished that an intelligent knowledge of local Maps, to be displayed on the walls, should be taught in elementary schools, for the scholars to understand better about hills, valleys and streams.

After the Address the Protection of Wild Flowers was discussed, and the chief outcome was a unanimous decision that Lists of rare plants ought not to be circulated, and the presence of such in each county should not be publicly mentioned.

Local Authorities moreover could help to protect the growth of common flowers in woodlands by exhibiting freely the Bye-laws and enforcing them in special instances. This would educate public opinion and prevent the gathering of roots.

At the second meeting Mr. T. Sheppard, of Hull, described the advantages of Nature Reserves for the protection of bird life, and described the three chief ones maintained in Yorkshire under private control. Although the National Trust has fortunately taken over the ownership of many Reserves, these are now becoming so scattered that difficulties of maintenance may arise. It was advocated that each County should form a local Trust for the ownership of any local spot that needed protection.

IDA M. ROPER.

September, 1927.

PRESIDENTIAL ADDRESS, 1927.

" Totemism "

By James Rafter, M.A.

SOME apology is due from me for offering this subject to a Society founded for the study of Natural History. In place of the usual scientific disquisition I venture to give, in extract form, the result of much sifting of the numerous books mentioned in the list appended hereto.

There are four words which I shall be using this evening, the first of course being totemism, and the others : totem, exogamy and fetishism. I give a definition of each one : Totemism is defined as " the use of totems, with all the social and religious observances connected with them." A totem is a class of material objects which a savage regards with superstitious respect, believing that there exists between him and every member of the class an intimate and altogether special relation. The name is derived from an Ojibway word " totam." It was first introduced into English literature in the nineteenth century.

Exogamy is the custom which prohibits a man from marrying a woman of his own tribe. It is a product of savagery, but it has few or no superstitions. There is a great difference between totemism and exogamy, for whereas the former has vanished from civilized races without leaving many traces amongst their descendants, the latter has bequeathed to civilization the momentous legacy of the prohibited degrees of marriage. Totemism probably existed before exogamy became established.

Fetishism, on which by the way I do not propose to enlarge, is a word applied to any object, large or small, natural or artificial, regarded as possessing consciousness, volition and supernatural qualities, and especially magic power. The fetish is, in short, a mascot—a luck bringer.

The totem is inherited, and it may not be changed at will. A fetish, on the other hand, is acquired by personal choice, by purchase or by inheritance, and it can be sold or discarded at will of the possessor in most cases.

It must be borne in mind that savage man is unable to distinguish between the animate and inanimate, and imagines every surrounding object to be, like himself, instinct with life. Trees, the wind, the river (which he calls the " long person ") all possess life and consciousness in his eyes. Light and darkness, heat and cold, were regarded as active and alert agencies. The sky was the All-Father, from whose co-operation with Mother-Earth all living things had sprung. This condition of belief is known as Animism.

If inanimate objects and natural phenomena were thus endowed it is readily understood that the creatures of the animal world were placed upon a still higher level. The savage observed that the denizens of the forest and prairie possessed greater cunning in forest craft than himself; that their hunting instinct was much more sure; that they seldom suffered from lack of provisions, and that they were more swift of foot. They were, in fact, his superiors in those faculties which he most coveted and admired. Various human attributes and characteristics became personified, and even exaggerated in some of his neighbours of wood and plain. The fox was proverbial for craft, the wild cat for stealth, the bear for a wrong-headed stupidity, the owl for a cryptic wisdom, the deer for swiftness. So deeply was he influenced by this seeming superiority that if he coveted a certain quality, he would place himself under the protection of the animal or bird which symbolized it.

Again, if a tribe or clan possessed any special characteristic such as fierceness or cunning, it was usually called by its neighbours after the bird or beast which symbolized its character. A tribe would learn its nickname from captives taken in war; or it might even bestow such an appellation upon itself. After the lapse of a few generations the members of a tribe would regard the animal whose qualities they were supposed to possess as their direct ancestor, and would consider that all the members of his species were their blood-relations.

This belief is known as totemism, and its adoption was the means of laying the foundation of a wide-spread system of tribal rule and custom, by which marriage and many of the affairs of life were, and are wholly governed. Probably all races have passed through this stage at some early period in their history, and its remains are to be found deeply embedded in our present social system. For example, some of the ornaments worn by English people at the present time are believed to bring good luck and protection from harm. The saying goes "Scratch a Russian and you find a Tartar." Applying that saying to ourselves we might say "Scratch an English man or woman and you find a substratum of superstition," which is really a survival of the days when we were barbarians.

The civilized person who attaches that very ancient charm, the Swastika, or any other charm for the matter of that, to his watch-chain, or her bangle, is unconsciously following in the footsteps of many pagan ancestors, but with this difference—that the idea of "luck" residing in the trinket is weak in the civilized mind, whereas in the savage belief the "luck" resident in the fetish is a powerful and living thing, an intelligence which must be placated with prayer, feast and sacrifice.

It is strange that black cats are supposed to bring good luck. Yet in the days of witchcraft, and not a great many years ago either, such animals were invariably associated with women who were done to death, because they had the misfortune to possess an evil reputation. Now-a-days black cat figures in abundance are exposed for sale in our best emporiums.

A mental peculiarity of the savage mind should be considered. Like civilized man the savage is curious. The first faint impulses of the scientific spirit are at work in his brain; he is anxious to give himself an account of the world in which he finds himself. He draws no hard and fast line between himself, and the things in the world. He regards himself, as I have before mentioned, as literally akin to animals and plants and heavenly bodies; he attributes sex and procreative powers even to stones and rocks, and he assigns human speech and human feelings to sun and moon and stars and wind no less than to beasts, birds and fishes. This is admirably borne out in that delightful book "Uncle Remus," wherein animals talk to each other, joke, scheme, and play tricks upon one another just like human beings.

There is much difference of opinion as to the origin of totemism. The myths of savages about its origin are of no historical value. These myths vary as much as the civilized makers of modern hypotheses. Some claim descent from the totem object; others believe that an original race of animals peopled the world; animals human in character, but bestial (a belief, by the way, not so far removed from the modern theory that we are all descended from apes). These animals became men, while retaining *rapport* with their original species; or, their spirits are continually re-incarnated in women, and are born again. Some Australian tribes believe that the All-Father, whom they call "Baiame," gave totems and totemic laws to man.

The view of Dr. Frazer, the author of "The Golden Bough" is that each totem group was charged with the superintendence of some department of Nature, from which it took its name. The control was by magical means to procure for the members of the community, on the one hand, a plentiful supply of all the commodities of which they stood in need; and on the other hand, an immunity from all the perils and dangers to which man is exposed in his struggle with Nature.

Australia, with North America, provides the examples of those institutions which seem to be "nearest to the beginning." In Australia the aborigines are the least sophiscated among peoples. The North American tribes on the other hand have been much contaminated by our civilization, hence the lesser value of their records.

There is infinite variety in the ways in which clans or tribes sprang from the animal or vegetable world. The accounts are fascinating, and one might occupy a whole evening in dealing with that aspect of the subject alone. It follows that the object selected as a totem has some relation to surroundings ; for example, a pearl oyster, or a dugong totemic group would not be found in Central Australia ; similarly neither is there, say, a porcupine grass group on the shores of the Gulf of Carpentaria. In accordance with the distribution of animals or plants we find a corresponding distribution of totemic groups. Groups thus formed gave each other soubriquets, such as Emu, Frog, Ant, Snake, Grub, and so forth.

As I have said before, the members of a clan or group call themselves by the name of the totem, and commonly believe themselves to be actually descended from it. The following examples will explain how this comes about : The Turtle clan of the Iroquois tribe in North America say they are descended from a fat turtle, which, burdened by the weight of its shell in walking, contrived by great exertions to throw it off, and thereafter gradually developed into a man. Thus at some period or the other the totem has changed into human form through the medium of the Great Spirit. The Californian Indians say they are descended from Coyotes. The loss of their tails, which they still deplore, was produced by the habit of sitting upright. The Bear clan of the Ottawa tribe ascribed its origin to a bear's paw, without explaining the precise nature of the relationship. However, this may be, the Bear clan of the Ojibwas was held to resemble the bear, its totem, in disposition. The members were surly and pugnacious, and the war-pipe, and the war-club were committed to their custody. The Crane clan were so called as they were thought to possess naturally a loud ringing voice, and they were the acknowledged orators of the tribe. In China, among the Lolos of Szechwan, their surnames always signify the names of a tree or animal or both, and these are considered the ancestors of the family bearing the name. Coming nearer home it is said that in Connemara and the islands off the west coast of Ireland there are persons who claim that they have seals' blood in them, and that is why they are such good swimmers. This undoubtedly dates back to the days when totemism flourished. The same may be said of the Scottish Isles.

Turning to the religious aspect of the question, few generations would elapse before the sense of ancestral devotion to the totem would become so strong as to be exalted into a fully developed system of worship of it as a deity. That the totem developes into the god is proved by the animal likeness, and attributes of many deities in lands widely separate. It accounts for the jackal and ibis-headed gods of Egypt, the bull-like deities of Assyria, the bestial gods of India, and so on.

Some consider totemism as a religious institution. It is also a material and moral force, and is bound up with the organization of Society. It is the earliest form of religion, and of society everywhere. Egyptian mythology is probably the oldest of all those known to us. Its gods are mainly personifications of such natural forces as the sun, the rain, the wind, as affect the welfare of the crops, and they were held in extreme awe, and their anger greatly dreaded. The gods of the Egyptians were remote and awe-inspiring, and had lost most of their human characteristics. Many of them are represented as having the forms of animals and birds, *e.g.* lioness, cow, jackal and ibis. There is no doubt in my mind that this is a relic of the totemism which existed in the early stages of that nation's development.

Although regarded with reverence and looked to for help the totem is never, where totemism is not decadent, prayed to as a god, or as a person with powers which we call supernatural. The supreme or superior being of low savage religion or mythology is never a totem. He may be able, like Zeus in Greek mythology, to assume any shape he pleases. In the myths of some Australian tribes he ordained the institution of totemism.

The North American Indian regards his totem as a mixture of man and beast and god. In Samoa the so-called totem is the vehicle of a god ; in Australia no such idea is found. Not worshipping ancestral spirits, an Australian will not, like an ancestor-worshipping African, explain his totem as an ancestral spirit.

The " religious " status of the totem is lowest among people where its influence on social regulations is greatest, and *vice versâ*. The breaking of a totemic law or custom was regarded as a serious crime. These laws were observed with a rigour beside which the rules of the religions of civilized peoples appear lax and indulgent. The individual, as a rule by no means invariable, may not kill or eat the name-giving object of his kin, except under dire necessity.

There are customs of burying and lamenting dead animals which are regarded with reverence by this or that " family " or " clan." One clan amongst the Samoans was said to offer " first-fruits " to its sacred animal, the eel ; while the clan that revered the pigeon kept and fed a tame one. But in Samoa, though the sacred animals of clans or families are in all probability survivals of totemism, they are not regarded by the people as the vehicle of class or family gods, and therefore receive honours not paid to the hereditary totems of Australia which have nothing god-like. At one time the lobster was generally considered sacred by the Greeks, and not eaten. If the people of Seriphos, an island in the Ægean Sea, caught a lobster in their nets, they put it back into the sea ; if they found a dead one they buried it and mourned over it as one of themselves. The solemn burial of a sardine by a riverside is a ceremony observed in Spain on Ash Wednesday.

A point to note in savage opinion is the belief in magic and sorcery. The world and all the things in it being vaguely conceived of as sensible and rational, obey the commands of certain members of the tribe, chiefs, jugglers, conjurors, and what you will. Rocks open at their order, rivers dry up, animals are their servants, and hold converse with them. These magicians cause or heal diseases and can command even the weather, bringing rain or thunder or sunshine at their will. There are few supernatural attributes of Zeus or of Apollo that are not freely assigned to the tribal conjuror.

Among minor savage beliefs is the common faith in friendly or protecting animals, and also the notion that "natural deaths," as we call them, are always unnatural, that death is always caused by some hostile spirit or conjuror.

The savage has very strong ideas about the persistent existence of the souls of the dead. They retain much of their old nature, but are often more malignant after death than they had been during life.

By virtue of the close connection between man and the animals, the souls of the dead are not rarely supposed to migrate into the bodies of beasts, or to revert to the condition of that species of creatures with which each tribe supposes itself to be related by ties of kinship or friendship, with the usual inconsistency of mythical belief, the souls of the dead are spoken of, at other times, as if they inhabited a spiritual world, sometimes a paradise of flowers, sometimes a gloomy place which mortal man may visit, but whence no one can escape who has tasted of the food of the ghosts.

There are also various rites connecting the dead man with his totem at his funeral. Men may identify themselves with their totem, or mark themselves as of this or that totem, by wearing the hide or plumage of the bird or beast, or by putting on a mask resembling its face. This explains the meaning of what we are apt to regard as fearsome-looking masks and head-dresses when the natives are engaged in their tribal dances. It is merely a fanciful choice, as some of us imagine, but one strictly regulated by the totem.

The degree of "religious" regard for the revered object increases in proportion as it is taken to contain the spirit of an ancestor, or to be the embodiment of a god ; ideas not found among the most backward savages. It is only when such a system as totemism, with its intricate taboos and stringent laws bearing on the various relationships of life, comes to be adopted that a "moral" order arises. Speaking for myself I am inclined to the social aspect of totemism combined with the desire to ensure a good supply of food and water.

As the totem is an ancestor, so all ancestors are looked upon with reverence, and deference to living progenitors becomes a virtue. In such way a code of morality is slowly but certainly produced.

As regards marriage—Darwin supposed that man was at first a jealous brute who expelled his sons from the neighbourhood of his women, thus securing internal peace of his fire-circle—there were no domestic love feuds. The sons therefore of necessity sought wives elsewhere and so were exogamous. As man became more human, a son was permitted to abide among his kin, but he had to capture a mate from another tribe.

In the savage world it is an all but universal rule that people of the same hereditary totem may not intermarry, even if the lovers belong to tribes, however remote or separated by the breadth of the continent.

The rule of non-intermarriage within the totem was in some myths, of divine institution ; in others it was invented by the primitive wandering totemic beings ; or was laid down by the wisdom of mere men who saw some unknown evil in consanguineous unions.

To eat the totem is sometimes thought to be automatically punished by sickness or death, but this danger does not attach to marriage within the totem. Such transgressors would be punished by the men of the clan. The rule that marriage must be outside of the group name was strong in Australia. Frog may not marry frog, or Emu emu. The usual savage superstition which places all folk in mystic rapport with the object from which their names are derived gradually gave a degree of sanctity to Frog, Emu and the rest. And so they became what are called Totems.

With regard to the child: the Arunta tribe of Central Australia held the belief that children are incarnations of pre-existing animal or vegetable spirits. Many native beliefs regarding the birth of children are exceedingly strange and quaint, so much so that the discussion of such is naturally more fitting for a medical debating Society.

As a rule the child takes the class and totem names of its mother. One thing has struck me in preparing this paper, that when inheritance is through the mother, otherwise matrilineal descent, instead of through the father, totemism appears to persist; but if there is a change to paternal lineage, the tendency is for totemism to decay.

The mention of "decay" brings me to my next point—No race is known which is in the act of becoming totemic, as in all peoples which can be studied totemism is an old institution, and in most is manifestly decaying or being transmuted. Over a large area of the globe, embracing Europe, the greater part of Asia, South America and Polynesia, North Africa, and the extreme north of North America inhabited by the Eskimo, totemism is now unknown. But amongst many of the peoples of these regions certain beliefs and practises have been reported, which seem to bear traces of a former prevalence. Totemism, wherever it exists, has a tendency to disappear under missionary influence.

In India the decadence of totemism has been caused chiefly by the spread of Hinduism, and with it the extension of the caste system. It is now found only among the non-Aryan tribes, and chiefly among the Dravidians, there being about 70 animal, vegetable and mineral totems.

The connection between a man and his totem is mutually beneficent, the totem protects the man, and the man shows his respect for it in various ways, by not killing it if it be an animal, and not cutting or gathering it if it be a plant.

Some clans avoid looking at their totem, and others are careful not to speak of it by its proper name, but use descriptive epithets instead, *e.g.*, the Delaware Indians have three totems: the wolf, turtle and turkey—they were referred to respectively as "round-foot," "crawler" and "not chewing," the last referring to the turkey's habit of swallowing its food. These clans call themselves by these descriptive names; so I have no doubt that the Black Feet Indians obtained their name in similar fashion—possibly from the paws of the black bear.

In this connection I should add that parts of animals were taken as totems. This is clearly to be seen in the case of Egypt, the origin and early development of which is obscure. Each district in that country had its own peculiar object of adoration in some animal. But no matter what changes took place in the country's long history, the same attitude towards these animals prevailed to the end. One district venerated the ibis, one the crocodile, one the cat, one the ram, one the gnat, and so on.

When the objects of adoration took human form they were identified with various animals, and were represented on the monuments with the heads of the appropriate animals. The animals remained sacred, as their numerous mummies attest. At Bubastis the cat was venerated, and the goddess Bast had her seat.

That our British ancestors possessed a totemic system is undoubted. The clan Chattan of the Highlands are "the sons of the cat." One battalion of an Irish tribe was cat-headed, or rather, wore the totem crest of a cat. The swine gods and other animal deities possessed by the British Celts assist this theory, as do the remains of many folk-customs in England and Scotland.

Now a word or two as regards Heraldry. Heraldry is but so many family symbols which have come down to us from the distant days when our forefathers painted them upon their shields, or wore them upon their helmets as the badge of their tribe, and thus of its supposed beast progenitor or protector. The animals, birds and fishes which so plentifully besprinkle our modern coats of arms were not originally chosen haphazard, but because of all they meant to the wearers. To this day some of the North American Indians display their carved totems on poles outside their dwellings or on graves.

The more or less permanent settlement of the tribes along the North American coast has led to the division of the population into ranks or castes, and to a continually higher value being set on the crests or badges as marks of rank and wealth, and as symbols of descent from a distinguished ancestor. The same remark applies to us, for no one would think of looking for coats of arms among the slum population of our cities. Heraldry, therefore, may be regarded as a legacy of totemism.

A few remarks as to totemic customs. Among the Menemini, a member of the Bear clan, who, when hunting, met a bear would apologise, and ask forgiveness before killing it. The Abenaki tribe painted their totems on their arms, breasts and legs. The Sauks or Musquakies held dances in honour of their totem. The Wolf gens will pray to the wolves "We are your relations, pray don't hurt us." But notwithstanding this fact they will hunt wolves without hesitation. In Australia a man who was lax as to his totem was not thought well of, and was never allowed to take any important part in the ceremonies. Some Australian tribes would not harm his totem if he could avoid it, but at a pinch he would eat it in default of other food. In order to injure another person he would, however, kill that person's totem.

In Ashanti the totem animal is revered. It is addressed as "grandfather," a title of respect used in addressing the kings of that country. Among the Bechuanas the chief is always addressed by the name of the totem, as "O Crocodile," "O Lion." His totem is held sacred and the animal, plant or other object is regarded with fear and reverence. I should add, however, that totemism is decadent among the Bechuanas. The Bataung tribe has the lion for its totem, and they carefully abstain from touching its flesh, for, say they, "how could one think of eating his ancestor ?" The chief of the tribe may not even wear a lion's skin by way of royal mantle.

Men of a clan whose totem is any kind of tree may not go under the shade of the tree. They may not use its produce in any shape unless it is an indispensable article of diet or household use. The Salt clan abstain from taking raw salt, but will use it in flavouring their food or drink.

It is surprising to what lengths some clans will go in totemic matters, *e.g.* the members of the Tiger clan may not marry in the month of Magh (December-January), because the name of Magh rhymes with Bagh, the Hindi word for Tiger. This is said to be due to timidity of superstition. Speaking of India, totemism is now in decay. An unintentional breach of a tabu is no longer believed to entail any serious consequences, though looked upon with social disapproval.

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Photograph by] REED WARBLER AT NEST. [*R. P. Gait*

Crises in Evolution.

(*Summary of Paper read to the Geological Section, October 20th*, 1927)

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BY Crises in Evolution I do not refer to such events as the publication of the "Origin of Species," or the trial of a schoolmaster in Tennessee. I wish rather to consider the way in which Evolution works, and to enquire as to whether its course is absolutely even, or whether (under some stimulus or other) there may not have been occasional spasms of especially rapid change.

Palæontologists have a unique opportunity of watching the effects of evolution. They, and they alone, can see the results as they have piled themselves up in the sequence of time. Others, the neontologists, can experiment and speculate on the mechanics of evolution, but they cannot prove that it has any real result because of lack of time. It is, however, foolish to make any distinction between neontology and palæontology. Every biologist who has studied anatomy has therein done palæontological work; for as soon as an organism is dead it is palæontological material, and no longer biological. There is no fundamental difference between an animal that died five minutes ago and one that died five million years ago; the quality of evidence available in both is essentially the same.

You must all be familiar with the outlines of the history of geological thought; that in the 16th, 17th and 18th centuries the prevalent views of Cosmogony can be summed up in the word "Catastrophic." For various reasons, mainly preconceived, it was necessary to produce the whole stratigraphical sequence in six days. This had to be achieved by frequent alternations of constructive and destructive effort. As the exponents of this view became more acquainted with the facts of Geology, the number of catastrophies steadily increased, until the theory became farcical. Naturally a "Reformation" occurred, leading to a Renaissance of Reason. The counterblast was provided by the school of the Uniformitarians, who interpreted the whole of the past in literal terms of the present. Perhaps this school had its most convincing exponent in Lyell, and reached its culmination in Darwinism. In Darwinism we get the idea of a gradual, almost infinitely slow, progress of life from one form to another under conditions precisely paralleled to-day, and this is surely the palæontological equivalent of Uniformitarian creeds.

Since otherwise sane men were Catastrophists, and otherwise reliable minds embraced Uniformity, it may be presumed that the truth lies somewhere between.

If I may be allowed a personal confession, I may say that I believe in analogy as a means of teaching, and especially as an incentive to research. Perhaps this belief results from a sort of Monotheism that assumes the laws of cause and effect to work similarly in all spheres.

Look at human history and you will find that there has been progress of sorts (sometimes it may have been " progress backwards "), and that it has been in the main gradual and uneventful —produced unconsciously by very small contributions made in each generation. At the end of a couple of centuries there is an obvious change in the quality of the people or of their government ; but it would usually be hard to find exactly when the change came. Nevertheless, every now and then, without any particular display of comets or other celestial portents, something may have happened to change the whole course of history—something which passed unnoticed at the time. Reducing this analogy to the individual scale, you know that there have been times when you did something or did not do it, in the ordinary round of events ; and yet because you did or failed to do it everything has gone differently since. Critical moments do not always seem critical at the time. As an illustration one might cite the discovery of America. There can be no doubt that that event led to developments in that quarter of the globe which have had, and must continue to have, a great influence on world-history. But America was discovered as a quite ordinary piece of land in the course of a not at all extraordinary expedition that was looking for something else. The discoverer of America, however far sighted, could not have realised what a tremendous thing he had done—it is only now that we can begin to appraise it. It is something of that sort that I mean when I speak of Crises in Evolution.

When we study the existing fauna and flora, we find some creatures possessing structures that are miracles of perfection in their adaptation to particular uses. Further, in many such cases, it is difficult to imagine that such structures would be of any use whatever unless they were practically perfect. Some of the Sea-Urchins have a marvellous biting-apparatus built of forty separate ossicles and worked by a very great number of beautifully balanced muscles. " Aristotle's lantern " is certainly meant for a biting organ (whatever additional functions it may serve), and those Sea-Urchins that have it can put it to very effective use

Some of the earliest Echinoids known (those from the Silurian), which were in many respects but a foreshadowing of what the Sea-Urchins were to become, had absolutely perfect "Lanterns." On the other hand, we know that the various Sea-Urchins that have no "Lanterns" have lost them by slow degrees. We can trace the gradual deterioration of the apparatus in Ontogeny and Palæontology.

It is, therefore, unnecessary to imagine the slow degeneration of a structure that has lost its value,—we can watch it happen. But it is difficult to form a clear idea of the opposite process. Once a structure exists it can slowly decay ; but can it start its existence as a promise (just as it closes it as a memory), and, with uncanny foresight, develop through a long series of ineffective stages until at last it becomes workable ? Let us look for some analogy (not too remote) to give an answer.

At certain stages in geological history very great readjustments seem to have occurred in the population of the world. These stages often appear to coincide with paroxysms of orogenic movement ; but this association may be due to breaks in the chain of evidence quite as much as to "lurches forward" in the progress of Evolution. It is generally agreed that life, however originated, began in water. If life first appeared in the sea, there must of necessity have been a considerable period when the rivers, lakes and land were barren of life (whether or not they were fit to support it). We know very little about the land in Lower Palæozoic times ; but at the beginning of the Upper Palæozoic we find a fair amount of evidence. There were, by then, animals and plants living in fresh water ; and (to take a case) the fishes of the Old Red Sandstone give some indication of being new-comers. In the rivers and lakes of the Devonian period these fishes had scarcely any dangerous competitors. They were in strange surroundings, and had ample room there. It is noteworthy how many weird forms arose, and how far from the direct line of fish-evolution they wandered.

Again, with the oncoming of the Carboniferous period there were exceptional opportunities for the spread of swamp-vegetation. Huge areas of "Dismal swamp" developed ; and it is doubtful if any flora before or since contained more extremes of specialization than were to be found in that of the Coal-Measures.

In Carboniferous times some fishes began to breathe air instead of water, and some compressed their larval stages into egg-shells, thus dispensing with the need for permanent aquatic life. We have no evidence of strictly land-animals before the Permian ; but the terrestrial Reptilian fauna of the Permian and Trias is a stock source of inspiration for humorous artists. Many more orders of Reptiles were in existence then than have ever lived together since ; and they showed vast diversity of form, ornament and habit. In the relatively short space of a single period they dominated the world ; they held sway (albeit losing more than they gained) throughout the Mesozoic era, and (for reasons that we can suspect but hardly understand) abdicated at the close of the Cretaceous.

All through the Mesozoic there lived a humble little group of insectivorous Marsupials rarely surpassing a rat in size. These creatures probably appeared in Triassic times, but they gave no challenge to the Reptiles ; they " lay low and said nuffin." But the terrestrial reptiles collapsed during the Cretaceous submergence ; and when the land rose again to form the Cainozoic continents it supported hardly any large animals. The little sheltered " rats " which, till then, had not dissipated their energies in riotous evolution, found almost limitless worlds to conquer and few foes to overcome. And in the early periods of the Cainozoic era, the Mammals produced almost as many and as grotesque types as had the Reptiles in the Permo-Trias.

" Invasion " of new territory, and concomitant extravagance of variation, happened with some degree of suddenness ; the retreat to the final collapse was slow. If it is indeed a fact that within the short space of a period the reptiles overran the world, and at the same time produced all fundamentally important types of reptilian Orders, it would seem a precisely analogous fact that the Mammals behaved in exactly the same manner when they got the chance. These are only two cases out of very many that could be cited to support the belief that absence of competition serves to encourage rapid specialization.

Some explanation of the coincidence may perhaps be found in the last chapter of Darwin's " Variation of Animals, etc." Darwin states that " variability mainly depends on changed conditions of life." Possibly it would be nearer to the facts to say that variability reveals itself most effectively under changed conditions of life. When the first definitely terrestrial vertebrates appeared they were certainly enjoying " changed conditions," and there lay before them a world covered with plants waiting to be eaten, and little competition. Any variant (not actually suicidal) that might be born would have as good a chance of survival as the most orthodox type. Until the world became thickly populated, and an internecine struggle for existence began, there was no real check on " individualism." At the present time, all sorts of " monstrosities " are born ; but in the struggle for existence, those types that do not conform to the normal, as well as those born with a fatal defect, stand a poor chance. So we find that pioneers

—such as the first land reptiles, the first land-plants, and the first mammals—have a tendency to " run amok " in variation through lack of competitive control.

Here we find our analogy with the case of the Sea-Urchins' " Lantern." If a change of habitat can cause rapid evolution in phylogeny, it seems reasonable to postulate that a change of habit will have a comparable effect in morphogeny. In the case of the Echinoids, they will have been (and still are), the only members of their phylum to masticate their food. The assumption of that habit, even if imperfectly carried out with makeshift tools, will have eased the burden of competition, and have placed the Sea-Urchins in a class apart from their companions. By analogy this would result in rapid morphogenetic evolution.

By way of summary we can propound two questions—both probably answerable in the same way. Can organisms transported into a new environment show more than the normal rate of phyletic evolution ? And can structures necessary for the performance of a vitally important function develop rapidly in morphogeny ? The answer to the former question seems certainly to be in the affirmative. Absence of competition *does* mean acceleration of evolution. And since evolution as determinable by Palæontology must always be more on a morphogenetic than a phylogenetic plane, the fact that we can see evidence which we regard as " genealogical " implies that we have looked through a morphogenetic glass. Hence the analogy that we chose to lead us towards an answer to the second question proves to be no analogy after all, but the very object of our quest !

Perhaps a final outburst of analogy will make my position clear. The course of world evolution as evidenced by stratigraphy seems to include occasional (probably periodic) spasms of upheaval followed by long eras of slow degradation—a sort of " heart-beat rhythm." Is it too speculative to suggest that the course of organic evolution, if expressed graphically, would show a similar succession of " escarpments and dip-slopes " ? Although a mixed analogy is scarcely less distressing than a mixed metaphor (being in fact the same, as are morphogeny and the palæontological view of evolution), I think that the combination of Geology, Physiology and Physiography (with all its wide implications) in this paragraph explains more fully than a bare " *ad hoc* " statement my conception of " Crises in Evolution."

The Apterygota of the South-West of England.

By H. Womersley, F.E.S.

Part IV.

DURING the period since Part III of this List was published I have concentrated my attention on the Orders Protura and Thysanura (Machilidæ). The results of these researches have been published in the Entomologist's Monthly Magazine, 1927, Vol. lxiii, pp. 140–154, 236.

Of the Protura we have in our area five species belonging to two families and four genera. Of these, three species are new to science. In the Thysanura a systematic survey of the Machilidæ along the shores of the Bristol Channel is being made, and has already brought to light a new species of the genus Petrobius from the Devon and Somerset coasts.

While a number of new localities for Collembola are to be recorded, only four species are new in our area. For the first time a few records from Lundy are available, but it is hoped in the near future to thoroughly investigate the Apterygota of the Island.

For help in these insects I am greatly indebted to Messrs J. M. Brown and R. S. Bagnall and Prof. F. Silvestri, as well as the various persons who have sent me specimens.

Order—**Protura** (Silv.).
Family—Acerentomidæ (Berlese).
Sub-Family—Acerentominæ (Wom.).
Genus—Acerentomon (Silv.).

1. A. BAGNALLI (Wom.).

This is the species recorded by myself as *A. doderoi* from under old bark, Blaise Castle Woods, Bristol, February 23rd, 1924. I have taken it in the same locality since in very considerable numbers.

2. A. NEMORALE (Wom.).

Two specimens in the rotten sap-wood of an old stump, Brockley Combe, Som., April 17th, 1926.

Genus—Acerentulus (Berlese).

3. A. CONFINIS (BERLESE).

Fairly common under stones, Brockley Combe, Som., March, 1925; October, 1926; Backwell Hill, Som., 1926–27.

Sub-fam—Mergentominæ (Wom.).
Genus—Parentomon (Wom.).

FIG. I

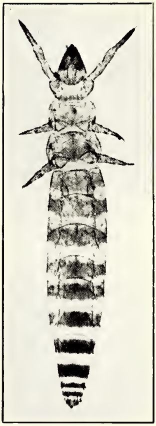


FIG. II.

Fig. I. *Acerentomon bagnalli.* Wom.
Fig. II. *Acerentulus confinis.* Berlese.

Photo by] [*G. James*

4. P. CLEVEDONENSE (WOM.).

A most interesting addition to our British list, necessitating a new genus and sub-family. Norton Wood, Clevedon, Som., September 21st, 1926. Also Backwell Hill, Som., October 16th, 1926. All under stones.

Family—Eosentomidæ (Berlese).
Genus—Eosentomon (Berlese).

5. E. RIBAGAI (BERLESE).

All the Eosentomons that I have taken in our area appear to belong to this species. My records are Backwell Hills, Som., November 27th, 1926 and December 19th, 1926 ; Brockley Combe, Som., December 26th, 1926 ; Keynsham, Som., October 30th, 1926, all under stones. It has also been taken by Mr. R. S. Bagnall at Babbacombe, S. Devon, 1918.

In addition to the above records I have also taken solitary immature specimens of the genus Acerentomon (1) under a stone, Cranham Woods, Glos., September 13th, 1926 and (2) under a stone, Brockley Combe, Som., 1926.

Order—**Thysanura** (Latr.).
Family—Machilidæ.
Genus—Petrobius (Leach) Carpenter.

2. P. CARPENTERI (BAGNALL).

This species occurs everywhere along the North Devon coast from Lynton to Clovelly, and also on Lundy Island. July 23rd to August 6th, 1927 ; Man Sands, South Devon, September, 1927 (C. Bartlett) ; Aust, Glos., September 24th, 1927.

12. P. MARITIMUS (LEACH) CARPENTER.

Specimens of this species were caught on the cliffs at the Ness, Shaldon, S. Devon, September 11th, 1927. These specimens however, show some slight variations from the diagnosis given by Carpenter. The tip of the mandible bears more prominent teeth than his description would lead one to expect. In mature specimens however there is a strong tendency, especially in the female, for them to be worn away. The spine on the 9th stylet is not as long as figured, being only about one-fourth the length of the stylet. Other details agree with his careful description. Also taken at Man Sands, September, 1927 (C. Bartlett). Specimens ♀ taken on Scilly Isles, 1927, by Mr. O. W. Richards were probably this species.

13. P. SILVESTRI (WOM.).

This new species from the North Devon coast is not so plentiful as the preceding. It is very closely related to *P. maritimus* of Leach and Carpenter, and the specimens sent me from Fistral Beach, Newquay, by Mr. C. W. Bracken, and which I recorded as *maritimus*, are really this new species. I have taken it at Clovelly, Lee Bay, Morthoe, Ilfracombe and Lynton. It also occurs locally on the Glamorganshire coast along with *P. carpenteri* at Barry Island, August 29th, 1927. I have also recently received specimens of this and the preceding species from Porlock, Som., September, 1927 (A. B. Llewellyn). Scarce, along with very large numbers of *P. carpenteri* at Brean Down, Som., and Kewstoke, Som., September 21st, 1927 ; Sand Point, Som., September 23rd, 1927 ; Man Sands, S. Devon, September, 1927 (C. Bartlett). The ♀♀ taken on Lundy Island, July, 1927, and sent by Mr. O. W. Richards are this species.

Family—Lepismatidæ.
Genus—Thermobia (Berg.).

9. T. DOMESTICA (PACK) = FURNORUM (ROVELLI).

Large numbers of this species of silver-fish (fire brats) were taken by Mr. A. Kromler at Messrs. Packer's factory, Bristol, Glos., November 23rd, 1927.

Family—Campodeidæ.
Genus—Campodea (Westwood).

5. C. LANKESTERI (SILV.).

In hot house at West Town, Som., September 6th, 1926.

6. C. LUBBOCKI (SILV.).

Lawrence Weston, Glos., May 24th, 1925 ; Feeder Road, Bristol, January 23rd, 1923 ; in garden at Mark, near Highbridge, Som., October 15th, 1927.

13. C. MEINERTI (BAGN.).

This appears to be the commonest species in North Somerset in natural soil, *i.e.*, not on rubbish tips, etc., such as are favoured by *C. lubbocki*. I have specimens from Backwell Hill, Som., February 3rd, 1924 and in 1926 ; West Town, Som., January 6th, 1926 ; Cadbury Hill, Congresbury, Som., April 21st, 1926 ; in a garden at Mark, near Highbridge, Som., October 15th, 1927.

14. C. FRAGILIS (SILV.).

One immature specimen, West Town, Som., November 6th, 1926.

Order—**Collembola** (Lubbk.).
Sub-order—Arthropleona (C.B.).
Section—Poduromorpha (C.B.).
Family—Poduridæ (C.B.).
Genus—Podura (Linn.) Tlbg.

1. P. AQUATICA (LINN.) TLBG.
Recorded from Savernake in Marlborough College Society's Report, 1923 (A.P.G.M.).

Family—Hypogastruridæ (C.B.).
Sub-Family—Hypogastrurinæ (C.B.).
Genus—Hypogastrura (Bourl.) C.B.
(Achorutes, Templ. Lubbk., Linn.).

2. H. ARMATA (NIC.).
One specimen under bark Savernake Forest, January 30th, 1926.

Sub-Family—Achorutinæ (C.B.).
Tribe—Pseudachorutini (C.B.).
Genus—Friesia (D.T.).

62. F. MIRABILIS (TLBG.).
A single specimen under lichen on Castle Rock, Lynton, August 1st, 1927. The terminal anal spine was apparently wanting.

Genus—Anurida (Laboulb.).

10. A. MARITIMA (GUER.).
On rock pools at Woolacombe, N. Devon, July 29th, 1927.

63. A. GRANARIA (NIC.).
Ilfracombe, July 24th, 1927.

Tribe—Achorutini (C.B.).
Genus—Achorutes (C.B.) Templ.

11. A. MUSCORUM (TEMPL.).
One specimen under bark Savernake Forest, January 30th, 1926. In similar habitat at Clovelly, Devon, August 3rd, 1927.

Family—Onychiurinæ (C.B.).
Genus—Onychiurus (Gerv.).

13. O. AMBULANS (LINN.) TLBG.
Goatchurch Cavern, Burrington, Som., August 15th, 1925 (Miss J. Barrington).

14. O. ARMATUS (TLBG.).
Ilfracombe, July 24th, 1927 ; Lundy Island, July 26th, 1927 ; Mark, near Highbridge, Som., October 15th, 1927.

15. O. FIMETARIUS (LUBBK.).
Goatchurch Cavern, Burrington, Som., August 15th, 1925 (Miss J. Barrington).

Genus—Tullbergia (Lubbk.) C.B.

76. T. QUADRISPINA (C.B.).
One specimen from Clovelly, August 3rd, 1927.

Section—Entomobryomorpha (C.B.).
Family—Isotomidæ (Schffr.).
Sub-Family—Isotominæ (Schaffr.).
Genus—Protanurophorus (WOM.).

78. P. PEARMANI (WOM.).
Two specimens from under lichen on fallen bough, Backwell Hill House grounds, West Town, Som., January 2nd, 1926.

Genus—Anurophorus (Tlbg.).

16. A. LARICIS (TLBG.).
Under bark of larch paling, West Town, Som., February 13th, 1926; Masbery Hill, Som., June 19th, 1926. Under lichen, Swanage, May 29th, 1926. Under bark, Stoke Bishop, Bristol, June 7th, 1926 (J.V.P.).

Genus—Isotoma s, str, (Bourl.) C.B.

17. I. VIRIDIS (BOURL.).
Under twigs, Savernake Forest, January 30th, 1926. In sphagnum, Grimspound, Dartmoor, June 5th, 1927; Lundy Island, July 26th, 1927.

19. I. MARITIMA (TLBG.).
Under shore debris, Kewstoke, Som., May 21st, 1927.

64. I. NOTABILIS (SCHFFR.).
One under bark, Savernake Forest, January 30th, 1926. Two under stones, Mark, near Highbridge, Som., October 15th 1927.

73. I. MINOR (SCHFFR.).
One in Mr. Garnett's hot house, West Town, Som., February 13th, 1926. Under twigs, stones, etc., Savernake Forest, January 30th, 1926.

Sub-Genus—Vertagopus (C.B.).

20. V. ARBOREA (LINN.) AGREN.
Common under bark, Savernake Forest, January 30th, 1926. Score Woods, Ilfracombe, July 24th, 1927.

Genus—Folsomia (Willem.).

25. F. FIMETARIA (LINN.) TLBG.
Savernake Forest, January 31st, 1926.

26. F. QUADRIOCULATA (TLBG.).
Savernake Forest, January 31st, 1926. In sphagnum, Grimspound, Dartmoor, June 5th, 1927.

Genus—Isotomurus (C.B.).

27. I. PALUSTRIS (MIAL.).
In sphagnum, Grimspound, Dartmoor, June 5th, 1926; Ilfracombe, July 24th, 1927; Mark, near Highbridge, Som., October 15th, 1927.

Family—Tomoceridæ (Schffr.).
Sub-Family—Tomocerinæ (C.B.).
Genus—Tomocerus (Nic.).

28. T. MINOR (LUBBK.).
Score Woods, Ilfracombe, July 24th, 1927; Mark, near Highbridge, Som., October 15th, 1927.

30. T. (POGONOGNATHUS) LONGICORNIS (LUBBK.).
Score Woods, Ilfracombe, July 24th, 1927.

Family—Entomobryidæ (C.B.).
Sub-Family—Entomobryinæ (C.B.).
Tribe—Entomobryini (C.B.).
Genus—Entomobrya (Rond.).

32. E. NIVALIS (LINN.).
Ilfracombe, July 24th, 1927; Mark, near Highbridge, Som., October 15th, 1927.

38. E. NICOLETI (LUBBK.).
In dead flowers of Arum, Burrington, Som., May 14th, 1927; Mark, near Highbridge, Som., October 15th, 1927.

39. E. ALBOCINCTA (TEMPL.).
Under bark, Savernake Forest, January 31st, 1926. Under lichen, Castle Rock, Lynton, August 8th, 1927.

Genus—Lepidocyrtus (Bourl.).

40. L. CYANEUS (TLBG.).
Savernake Forest, January 31st, 1926; Ilfracombe, July 24th, 1927; Mark, near Highbridge, Som., October 15th, 1927.

41. L. LANUGINOSUS (GOMEL.).
Savernake Forest, January 31st, 1926; Ilfracombe, July 24th, 1927; Mark, near Highbridge, Som., October 15th, 1927.

84. L. RIVULARIS (BOURL.).
In dead flowers of Arum, Burrington, Som., May 14th, 1927. In sphagnum, Grimspound, Dartmoor, June 5th, 1927.

85. L. PARADOXUS (UZEL.).
Specimens taken at Devonshire Road, Bristol, in 1924 are this species.

73. L. ALBUS (PACK.).
Goatchurch Cavern Burrington, Som., August 15th, 1925 (Miss J. Barrington).

Tribe—Orchesellini (C.B.).
Genus—Orchesella (Templ.).

45. O. CINCTA (LINN.) LUBBK.
Savernake Forest, January 31st, 1926; Ilfracombe, July 24th, 1927; Mark, near Highbridge, Som., October 15th, 1927.
45*a*. O. CINCTA, var. vaga.
From same localities.

47. O. FLAVESCENS (BOURL.).
Leigh Woods, Som., August 1st, 1926, along with var. pallida (Reut.).

46. O. VILLOSA (GEOF.).
Ilfracombe, July 24th, 1927; Mark, near Highbridge, Som., October 15th, 1927.

Genus—Heteromurus (Wankel.).

48. H. NITIDA (TEMPL.).
Savernake Forest, January 31st, 1926; Goatchurch Cavern, Burrington, Som., May 14th, 1927; Ilfracombe, July 24th, 1927; Mark, near Highbridge, Som., October 15th, 1927.

Sub-Family—Cyphoderinæ (C.B.).
Tribe—Cyphoderini (C.B.).
Genus—Cyphoderus (Nic.).

49. C. ALBINUS (NIC.).
Ilfracombe, July 24th, 1927.

Sub-Order—Symphypleona (C.B.).
Family—Neelidæ (Fol.).
Genus—Neelus (Fol.).

67. N. MURINUS (FOL.).
Under stone, West Town, April 2nd, 1927; Mark, near Highbridge, Som., October 15th, 1927.

Family—Sminthuridæ (Lubbk.).
Sub-Family—Sminthuridinæ (C.B.).
Tribe—Katiannini (C.B.).
Genus—Sminthurinus (C.B.).

86. S. QUADRILINEATA (TLBG.).

In hot-houses, Backwell Hill House, West Town, February 13th, 1926.

74. S. NIGER (LUBBK.).

In greenhouse, Ilfracombe, July 24th, 1927. These specimens should probably be referred to var. ochracea (Axels.).

Genus—Arrhopalites (C.B.).

77*a*. A. COECUS var. ATTENUATUS (CARP. & EVENS).

Goatchurch Cavern, Burrington, Som., August 15th, 1925 (Miss J. Barrington).

Tribe—Bourletiellini (C.B.).
Genus—Bourletiella (Banks) C.B.

52. B. BICINCTA var. REPANDA AGR. (AXEL.).

Ilfracombe, July 24th, 1927.

Tribe—Sminthurini (C.B.).
Genus—Allacma (C.B.).

54. A. FUSCA (LINN.).

Ilfracombe, July 24th, 1927 ; Lundy Island, July 26th, 1927.

Sub-Family—Dicyrtominæ (C.B.).
Genus—Dicyrtomina (C.B.).

56. D. MINUTA var. ORNATA (NIC.) LUBBK.

Savernake Forest, January 31st, 1926 ; Mark, near Highbridge, Som., October 15th, 1927.

The number of Collembola from our area is now brought up by this list to a grand total of 85 species.

Bristol Botany in 1927.

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

AMONG the schemes contrived by a thoughtful municipality for maintaining the health and happiness of its citizens —in future generations as well as in our own—the provision of open breathing spaces, available for the recreation and refreshment of all classes, has an essential value that cannot be overestimated. Sooner or later it must be recognized that a unique opportunity was seized by our city authorities when they acquired the Blaise Castle Estate, although in this case, doubtless, the investment was largely for the benefit of posterity. The city dweller of to-day, after a spell of noisy toil and ugliness, can now satisfy a yearning for quietude, peace and beauty, finding all preserved in perpetuity on a rapidly changing countryside that within a short period would be unable to furnish either. Here is an enclosure of large extent and varied scenic features that have been enthusiastically praised by many writers ; a Nature Reserve of engrossing interest to local naturalists.

Botanists know quite well that in any area the character of the soil largely determines the nature of its vegetation. And so in this tract of limestone upland none of the plants are calcifuge. All are lovers of lime. Apart from the waterside species they fall into two groups according to their need of sun or shade : rupestral, those growing in full exposure on bare rock about the Castle Hill, Lovers' Leap and Goram's Chair ; and sylvestral, those that seek shelter in greater or less degree. Of the latter a long list can be noted in the 100 acre belt of woodland that practically encircles the whole estate. On the western outskirt of these woods, where lies the Arbutus Walk, raspberries are plentiful, and among other accompanying brambles *Rubus raduloides* is the strongest and most conspicuous. These do not occur on the eastern border where the Beech Grove has its own especial charm. Not far from the mansion and a lily pool there stands a splendid Maidenhair tree (*Ginkgo biloba* or *Salisburia adiantifolia*) stated to be the largest in the kingdom. Besides the well-known Arbutus trees that grow as if they were really wild, other ornamental trees, conifers in particular, have been planted in the grounds. It is hoped they may be labelled in due time. Among native trees, ash, wych-elm, hawthorn, yew and birch are prominent. The shrubby underwood corresponds in the main with that of many limestone coppices. It seems remarkable that although the precipitous crags and cliffs that rise to 300 feet have not been defaced by quarrying, and Goram's Chair remains apparently just as the giant left it, yet they do not yield any of those peculiar species of outstanding rarity that characterize some similar rocks and gorges in the vicinity of Bristol. Even the Rock Hutchinsia, which according to old records was once plentiful on walls bounding the estate, seems to have died out. Between and below those rocks a tiny stream, the Hen, passes through a pleasant valley to join the Trym at Combe Dingle. The Snowdrops that are scattered along a portion of the slopes must have been originally introduced. They are not mentioned in Swete's *Flora Bristoliensis*. Still they have had a lengthy sojourn. There can be but a shadowy recollection of days so long past, yet these notes recall a misdeed of my youth the moral obliquity of which has never disturbed my rest. When as an utter stranger with a bent for botany I settled in Bristol in 1874 I had never seen a wild snowdrop, and was interested on hearing that they grew at Blaise Castle. Learning how the land lay from a local map I rose in the dark of a wintry morning, walked to Combe Dingle, climbed a boundary fence and rambled up the Blaise valley. With a couple of the dainty bulbs secure in my vasculum I passed out unchallenged through the lodge gates at Henbury, and so home to breakfast in great content !

The following notes refer to seasonal records throughout the district.

Capsella Bursa-pastoris Moench. (*Bursa pastoris* Weber.). Shepherd's Purse is a prolific and variable weed to be found where-ever cultivation has extended. From the earliest times, certainly for the last three centuries, its variations have been observed and discussed, and attempts made to classify its numerous forms by botanists both in this country and abroad. Thus Dillenius and Casper Bauhin recognized three segregates, a view adopted by De Candolle and Crèpin. Alexis Jordan described four species and Hobkirk six. Then F. A. Mott published his conclusion that in Britain there were nine. Until recently it has been customary to ignore these variations and to ascribe them to the influence of soils and exposure. No scientific data based on careful experiment and long-continued culture had been brought forward. Now, however, Dr. E. Almquist of Stockholm, by a painstaking study during thirty years or more, has convinced himself that very many races or varieties remain constant in cultivation for two or three generations ; and up to the present he has published descriptions of 200 constant forms derived from regions in several continents. Dealing with Capsellas collected in this country Dr. Almquist finds " 18 British species sufficiently distinguishable," and gives lists of localities where they have been gathered.[1] In the vicinity of Bristol, chiefly by the efforts of Miss Roper, six of these "species" have been detected, *viz.*: *C. batavorum*; *C. Brittonii*; *C. Druceana*; *C. gallica*; *C. bremensis* and *C. auriculata.* The most remarkable plant and apparently the commonest in Britain is *C. Druceana,* which Dr. Almquist had from me (Kingsweston Down) in 1890.

Trigonella ornithopodioides D.C. Still exists at the base of Sand Point, S.; *C. and N. Sandwith.*

Potentilla argentea L. One plant on an ancient slag-heap at Charterhouse on Mendip. Unknown elsewhere on the range; *F. Langford.*

Cratægus oxyacanthoides Thuill. Lance Coppice, Wickwar, G.; *Miss Roper.*

Cnicus arvensis Hoffm. A form with pure white flowers grows in a grassy lane near Earthcott, G.

Orobanche Picridis F. Schultz. Is now definitely added to the Bristol flora. Mr. Arthur Bennett, our veteran British botanist, informs me that Prof. G. Beck von Mannagetta, the monographer of the genus, has lately identified as this species a plant gathered by the late Mr. David Fry at Brislington, S., in 1894. *O. Picridis* has been reported from sandhills near Berrow, S., by Mr. J. E. Lousley, but with some doubt. And Mr. H. W. Pugsley has stated that he saw it at Berrow many years ago on *Crepis virens.* But in *Journ. Bot.* 1926, p. 18., Mr. Pugsley writes that although the oldest British records for this species are indisputable, more recent ones, especially for a form growing on *Crepis virens,* should probably be referred to *O. minor.* He describes the true plant as closely allied to *O. amethystea* with similar long calyx-teeth, but much paler in colour, and with more glandular corollas.

Veronica scutellata L. Sparingly by a stream near the Tan-pits, Lower Failand, S.; *H. J. Gibbons.*

Limosella aquatica L. As reported last year the original station for this uncommon species has been lost. But most fortunately it has been rediscovered by Mr. Gibbons on the margin of another pool in the same neighbourhood.

Myosotis palustris Hill. var. *strigulosa* Rchb. By the Land Yeo, near Wraxall, S.; *Miss Roper.*

Centunculus minimus L. A most welcome addition to the flora of our West Gloucestershire division. Mr. Gibbons detected a number of tiny plants growing in wet clay on Syston Common.

[1] *Acta Horti Bergiani,* 1907 and 1921.

Ajuga reptans L. A form with white flowers occurs by the stream at Edford, S.; and that with pink flowers on Beacon Hill, Mendip; *Miss Roper.* The latter form has been known for some years in Brockley Combe, S.

Rumex maritimus L. Has been more abundant at Hill, G., than at any period since it was first noticed; *E. Nelmes.*

Rynchospora alba Vahl. When reporting this sedge from the Mineries bog on Mendip Dr. Downes remarks on its rarity in North Somerset.

Anthoxanthum aristatum Boiss. (*A. Puelii* Lec. and Lam.) On waste ground by Wee Lane, Stapleton, G., with *Phalaris paradoxa.* A first record for the grass in the Bristol district.

Cystopteris fragilis Bernh. On walls of a ruined building on the Oldbury Court estate, G.; *H. J. Gibbons.*

Life History of Psocus Sexpunctatus (Linn.)

By J. V. Pearman, F.E.S.

At various times I have endeavoured to impress upon entomologically-minded members of the Society—especially those of the Field Section,—the fascination and value of investigations into the life histories of insects. Perhaps this little biography, sketched from observations on a common, but hitherto imperfectly understood, insect, may help to stimulate in some a desire to become better acquainted with insects as living creatures and not merely as specimens for the cabinet.

Psocus sexpunctatus (L) is one of the commonest, and at the same time one of the prettiest, of European psocids. It may be readily recognised by the semi-circular row of six spots in the apex of the forewing, to which it owes its name. The closely related *Psocus major* (var.) Kolbe is similarly marked, but is not nearly so common, and has been found locally only in Haw Wood, Henbury, on the *branches* of oaks, whereas *P. sexpunctatus* occurs in numbers on the *trunks* of nearly all fairly smooth-barked, green-coated trees in the district (*e.g.* horse-chestnut, lime, beech).

During August the females are busily ovipositing on the bare bark from which they have eaten off the growth of green pleurococcus, placing their smooth, oblong-oval, dark brown eggs singly, here and there, and hiding each one under a thick covering of sawdust-like bark fragments. Observations on related species led to the discovery of the curious manner in which this concealment is effected. Little pieces of bark are bitten off, thoroughly chewed, and swallowed. In some way, aided by contractions of the abdomen, the passage of the bark particles, undigested, through the alimentary tract is hastened, and very soon they are passed out at the anal end, swimming in a growing drop of a glutinous fluid which flows around the egg as it is being extruded. When the egg is placed in contact with the tree trunk, the surrounding globule begins rapidly to shrink, and since the insect keeps the tip of its abdomen for some time closely applied to the egg, the idea is thereby conveyed that surplus liquid is being drawn back into the body. Eventually the fluid contracts and hardens to form a thin membrane-like pellicle fitting closely around the egg, and having firmly glued on its outer surface a thick layer of finely divided, branny, bark flakes. As the insect drags away the end of its body, the upper side of the still plastic egg-coat is scored with two wide flat furrows.

Under their protective covering the eggs pass through the winter and on to mid-May, when hatching begins. If, at this time, an egg be opened, the mature embryo will be found lying on its back, somewhat curled up, tightly enclosed in the amnion, or embryonic cuticle, that separately encloses all its limbs and appendages, which are pressed down to the body. On the amnion, above the front of the head, lies the instrument with which the egg-shell would be cut through. This is a small, delicate looking, but hard structure having a sharp-pointed tooth at its fore end (which points towards the mouth) and at its middle part a tridentate saw, set crossways. A small area of the head immediately beneath the egg-cutter can be forced outwards, bubble-like, by pressure from the blood stream when pumped up into the head by regular abdominal contractions, and it is by the alternate filling and emptying of this blood sac that the instrument is operated. It is impossible to see through the opaque egg shell exactly what goes on, but it is probable that there is also lateral motion of the head, for a neat three sided flap is cut through shell and barky coat.

Strenuous efforts are made by the hatching psocid. The pumping contractions are continued after the exit has been pierced, and much air is swallowed during its exertions. Pushing upwards by lengthening the body, the insect slowly forces its way, upright, through the opening made. When about three parts emerged it proceeds to divest itself of the amnion by bending forward and strongly arching its back, until the thin cuticle gives to the strain and tears along the back of the thorax. Through this rent, by reversing the bending, head, antennæ, and limbs are drawn in succession, and finally the young psocid sinks down, grasps the bark with its feet, and pulls free the last part of its abdomen, leaving the amnion a crumpled mass protruding from the aperture of emergence. The insect now rests while the body settles into its proper form, the skin hardens, and the head pulsations subside ; and then wanders away in search of food.

At this stage (the first nymphal instar) it bears some resemblance to its relative the common booklouse, without, however, any trace of wings. Particularly noticeable are the long, thin, dark, antennæ, held in a stiff curve over the back, reminding one of the long horns of some of the antelopes. Each, though composed of only 2 basal and 6 flagellar segments* (of which the apical is longer than all the others together) is more than $2\frac{1}{2}$ times the body length, so that before hatching it had to lie doubled upon itself. Unlike the adult, the nymph is beset on

* The adult antennæ are made up of 2 basal and 11 flagellar segments, additional joints being added after some of the moults.

head (including the eyes), body, and outer edge of the tibiæ (shins), with erect trumpet-shaped hairs that secrete a sticky substance; grains of dirt and pleurococcus adhering to these hairs make the creature hardly distinguishable from its surroundings.

After about ten days the nymph moults its skin, repeating the manœuvres by which it shed the amnion at hatching. Grasping the bark firmly with its feet, it elongates its body, and by abdominal contractions pumps the blood stream up into the head, where again the central bubble-like swelling forms and subsides at intervals, and two other similar pulsating areas appear on the epicranium. The same strong arching of the back precedes the splitting of the skin along the mid line of the thorax, withdrawal is effected as before, and the renewed nymph rears upright with its tail held in the cleft of the old skin, occasionally jerking its legs to prevent adhesions whilst they are still moist and sticky (such accidents usually ending fatally).

Thereafter, at about ten day intervals, the moulting is repeated, and in each new instar an increase in bulk can be noticed, as well as a gradual assumption of the adult characters. Wing rudiments can be detected in the fourth instar, and the beginnings of the ocelli (three simple median eyes) usually in the fifth. When large enough to be visible to the naked eye, the nymph has a dumpy, toad-like appearance, heightened by its habit of squatting closely to the bark. In all immature stages the sticky gland hairs are borne (occurring also on the wing pads), and after each moult a fresh jacketing of dusty particles is quickly acquired.

About the middle of July the sixth and last moult occurs, and the perfect insect appears. At this sloughing, the wings when first freed from the nymphal skin are short, narrow, fleshy and wrinkled, but soon commence to lengthen, widen, and assume the lamellar form, hardening from the base outwards. As they expand the insect holds them out from the side of the body, and the forewings double upon themselves until their tips rest just below the shoulders, straightening out again gradually as hardening proceeds. By the time they are dry and firm the wings have fallen into their natural position along the sides of the body. For a period after entering the adult condition the insect is pale in colour, and its markings show only faintly. It takes several hours—sometimes a day or two—for the colours to attain their full depth, the wings being the last to darken. An earlier observer recorded a case of albinism in this species, misled by the pallor of the wings of some examples that had died in the teneral condition.

Pairing takes place early,—as soon as the females are fully mature,—and seems to occur only once in the lifetime of the individual. A preliminary "courting dance" is made by the males, the only occasion on which these rather sluggish insects display much activity. In general, the males develop faster than the females, and are already mature when the latter are entering the imaginal state. Ordinarily both sexes live placidly together, but prior to mating the male becomes highly excited. Then, holding its wings horizontally half-opened, occasionally slightly fluttering them, it runs around the female, often pirouetting in a half turn, waltzing with an appearance of foolish intentness. Should the female resent the suitor's advances, she removes from the scene, leaving the male whirling round in stupid bewilderment. When rivals meet they rush at, and jostle, one another with a mock air of ferociousness, but no real combats ensue and no injuries are inflicted.

A fortnight or so after pairing, or about a month from the last moult, the females commence to oviposit, accomplish their destiny, and perish towards the end of September, having been predeceased by the males. Throughout their whole existence the insects seldom wander far from the vicinity of the spot where they hatched, only travelling short distances to fresh pastures as their food supply becomes used up, or running further afield when danger threatens, on the latter occasions rarely, if ever, using their wings but trusting to their remarkable fleetness of foot. However, in certain states of the weather,—particularly when the air is hot, dry and still,—the mature adults will take flight and seek a fresh habitat in which to found a new colony. But when the needed stimulus is lacking, they remain in their old haunt, where, in due course, they will be succeeded by the next generation.

Diptera—An Appeal.

By H. L. Audcent.

DIPTERA, as their name implies, are insects which have only two wings ; in place of the other pair of wings there are two small clubbed appendages, called Halteres. Like all insects the adults have six legs (three pairs) and each leg consists of coxa, femur, tibia and five tarsal joints ; the last joint usually bears two claws, and may have a pad or empodium. The head, thorax and abdomen are quite separate, and may be moved independently of each other.

Diptera include the Housefly, Bluebottles, Greenbottles, Hoverflies, Daddy-long-legs, Gnats, Mosquitoes, Gadflies and Botflies. A few isolated species, that do considerable harm to man or to his domestic animals and crops, have been thoroughly studied ; *e.g.*, the Mosquito, which has enabled man to cope with several tropical diseases. The life-history of many of them is still unknown, and in many cases it would be impossible to answer correctly the query "Where do flies go in the winter-time ?" Diptera are of immense economic importance, for in their larval state they help to break down the dead animals and plants, which without their aid would encumber the earth, and in their adult state they pollinate many flowers, which, without them, would never set fruit.

Yet the study of Diptera is the Cinderella of all the branches of Entomology, and the reasons for its neglect are the same as for the heroine of the fairy tale, *viz*: that her sisters are more beautiful. Everyone is attracted by the georgeous butterflies, the gaudy beetles, the striped wasps and the magnificent dragonflies.

The sombre-hued flies are neglected, and yet among them some are very prettily clad in metallic blues and greens and raiment striped with gold. Unfortunately they are not very suitable insects to rear indoors for their larvæ, ugly white grubs, feed mainly on decaying matter or are parasitic in larger living animals, such as caterpillars, as every Lepidopterist knows to his sorrow. On the other hand they are easy to catch. No nocturnal rambles as for moths, no sifting dead leaves and moss as for beetles, no long chase with huge nets as for butterflies and dragonflies, no dread of the sting as for wasps. They frequent flowers in the brilliant sunshine and are easily caught with a small home-made net. Take a piece of stout wire, one-eighth inch diameter, and about two and a half feet long. Bend it at the centre to make a circle of about six inches diameter, and twist the ends of the wire together to form a handle. Sew round the circle a bag of muslin about one foot in depth, and your net is ready. It is well to have a spare net with you when you go hunting, in case the net catch in brambles and be torn. The smaller flies can be swept from grass and bushes with a larger net made of coarse calico, but the beginner does not need a sweeping net. For a sweeping net, which is a foot in diameter, and needs a very strong frame, it is best to buy a folding frame. The net, which is about two feet deep, is made of very coarse calico and a walking stick serves admirably for a handle. The killing bottle is just a small bottle or glass tube with a pad of blotting paper or a perforated rubber bung, soaked in chloroform, benzole, or even petrol, at the bottom. The fly is transferred from the net to the killing bottle, so there is no need to carry dozens of chip boxes. Also no need for setting boards ; just a pin through the thorax, a little on one side of the middle line, the wings pressed down horizontally, though even that is not essential, nor desirable in the case of small flies, and the legs disentangled. It is essential that the legs be spread out, and for that purpose it is often necessary to pass the pin through a piece of thin cardboard (*e.g.*, postcard) till the body rests on the card and the legs can be spread out horizontally on the card. In a few days the fly is set and can be pulled off the cardboard. The pins used are the usual entomological pins, silvered or black, and the pins must be pushed through the fly so as to leave enough pin on the underside to allow the fly to be held upside down for examination. Continental Dipterists mount all their flies on pins two inches long ; British Dipterists use shorter pins and fix the pinned small flies on bits of celluloid, card, cork, elder pith or polyporus, through which passes an ordinary long, strong pin. Only the ordinary pin is handled when examining a fly, and thus the risk of damaging the insect is minimized.

The collection is best housed in cardboard boxes lined with cork. This is much less expensive, and much more convenient than a cabinet, for it allows of the expanision of the collection at any point by the inclusion of a new box between two others. They must, of course, be kept in a dry place to avoid mould, and mites can be kept away by putting in each box a small perforated pill-box containing Paradichlorbenzene, a solid somewhat resembling Naphthalene, but much more effective. Specific labels must be written by hand, as the only printed list of British Diptera is quite out of date. We are expecting a new List shortly. Each fly must carry a label giving locality, date and name of collector ; abbreviations should not be used.

Unfortunately just because there are so few collectors of Diptera, the literature is very meagre, and the few books are very expensive. To study Diptera thoroughly you need to be a polyglot ; an Englishman has written a monograph on one family, a Frenchman on another, a German on another, a Dane on another and so on. Futhermore when two dipterists have written monographs on the same family they disagree as regards classification. The nomenclature is in the melting pot, and it is not unusual to find a fly with two or more names. The specific differences are small and need careful study with the aid of the low power of the microscope. This need not discourage a student, it adds zest to his work. "This classification is cumbersome ; I will make a better one." But a beginner need not trouble about classification ; observation is what is needed. It is no very uncommon occurrence to find different specific names for the male and female of the same fly. One cannot blame the laboratory student overmuch for doing this, because male and female often differ to a great extent. Never neglect to catch a pair when possible and keep them apart from other flies ; such pairs are invaluable. Of course, locality and date of capture should accompany every fly, but besides these, notes should be made of the environment (*e.g.*, swift-flowing stream, pond, rotten log, etc.). Having caught, set and labelled your fly send it to an expert. Dipterists all the world over are paragons of virtue ! Nothing is too much trouble ; the helping hand is willingly stretched out to every novice. The flies will be returned named and helpful hints given you. Examine these flies carefully and compare your new captures with them. Soon you will learn to distinguish families, and then genera and species. If you have access to a library of books on Natural History, you may find there books on Diptera ; if there are no such books, ask the authorities to buy some ; supply follows demand.

How many species of Diptera are there in the British Isles ? Possibly 4,000, but no one knows exactly the number. Every season brings forth new records, not to mention the continuous splitting up of species. Here is a magnificent chance for the collector, who yearns to see his name handed down to posterity ! What has been done locally in the recording of Diptera ? Very little, and yet very much, when we consider the paucity of collectors. In 1915 Mr. H. J. Charbonnier published in the *Proceedings of the Somersetshire Archæological and Natural History Society* a list of 700 species. This list was increased by 200 in an addendum published in 1922 in the same *Proceedings* by the late Col. T. Jermyn ; and this year there will be published another addendum of 200 species. In Gloucestershire the late Mr. C. J. Watkins collected some 400 species, which are now in the Bristol Museum. To these Mr. H. J. Charbonnier and the Rev. A. Thornley added a few records. The author of this article has collected all available records and including his own, the total number of species listed for Gloucestershire is 1017.

The Bristol district, as defined by Mr. J. W. White, in his admirable *Flora of Bristol*, is peculiarly rich in its dipterous fauna. We have woods, moorland and seashore, all teeming with flies. There are records of flies, new to Britain, from Painswick, Olveston, Blaise Castle Woods, Leigh Woods, Brockley Combe, Shapwick Moor and Weston-super-Mare. Yet barely one quarter of the known British flies has been recorded for the Bristol district ; many new records await collectors. If you are a lover of Nature include the life-history of some fly in your studies. If you have a desire to help forward our knowledge of Nature, and are not already working on some branch of Natural History, study the Diptera ; you will be amply repaid for your trouble. Even if you have already a special study, add Diptera as a side line ; we want more field workers. There are not twenty dipterists in the British Isles, and only three in the West of England.

May I end up on a personal note ? I started collecting Diptera for a friend in 1916 and it was several years before I took up the subject seriously. I have very little time to devote to it, just occasional week-ends and holidays, and yet I now have a collection of 1600 species. I have found it a delightful hobby, taking me out in the fresh air in summer and affording interesting occupation in winter. There is no need to go far afield, no fatigue ; an hour's stroll in the Leigh Woods on a fine day will supply material for many hours of study by the fireside on a cold winter's night.

The Avonian Succession at Clevedon —A Description of the Coast Section.

By G. E. Bush, B.Sc.

1. Introduction.
2. Detailed description of the Section.
3. Comparison with other areas.

1. INTRODUCTION.

THE foreshore and cliffs between Clevedon and Pill Bay a mile to the south, expose a continuous section of Tournaisian beds ranging from the lower part of the *Cleistopora* Zone K_1 to the base of the *Syringothyris* Zone C_1. The entire section is contained within sheet IV, N.E., of the Six Inch map of Somerset, and almost the whole of it is shown in the map forming Pl. xxxix, Fig. 3 of the paper by Prof. S. H. Reynolds and Dr. E. Greenly quoted below (4). The succession has been briefly dealt with in the works cited at the end of this introduction, but the section though one of the finest in the Bristol district has hitherto never been described in detail.

I wish to express my thanks to Prof. S. H. Reynolds and Dr. Stanley Smith for suggestive criticism, and to Mr. A. W. Coysh for specimens of fish-teeth collected from Z_2.

The cost of the publication of this paper has been defrayed by a grant from the University of Bristol Colston Society.

LITERATURE.

(1) A. Vaughan, "The Palæontological Sequence in the Carboniferous Limestone of the Bristol Area." *Q.J.G.S.*, Vol. lxi (1905), pp. 225–228.

(2) E. Greenly, "Some Geological Studies at Clevedon, Som." *Proc. Bristol Nat. Soc.*, 4th Ser., Vol. v (1921), pp. 138–139.

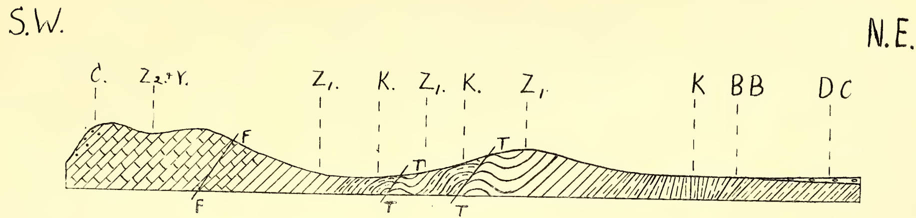
(3) S. H. Reynolds, "Geological Excursion Handbook for the Bristol District," 2nd. Ed. (1921), p. 83.

(4) S. H. Reynolds and E. Greenly, "The Geological Structure of the Clevedon-Portishead Area." *Q.J.G.S.*, Vol. lxxx (1924), pp. 460–1.

2. DESCRIPTION OF THE EXPOSURES.

With the exception of disturbances in Littleharp and Salthouse Bays there is no interruption in the regular sequence of

SECTION FROM CLEVEDON PIER TO WAIN'S HILL.



B. B. = Bryozoa Bed. K. = Cleistopora Beds. $Z._1$ & Z_2 = Zaphrentis Beds.
C. = Syringothyris Zone (Lam. Dol.). D.C. = Dolomitic Conglomerate.
F. = normal fault. T. = overthrust fault.

Horizontal Scale 12 *inches* = 1 *mile*. *Vertical Scale exaggerated.*

the beds, which as one passes S.W. from the Pier in Clevedon Bay to Pill Bay are traversed in ascending order.

Cleistopora Zone (K-beds).

These rocks are exposed throughout the foreshore of Clevedon Bay, and are brought up again by thrusts in Littleharp and Salthouse Bays. Since the storm of 1920 mentioned by Dr. Greenly (1) these beds have become gradually more and more hidden by shingle and mud.

The junction between the Km-beds and the Old Red Sandstone in the northern part of the Bay is concealed by Dolomitic Conglomerate, but as Greenly* points out, the divergence in direction of strike (20°) between the K-beds and the Old Red Sandstone suggest that the junction is a faulted one, and due to curvature of the strike.

The Triassic Beds also overlie the greater part of Km. Where exposed this consists of unfossiliferous, largely decalcified limestone and shales. The Landing slip is built over the Bryozoa Bed, which is similar in structure to that of the Avon section.

Lower Cleistopora Zone, K_1-Beds.

The lower part of K_1 is badly exposed, being very largely covered by mud and shingle, and is only visible at low tide. Towards the top of K_1 the bands of limestone thicken and become more frequent, and show a distinct curvature of strike associated with a greatly increased dip. Some bands are perpendicular, and some even appear slightly overfolded, but no repetition of beds can be traced.

The Section * is as follows :—

		ft.	ins.
1.	Red crinoidal limestones (Bryozoa bed) with platy shales	9	0
2.	Yellow argillaceous limestone in bands of 1 foot, alternating with thin shales	35	0
3.	Massive banded red and yellow limestone much veined with calcite	9	0
4.	Thinly bedded limestone...	3	0
5.	Green shales	3	0
6.	More massive crystalline limestone with shales	8	0
7.	Calcite-veined limestone with shaly partings	3	0
8.	Blue shale	2	6
9.	Pale blue-grey limestone of nodular appearance	1	6
10.	Blue shales	3	0
11.	Yellow crinoidal limestone	2	0
12.	Blue shale with platy limestone	3	0
13.	Blue shale	2	6
14.	Massive argillaceous yellow limestone	2	0
15.	Grey and green shale	0	4
16.	Deep red, very crinoidal, slightly oolitic limestone with bryozoa	2	0
17.	Thin red limestone alternating with thicker bluish-green and purple shales	16	0
18.	Grey shales and thin argillaceous limestone	40	0
	Total K_1	144	0

*Note. All sections are quoted in ascending order.

FAUNAL LIST K_1.

Spirorbis sp., ...	very common at top of Km and base of K_1.
Rhipidomella michelini (L'Eveillé)	common
Productus (*Avonia*) *bassus* Vaughan	common
Spiriferina octoplicata (J. de C. Sowerby)	rare
Leptæna analoga (Phill.)	one specimen
Cliothyris roissyi (L'Eveillé)	rare
Chonetes cf. hardrensis (Phill.)	rare
Chonetes stoddarti Vaughan	rare
Orthotetes cf. crenistria (Phill.)	rare
**Spirifer tornacensis* de Koninck	rare
‡*Cleistopora cf. geometrica* Edwards & Haime, (Vaughan)	rare (at top)

The only point worthy of note in the fauna of K_1 is the abundance of *Spirorbis* sp. in the shaly beds at the top of Km., and the base of K_1.

Upper Cleistopora Zone K_2-Beds.

The K_2 beds pass comformably into the Z-beds which form the southern arm of Clevedon Bay.

The succession is :—

		ft.	ins.
19.	Deep-red crinoidal limestone ...	1	0
20.	Grey shale ...	1	0
21.	Deep-red crinoidal limestone ...	0	3
22.	Grey shales ...	9	0
23.	Grey nodular limestone ...	0	9
24.	Crinoidal limestone weathering red ...	1	0
25.	Grey and greenish shales ...	23	0
26.	Grey crystalline limestone ...	1	6
27.	Yellow shales ...	11	0
28.	Yellow crumbly limestone ...	0	6
29.	Yellow shales ...	9	0
30.	Massive green and purple shales ...	19	0
31.	Bands of red crinoidal limestone with thin shales ...	12	0
32.	Thin red limestone alternating with shales ...	25	0
33.	More massive red and grey limestones to top of K_2 ...	56	0
	Total K_2 ...	170	0

**Spirifer clathratus*, Vaughan.
‡*Vaughania vetus* L. B. Smyth (Sci. Por. R. Dublin Soc. XVIII (1927) pp. 413–431.

FAUNAL LIST K_2.

Cleistopora geometrica Edwards and Haime ...	common
Spiriferina octoplicata (J. de C. Sowerby)	common
Rhipidomella michelini (L'Eveillé)	common
Cliothyris roissyi (L'Eveillé)	common
Camarotœchia mitcheldeanensis Vaughan	common
Orthotetes cf. crenistria (Phill.)	common
Spirifer tornacensis de Koninck	common
Productus bassus Vaughan	common
Productus cf. martini Sow., Vaughan	rare
Productus subpustulosus Thomas	rare
Euomphalus sp.	rare
Fenestella and *Rhabdomeson* sp.	rare

Lithology of the K-Beds.

Bands 9 and 23 as seen in the field suggest the algal limestones, such as are seen in the K-Beds of the Avon section. In thin section, however, the queer "patchy" character of the rock seems to be due not to any organic structure, but to a form of recrystallisation. It is a feature of the K-Beds of this section that no algal limestones have as yet been identified, thus contrasting with most sections of these beds in the Bristol district.

A further contrast is afforded by the fact that the development as a whole is more calcareous, and that the limestone bands exhibit a very unusual amount of calcite veining.

The most striking lithological feature of the upper Cleistopora beds is the recurrence of bands of red crinoidal limestone strongly resembling the Bryozoa Bed. These red crinoidal limestones often show oolitic structure in patches and sometimes are fairly rich in Bryozoa. A similar instance is cited by Vaughan in K_1 and K_2 at Portishead,[1] and by A. W. Coysh in K_1 at Downside, near Westbury-on-Trym.[2] The writer has also recorded similar oolitic and crinoidal limestones rich in Bryozoa from the Vallis Vale area near Frome.[3]

In the limestone beds near Breakwater Tank the zonal fossil *Cleistopora geometrica* seems to be more abundant than in any exposure in the district. Apart from this the K-Bed fauna is very poorly represented, the chief limestone-builders being crinoids.

Zaphrentis Zone (Z-Beds).

Sub-zone of Spirifer clathratus Z_1.

The succeeding Z-beds are exposed in the cliffs of the Green Beach. They are massive, dark crinoidal limestones packed with *Spirifer tornacensis* and *Camarotoechia mitcheldeanensis.* The fossils are generally replaced by silica and stand out clearly on

[1] *Q.J.G.S.*, Vol. LXI (1905), p. 230.
[2] *Proc. Bris. Nat. Soc.*, 4 S., Vol. VI., pt. IV (1926), p. 325.
[3] *Ibid*, pt. III (1925), p. 251.

the weathered surfaces of the cliffs. This is very strikingly displayed in the bedding planes below the Promenade Wall at the Pier end of the Green Beach. The abundance of silica is further emphasised by the occurrence of chert nodules in these beds. "Nests of calcite" are common throughout Z_1, and in addition, there is an unusual amount of calcite-veining.

Much of Z_1 is dolomitised, but the dolomitisation is incomplete giving the rocks a patchy appearance. In some instances the result of weathering on these dolomitised patches gives them the exact appearance of a close-grained sandstone. On treating with acid however, the dolomite crystals become apparent. In the headland forming the North arm of Littleharp Bay the Z-beds are thrown into a slight fold and are much buckled, and K-beds are thrust up over them at a considerable angle. These K-beds are much contorted, and the limestone bands shattered. In one of the thin limestone bands, seen in the southern part of Littleharp Bay *Cleistopora geometrica* can be identified.

The massive Z_1 limestones which apparently succeed these K-beds conformably are dark and crinoidal, and are packed with *Sp. tornacensis* and *Camarotœchia mitcheldeanensis.* They form the small headland known as Littleharp Point. Immediately to the south of the Point the Z-beds are again thrown into a slight fold by a second upthrust, which again brings in K-beds—consisting of limestone with green and purple shale. These beds are only occasionally exposed even at low tide, but it has been possible to confirm the approximate thickness of about 100 feet of the second upthrust of K-beds given by Greenly.[1]

In the poorly exposed limestones about 200 feet South of Littleharp Point *Sp. tornacensis* is again abundant in bands of dark crinoidal limestone identical with that forming Littleharp Point, and the base of Z_1. Approximately 100 feet of Z_1 can be traced at low water, and beyond that the rocks are obscured by mud and shingle.

THE SUCCESSION OF Z AND ASSOCIATED BEDS.

		ft.	ins.
36.	Massive, dark, highly crinoidal limestone with *sp. tornacensis*	9	6
37.	Massive crinoidal limestone	37	0
38.	Crinoidal limestone with chert nodules	20	3
39.	Less crinoidal jointed limestone dolomitised in patches and calcite veined...	18	6
	Break.		
	(Overthrust K-Beds, bands of limestone with green and purple shale), about...	70	0
40.	Massive dark crinoidal limestone with *Sp. tornacensis* ...	32	0
41.	Massive crinoidal limestones much veined with calcite ...	34	0
	Break.		
	(Overthrust K-Beds, bands of limestone with green and purple shale), about...	100	0
42.	Crinoidal limestones with *Sp. tornacensis*, about	100	0

[1] p. 138.

FAUNAL LIST Z_1.

Zaphrentis konincki Edwards and Haime	very rare
Spirifer tornacensis de Kon.	abundant
Camarotœchia mitcheldeanensis Vaughan	common
Leptæna analoga (Phill.)	common
Orthotetes cf. crenistria (Phill.)	common
Cliothyris roissyi (L'Eveillé)	common
Syringothyris cuspidata Sow.	rare
Productus cf. martini Sow., Vaughan	rare
Rhipidomella michelini (L'Eveillé)	rare
Productus subpustulosus Thomas	rare
Chonetes cf. hardrensis (Phill.)	rare
Reticularia lineata (Martin)	rare

SUBZONE OF SCHIZOPHORIA RESUPINATA Z_2.

The Z_2-beds first outcrop at Salthouse Point beneath a patch of Dolomitic conglomerate. The cliffs of Salthouse Point, Church Hill and Wain's Hill follow. Below Church Hill S.W. of Salthouse Point abundant bands of nodular chert occur; these may be better examined, however, in the excavated paths on the Hill itself. The chert nodules are exceptionally large, and weather white.

Immediately below the wall turret on the cliffs, the beds are traversed by a fault with a throw of about 2 feet. A large mass of fault breccia projects from the cliff containing crushed chert nodules. Just beyond this point, and nearly half way up the cliff is a bedding plane showing a very striking appearance. The rock resembles a pseudo-breccia from the weathered surface of which peculiarly shaped "nodules" stand out prominently. This structure is possibly due to pene-contemporaneous brecciation.

In Pill Bay the cliffs afford a very interesting section of the top of Z_2, γ, and a few feet of Laminosa Dolomite. In the West End quarry along the Old Church Road the top of Z_2, γ and about 10 feet of Laminosa Dolomite are again exposed. The γ-beds here and in Pill Bay are very dark, almost black, crinoidal limestones or "Petit Granit" type.

FAUNAL LIST Z_2 and γ.

Caninia cylindrica (Scouler)	common in γ only
Zaphrentis konincki E. and H.	common top Z_2 & γ
Productus subpustulosus Thomas (large var.) ...	rare
Chonetes papilionacea (Phill.)	common
Chonetes hardrensis (Phill.)	rare
Orthotetes crenistria mut. Z. Vaughan	common
Syringothyris cuspidata (Mart.)	common
Cliothyris roissyi (L'Eveillé)	common
Rhipidomella michelini (L'Eveillé)	common
Leptæna analoga (Phill.)	common
Schizophoria resupinata (Mart.)	common
Spirifer tornacensis de Kon.	common
Cyathophyllum θ Vaughan	rare in γ
Syringopora θ Vaughan	very common
Michelinia favosa (Goldf.)	very common
Psammodus rugosus Agg.	in one band only

NOTE ON FAUNA OF Z AND γ BEDS.

Corals are extremely rare in Z_1, the only examples found being two or three poorly preserved specimens of *Zaphrentis konincki*. In Z_2 and γ, however, the coral fauna rapidly becomes predominant. *Psammodus rugosus* occurs in a bed at the top of Z_2, and may be collected in West End Quarry, and in the cliffs at Pill Bay. This is approximately the same horizon as the "Fish-Beds" of upper Z_2 in the Avon section.

Syringothyris Zone C-Beds.

This zone is only represented by 10–15 feet of laminosa-dolomite exposed in West End Quarry, and in the cliffs at Pill Bay. It is a fine grey dolomite barren of fossils.

3. COMPARISON WITH OTHER SECTIONS.

Cleistopora Beds.

1. The chief interest of the Clevedon Coast section lies in the continuous exposure of the greater part of the K_1-Beds. The development is more calcareous on the whole than that of the Avon section, and calcite veining is unusually common.
2. In contrast to the Avon section no algal limestone has been identified.
3. In common with sections described at Portishead, Downside, Westbury-on-Trym and Vallis, Frome, there are recurrences throughout K_1 and K_2 of the conditions under which the Bryozoa-Bed was laid down.
4. As with the neighbouring section at Portishead the zonal fossil *Cleistopora geometrica* is common.
5. No band corresponding with the "palate-bed" of the Avon section has been identified.

Zaphrentis Beds.

1. The occurrence of chert nodules in Z_1 affords a correlation with the Z_1 of the Avon section in this respect, whilst the frequent bands of nodular chert, and the silification of the fossils of Z_2 recall strongly the development at Vallis, Frome.
2. The upper Z-Beds at Sodbury exhibit calcite veining similar to that described in the Clevedon section.
3. The dolomitisation of the Z-Beds is more patchy than in the Sodbury, or the Avon section.
4. The occurrence of fish-teeth in upper Z_2 can be correlated with the "fish-beds" of Z_2 in the Avon development.
5. The late appearance of the coral fauna in Z_2 corresponds with other local developments.
6. *Syringopora θ* associated with *Michelinia favosa* becomes abundant at the same horizon as in the Avon, Burrington and Vallis sections.

Notes on Sections of Old Red Sandstone in the Bristol District.

By F. S. Wallis, Ph.D.

In a paper read before the Geological Society of London on May 25th, 1927[1] an account is given of the petrology and palæontology of the Old Red Sandstone of the Bristol District and certain facts are elucidated regarding the source of these sediments and the geographical conditions under which they were deposited. In the above mentioned paper stratigraphical details are in the main omitted ; they are given in these present notes

For the convenience of direct comparison between these two papers the exposures are here described in the same order as in the *Q.J.G.S.* paper, and in order to make the present notes more complete, some of the facts regarding the general structure are repeated.

A.—OUTCROPS WITHIN THE RIDGE OF AVONIAN ROCKS STRETCHING FROM PENPOLE POINT *viâ* WESTBURY TO DURDHAM DOWN.

The Old Red Sandstone involved in this anticlinal fold, though in the main covered by Triassic deposits, is exposed in some interesting sections.

1. Section on Lower Railway Line (now disused) on right bank of River Avon.

The junction with the Carboniferous Limestone is bricked up, and the following is measured from the brickwork in a northwest direction.

		ft.	ins.
12.	Laminated siltstone[2]	12	0
11.	Micaceous sandstone	1	0
10.	Laminated siltstone	38	0
9.	Conglomeratic sandstone (fossiliferous)	9	0
8.	Laminated siltstone with subordinate sandstone	4	0
7.	Conglomeratic sandstone (fossiliferous)	2	0
6.	Laminated siltstone with subordinate sandstone	35	0
5.	Conglomeratic sandstone (fossiliferous)	6	0
4.	Laminated siltstone with subordinate sandstone	20	0
3.	Sandstone, generally false-bedded and slightly micaceous ...	80	0
	(After a gap of 270 yds. the section continues south-west of the Knoll.)	480	0
2.	Sandstone, hard and compact, often false-bedded with scattered augen-quartz pebbles	300	0
1.	Conglomerate with calcareous matrix (easily weathering to a gravel)	22	0
		1,009	0

[1] *Q.J.G.S.*, Vol. LXXXIII (1927), pp. 760–89 (henceforth referred to as the "*Q.J.G.S.* paper").

[2] The colour of all rocks may be taken as red or green unless otherwise stated.

2. Section on Upper or Avonmouth Railway Line on right bank of River Avon.

The junction with the Carboniferous may be seen immediately to the north of the brickwork. The section is much overgrown, and the sequence is better exposed on the lower line, although Beds 1 and 2 are more easily observed here.

3. Road-Cutting on Portway between Shirehampton and Sea Mills.

This cutting was made in the construction of Portway during 1922–24.

In descending order the beds are as follows :—

		ft.	ins.
20.	Massive sandstone with subsidiary siltstone	300	0
19.	Siltstone with subsidiary sandstone	50	0
18.	Massive micaceous sandstone with subsidiary siltstone ...	100	0
17.	Massive sandstone with subsidiary siltstone	110	0
16.	Sandstone and siltstone	26	0
15.	Massive false-bedded sandstone	42	0
14.	Thinly-bedded sandstone with bands of siltstone	80	0
13.	Massive conglomeratic sandstone	9	0
12.	Sandstone and laminated siltstone	80	0
11.	Massive sandstone	6	0
10.	Thinly-bedded sandstone with subsidiary siltstone	110	0
9.	Massive sandstone	14	0
8.	Laminated siltstone with thinly-bedded micaceous sandstone	9	0
7.	Conglomeratic sandstone	2	6
6.	Siltstone with lenticular sandstone	12	0
5.	Sandstone, false-bedded, with scattered augen-quartz pebbles	14	0
4.	Siltstone	0	6
3.	Sandstone with scattered augen-quartz pebbles	2	6
2.	Siltstone	0	6
1.	Sandstone (lenticular)	1	0
		969	0

4. Railway Section at Horseshoe Point.

This section repeats a portion of that exposed in the above-described road-cutting, and also exhibits some beds earlier in the sequence. The beds appear in an apparent syncline. Prof. S. H. Reynolds[1] has fully described the section, showing the complicated folding and faulting at both the western and eastern ends with a diagram.

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[1] "A Geological Excursion Handbook for the Bristol District." Second Edition (1921), pp. 47–9.

The descending sequence is as follows :—

		ft.	ins.
44.	Laminated deep red siltstone	6	0
43.	Thinly bedded sandstone	8	0
42.	Laminated siltstone	1	0
41.	Flaggy micaceous sandstone	6	0
40.	Massive false-bedded sandstone	8	0
39.	Thinly-bedded sandstone...	1	6
38.	Laminated siltstone	1	0
37.	Flaggy sandstone	4	6
36.	Laminated siltstone	7	0
35.	Massive false-bedded sandstone	16	0
34.	Siltstone with thinly-bedded sandstone	6	0
33.	Massive false-bedded sandstone	28	0
32.	Laminated siltstone	3	0
31.	Massive false-bedded sandstone	4	0
30.	Laminated siltstone	1	0
29.	Massive sandstone, some false-bedded	25	0
28.	Impure cornstone	2	0
27.	Thinly-bedded sandstone with subsidiary siltstone	4	0
26.	Brecciated siltstone	1	0
25.	Massive sandstone	8	0
24.	Brecciated siltstone	6	0
23.	Massive sandstone, with subsidiary siltstone	10	0
22	Laminated siltstone	4	0
21.	Massive false-bedded sandstone	10	0
20.	Impure cornstone	4	0
19.	Massive sandstone	14	0
18.	Laminated siltstone	2	6
17.	Brecciated siltstone	2	0
16.	Thinly-bedded sandstone...	2	6
15.	Massive false-bedded sandstone	1	6
14.	Laminated siltstone	4	0
13.	Brecciated siltstone	8	6
12.	Massive false-bedded sandstone, with subsidiary siltstone	12	0
11.	Siltstone, passing into brecciated siltstone	8	0
10.	Laminated siltstone	2	6
9.	Siltstone	2	6
8.	Siltstone with thinly-bedded sandstone	4	0
7.	Thinly-bedded sandstone...	8	0
6.	Laminated siltstone	2	0
5.	Impure cornstone	2	0
4.	Laminated siltstone	2	0
3.	Sandstone with siltstone (some brecciated)	8	0
2.	Impure cornstone	6	0
1.	Thinly-bedded lenticular sandstone with subsidiary siltstone	22	0
		289	0

The lower portion of Bed 12 in the road cutting on Portway may be correlated with Bed 44 in the above sequence.

5. St. Monica's, Durdham Down.

The main interest of this temporary section (covered in 1925) lies in the fact that the junction beds of the Avonian and Old

Red Sandstone were exposed, and that a Fish-bed is present. The section has recently been described[1&2]

6. A number of other small exposures also occur in this area. All these have been recorded in the *Q.J.G.S.* paper.

B.—AREA STRETCHING FROM RIVER AVON (LEFT BANK) TO NEIGHBOURHOOD OF CLAPTON-IN-GORDANO.

The rocks are fairly well exposed in the Portishead railway line, while only the upper 20 feet can be examined on the riverside. The bed of green micaceous sandstone formerly taken as the top bed of the Old Red Sandstone[3] is now referred to the base of the Avonian[4] on account of the presence of fish scales (*Strepsodus*).

The following section was measured, in descending sequence, on the railway line, beginning immediately below the micaceous band mentioned above.

		ft.	ins.
31.	Thinly bedded sandstone	2	6
30.	Quartzite	0	6
29.	Thinly bedded sandstone	0	6
28.	Sandstone	1	0
27.	Massive quartzite	1	0
26.	Sandstone	0	6
25.	Siltstone	2	6
24.	Massive sandstone	6	0
23.	Quartzite	1	0
22.	Siltstone	1	0
21.	Conglomerate sandstone	1	0
20.	Siltstone	2	6
19.	Micaceous sandstone	1	0
18.	Siltstone	0	6
17.	Quartzite	1	0
16.	Laminated siltstone	4	0
15.	Conglomerate sandstone	4	0
14.	Sandstone with subsidiary siltstone	10	0
	Very overgrown (including small valley opposite Bishop's Knoll)	940	0
13.	Massive sandstones, with a few augen-quartz pebbles ...	60	0
12.	Conglomerate	0	6
11.	Massive sandstone with augen-quartz pebbles	2	6
10.	Laminated siltstone	1	0
9.	Massive sandstone	1	6
8.	Laminated siltstone	1	0
7.	Conglomerate with sandy matrix	10	0
6.	Cornstone	8	6
5.	Massive sandstone	10	0
	(Small valley here interrupts the exposures)...	40	0
4.	Massive-false-bedded sandstone, with scattered augen-quartz pebbles, lenticular conglomerate beds and siltstones	100	0

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[1] *Geol. Mag.*, Vol. LXII (1925). pp. 464–73.

[2] *Proc. Bris. Nat. Soc.*, Fourth Series. Vol. VI, Pt. II, 1924 (1925). pp. 179-182.

[3] "A Geological Excursion Handbook for the Bristol District." Second Edition (1921). p. 45.

[4] *Q.J.G.S.*, Vol. 77 (1921). p. 217.

		ft.	ins.
3.	Conglomerate with sandy matrix	4	0
	Tunnel	160	0
2.	Massive sandstone with subsidiary siltstone	80	0
	Paradise Bottom	280	0
1.	Massive sandstone (to end of section)...	50	0
		1,789	6

Details of the scattered exposures which occur in the area extending from the left bank of the Avon Gorge to the unconformable junction with the Coal Measures at Clapton-in-Gordano are given in the *Q.J.G.S.* paper.

C. — A COASTAL RIDGE BETWEEN PORTISHEAD AND CLEVEDON.

The following section was measured, in descending sequence, in a S.W. direction from the southern end of Woodhill Bay, Portishead (average dip is 28° S.E.) :—

		ft.	ins.
18.	Thinly-bedded fossiliferous siltstone (to top of cliff) ...	8	0
17.	Massive lenticular sandstone, partly false-bedded, with scattered augen-quartz pebbles, merging laterally into brecciated siltstone	2	6
16.	Lenticular siltstone	0	6
15.	Massive sandstone, showing wedge-shaped bedding	4	0
14.	Lenticular brecciated siltstone	0	6
13.	Massive sandstone	6	0
12.	Massive false-bedded quartzite with scattered pebbles of augen-quartz. False-bedding delineated by weathering of hæmatite	6	6
11.	Massive conglomeratic sandstone	6	6
10.	Brecciated siltstone with subsidiary sandstone beds. Basal 6 inches is fossiliferous. This horizon crops out on the foreshore to the N.E., and in that position was well-known to the older geologists	4	6
9.	Massive false-bedded quartzite overlain by sandstone and underlain by brecciated siltstone. (Near the second promontory a contemporaneous channel was eroded in bed 9 and top of bed 8.)	3	6
8.	Massive sandstone with a central lenticular false-bedded band of fossiliferous conglomeratic sandstone	2	6
7.	Massive fossiliferous conglomeratic sandstone, intercalated between laminated siltstone	2	6
6.	Conglomeratic sandstone	2	0
5.	Laminated micaceous siltstone, sometimes brecciated, with beds of subsidiary sandstone	18	6
4.	Massive, false-bedded, sandstone, upper surface marked by a conglomeratic band	18	0
	(Fault here intervenes)		
3.	Massive sandstone with lenticular beds of conglomeratic sandstone	20	0
2.	Conglomerate	12	0
1.	Massive, false-bedded sandstone with irregular pipes and beds of calcareous material	12	0
	(Fault here intervenes and repeats part of the sequence from middle of bed 3.)		
		130	0

The coast from this point south-westward to Clevedon consists chiefly of Dolomitic Conglomerate with patches of the underlying Old Red Sandstone appearing at intervals. Many examples of unconformity may be noted, and the following is a tabulation of the chief faults. They are all tensional faults of the normal type, the fault plane being generally vertical. The clean-cut, non-eroded face of the Old Red Sandstone abutting against the Dolomitic Conglomerate gives sufficient proof of the post-Triassic age of the fault.

1. A fault 220 yards N.E. of Club House, Portishead, with downthrow to the south brings Dolomitic Conglomerate against Old Red Sandstone (bed 4).

2. 130 yards north of Club House, Portishead, a fault with down-throw to the south repeats part of the sequence from the middle of bed 3.

3. A small stream, 130 yards N.N.W. of Club House, Portishead, has eroded its valley along a fault plane.

4. A fault 130 yards N.W. of Club House, Portishead, brings Dolomitic Conglomerate and Old Red Sandstone into juxtaposition and has a downthrow to the south.

5. Two faults, in the middle of a small bay at the northern end of Ashdown Road (near Black Nore Farm) account for an isolated patch of Old Red Sandstone flanked by Dolomitic Conglomerate.

6. A similar exposure, also accounted for by two faults, lies immediately to the north of Black Nore Farm.

7. A small fault occurs within the Dolomitic Conglomerate about 110 yards south of Charlcombe Bay.

8. About 220 yards N.E. of Walton Bay a fault with a downthrow on the north gives rise to the Walton Bay notch.

9. Immediately to the south of Culver Cliff the Dolomitic Conglomerate is thrown down against a northern mass of Old Red Sandstone.

10. A small fault, 350 yards S.W. of Culver Cliff, brings Old Red Sandstone up against a northern mass of Dolomitic Conglomerate, and gives rise to the Walton-in-Gordano notch.

11. And finally in Ladye Bay a fault with downthrow to the south gives rise to the Ladye Bay notch.

A few inland exposures occur in this area ; they have also been described in the *Q.J.G.S.* paper.

INDEX TO FOURTH SERIES, VOL. VI.